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A Decision Making Model for Outsourcing and Offshoring of Product Design and Development within the Automotive Industry

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A thesis submitted in partial fulfilment of the University's requirements for the Degree of Doctor of Philosophy

Abstract

The automotive industry has become multidimensional and extremely complex over the last two decades, with organisations developing global strategies; vehicles being developed in multiple locations and the aggressive expansion of the product portfolio. Outsourcing and offshoring in manufacturing of sub/complete assemblies has attracted attention from researchers who are still analysing this dynamic and multifaceted sector, whereas research studies concerning strategic decision-making in product design and development are only gradually progressing through the pipeline. Outsourcing and offshoring of product design and development requires organisations to re-evaluate their business models and further change the mind-set to ensure successful engagement and also to be able to retain their competitive positions.

Automotive organisations can become complacent and incorrectly assume that their business models can withstand new challenges, therefore losing their competitive advantage and, furthermore, facing complications with maintaining robust outsourcing and offshoring strategies. This creates a complex and challenging environment within the automotive industry where product design and development requires a new organisational decision-making strategy compared to the last two decades where operations were constrained within the boundaries of an organisation.

The literature in the area of outsourcing, offshore outsourcing and offshoring of product design and development within the automotive industry is inadequate, and many of the empirical findings and contributions from this research study is new knowledge, although some results are consistent with findings reported from other non-automotive sectors. The literature examination also identified a number of gaps on how automotive organisations amongst Original Equipment Manufacturers, Engineering Service Providers and First Tier Suppliers are outsourcing, offshore outsourcing and offshoring their product design and development activities. This has identified that organisations are using trial and error outsourcing and offshoring models at great expense and these organisations have failed to meet their expectations.

This study further identifies a gap in the literature where decision-making models concerning product development and design within the automotive industry are unexplored. There is a lack of attention to the various stages required for an automotive organisation to make strategic and firm decisions when outsourcing, offshore outsourcing and offshoring. This includes drivers and challenges experienced; the decision-making process; and the solutions implemented on outsourcing, offshore outsourcing and offshoring their product design and development activities.

In this new context, product design and development presents fresh challenges to the automotive industry. These challenges consist of managing external organisations; working with different cultures across international countries; managing a wide range of skill competency; and managing the delivery of engineering solutions from more than one location. This requires organisations to fully understand which activities can be outsourced or offshored to either an external organisation or a wholly-owned subsidiary.

This study is designed to examine how automotive organisations amongst the three segments; 1) Original Equipment Manufacturers; 2) Engineering Service Providers and 3) First Tier Suppliers

are currently managing their product design and development activities including the extent to which they are outsourced, offshore outsourced and offshored and the mechanisms involved with strategic decision-making. The three segments all contribute to the product design and development activities within the automotive industry.
This study is designed in three phases: Phase 1 consisted of interviewing 50 automotive organisations with a total of 99 in-depth interviews. Phase 2 consisted of six in-depth case studies to further understand the complexity when automotive organisations outsourced, offshore outsourced and offshored their product design and develop activities. Phase 3 consisted of developing the strategic decision-making model for the three automotive organisations in the three segments, and was further tested through 10 focus group workshops.

The study findings have identified that a lack of strategy was implemented within the automotive organisations when making key decisions on outsourcing, offshore outsourcing and offshoring of product design and development. The decisions were disconnected from a strategic and operational perspective, were based on increasing engineering resources and short-term economic benefits. The organisations' focus was distant from the product design and development activities which ended up with these organisations facing challenges with understanding their own activities. The drivers for all three automotive segments, when outsourcing, was the need to increase their engineering resources to fulfil the product cycle plans. When outsourcing, costs also became important to ensure value in relation to the product design and development was achieved. However, when the three automotive segments offshore outsourced or offshored, their product design and development cost was a key driver followed by increasing the engineering resources.
There were hidden costs which were only exposed during the journey and consisted of additional training both internally and externally; additional resources were required for the projects; reworking of product design and development activities and sensitive activities were back-sourced due to their uniqueness and competitive advantage. The automotive organisations based in all three segments lacked the ability to make key strategic decisions and the management teams lacked the experience to provide solutions to the challenges in this new global, complex environment. For example, it involved managing external organisations that were responsible for near core product design and development activities which had always been undertaken internally.

The strategic decision-making model developed in this work is a tool that automotive organisations should use when considering outsourcing, offshore outsourcing and offshoring their product design and development activities. The methods used within the model are well known to the automotive industry. The model addresses the challenges an automotive organisation experiences on operational and strategic levels to ensure both short-term and long-term perspectives are taken into account. The strategic decision-making model is titled *"A strategic decision-making model for outsourcing/offshoring outsourcing and offshoring of product design and development within the automotive industry".*

The novelty aspect of the empirical findings was the in-depth analysis of the drivers; the challenges; the decision-making model and the associated process necessary to achieve the decisions at each stage of the model. Further novelty was derived through the development of the strategic decision-making model, which is a new development in the automotive industry.

Acknowledgments

The PhD journey is like no other experience one could go through in life that ultimately tests your capabilities: mentally, physically and spiritually. The journey has consisted of many ups and downs and has been difficult during times when tough decisions were required. The question still remains: *Would I ever do this again?* The answer is: *Yes, this has been the most dynamic academic journey throughout my professional career without any doubts or regrets*.

I would like to thank my PhD Director of studies Dr Richard Anderson for the constant support and for maintaining the pressure to strive and achieve excellence. I'm rather confident that without his continuous support and critique of the research, of both which have underpinned my work, I would not have had the relevant tools required to engineer a complete thesis.

During the research journey, I had great pleasure in meeting a number of intelligent and competent people whose wisdom was used when developing ideas. For instance, six academic papers were accepted and presented at various conferences that enabled the research depth to be scrutinised and further enhanced through the valuable comments made from the peer review sessions and audience. I had the great pleasure of meeting leading scholars in this discipline area, who provided valuable insight in the subject and were from highly recognised institutions, such as the Massachusetts Institute of Technology; Cambridge University; Duke University; Monash University; Trinity College Dublin and many other institutions.

I sincerely thank all of the automotive organisations (there are too many to mention) which allowed me to visit and interview many different people (engineers; line managers; senior executives; chief executive officers and other senior people) and of whom gave permission to collect the data for this research.

I am grateful to the people that I have worked with during the research journey who have given me indirect support and comments to further enhance the research study. Your support has been highly appreciated.

My great thanks are also extended to the Professors who personally committed their time, dedication and participation during the workshops and provided critical information when reviewing the development of the decision-making model. I am not only thankful for their time, dedication and participation but for the valuable comments and suggestions that improved the quality of this research. Their experience and knowledge in this field was highly deemed and respected.

Finally, I must express my gratitude to the 50 automotive organisations that participated in this research and, more importantly, the employees within these organisations: taking their time to be interviewed and further questioned around the research topic. My expressed gratitude is stretched to the key practitioners who provided insights during the interviews and workshop activities.

Steve Simplay
April 2015

Publications

Below are the publications resulting from this research.

Referred Conference Proceedings

Paper I: Simplay, S. and Hansen, Z. (2013) Proceedings of the 20th Euroma Conference. 'Global Product Development: An Attempt at Harmonising the Research Effort'. Held 7th - 12th June at Dublin, Ireland: EUROMA.

Paper II: Simplay, S. (2014) Proceedings of the International Design Conference – Design 2014. ‘Offshoring of engineering services: A case study from the automotive industry’. Held 21st – 24th May Dubrovnik Croatia.

Paper III: Simplay, S. Anderson R,. (2014) How has the automotive industry approached outsourcing and offshoring of core engineering services? 21st EUROMA Conference – Operations Management In An Innovation Economy, Italy, Palermo. EUROMA 2014 Conference Proceedings.

Paper IV: Simplay, S., Anderson R,. (2014) The drivers to outsourcing and offshoring product development and design: Empirical analysis from the automotive Industry. 20th International Product Development and management conference. EIASM 2014 conference proceedings.

Paper V: Simplay, S. and Zaza Lee Hansen, (2014) Proceedings of the 18th Cambridge International Manufacturing Symposium ‘Offshoring trends in the manufacturing process within the automotive industry. Held 11th – 12th September 2014, Cambridge UK.

Paper VI: Simplay, S. (2015) Where is innovation developed when automotive organisations outsource and offshore their vehicle product design and development? 22nd Innovation & Product Development Management Conference, Copenhagen, Denmark. EIASM 2015 conference proceedings.

Journal Publications

Two journal articles are in progress and expected to be published in 2017. The first journal article will be published in the California Management Review and second article in the Massachusetts Institute of Technology Sloan.

Declaration of Originality

The research presented in this thesis, to my knowledge and belief has been crafted from first principles and contains no previous published work by a third party, unless reference within the context in the thesis. The thesis submission is for a Doctor of Philosophy Degree from Coventry University from April 2012 – April 2015.

This document contains *440 pages* and *144,917* words including references and appendixes.

Steven Simplay.
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Abbreviations

The following abbreviations are used in this thesis.

ACM – Association of Computing Machinery.
AIMS – Automated Issue Management System.
APPS – Appendix.
BIW – Body in White.
BOT – Build Operate Transfer.
BPO – Business Process Outsourcing.
CEs – Contract Employees.
CAD – Computer Aided Design.
CAE – Computer Aided Engineering.
COC – Centres of Competence.
CIO – Chief Information Officer.
CTO – Chief Technology Officer.
CEs – Contract Employees.
ESO – Engineering Services Outsourcing.
ESPs – Engineering Service Providers.
FRN – France.
FTEs – Full Time Employees.
FTSs – First Tier Suppliers.
GER – Germany.
GmbH – Gesellschaft mit beschränkter Haftung.
HQ – Headquarters.
IEEE – Institute of Electrical Electronic Engineers.
IB – International Business.
IND – India.
IP – Intellectual Property.
IS – Information Systems.
ITL – Italy.
IT – Information Technology.
ITO – Information Technology Outsourcing.
JLR – JaguarLandrover.
M&A – Mergers & Acquisition.
MD – Managing Director.
MNC – Multi National Corporation.
ODEC – Offshore Design Engineering Centre.
OEMs – Original Equipment Manufacturers.
ORN – Offshore Research Network.
OWOS – Offshore Wholly Owned Subsidiary.
PCS – Product Creation System.
PDD – Product Design and Development.
RASIC – Responsible, Accountable, Support, Informed, Consulted.
REFS – References.

R&D – Research & Development.
RBV – Resource Based View.
RDT – Resource Dependence Theory.
ROI – Return on Investment.
SEZ – Special Economic Zones.
SCM – Supply Chain Management.
SGA – Singapore.
SM – Strategic Management.
SME – Strategic Medium Enterprise.
SWD – Sweden.
TCE – Transaction Cost Economics.
UK – United Kingdom.
UN – Under Body.
UP – Upper Body.
US – United States.
VP – Vice President.
Y2K – Year 2000.

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Chapter 1 . Introduction

1.1. Study Background

The global economic crisis of 2008 and the globalisation of organisations has impacted the automotive sector significantly (Cattaneo *et al.* 2010). The globalisation has impacted how automotive organisations are outsourcing and offshoring their PDD activities. The economic crisis has developed new challenges amongst OEMs; ESPs and FTSs.

The impact within OEMs started when General Motors and Chrysler filing for Chapter 11 bankruptcy between 2008 and 2009; Toyota posting losses in 2009 and in the same year BMW experienced significant profit reductions and losses along with Daimler, Fiat, Renault and Peugeot. This has forced organisations to reduce costs by downsizing their operations and assign new global strategies including different methodologies in PDD and how they are conducted (Allen *et al.* 2013).

Further, in Europe, Spyker cars acquired Saab from GM in 2008; TATA Motors acquired Jaguar Land Rover in 2008; Geely acquired Volvo in 2010 and Fiat acquired Chrysler in 2014. On the other hand Porsche overcame the automotive crisis due to the premium cost of their vehicles and in 2008 increased its stake in Volkswagen. By 2012, Volkswagen had acquired Porsche and is a fully owned subsidiary. To reduce the PDD costs associated with producing an automotive vehicle OEMs are assigning joint development strategies to support both organisations and risk sharing the product development cycle. In 2013 Daimler and Renault engaged to develop a new vehicle; BMW and Toyota in 2014 signed a product development and design contract to develop a new sports car platform with estimated savings of $1 billion; Daimler and Renault in 2014 extended their agreement for Renault to supply Daimler with diesel engines including many other smaller joint development activities taking place. However, the majority of cost reduction activities involving the PDD are not made public and are retained internally within the organisation.

The impact within ESPs was Pininfarina acquiring MPX GmbH in 2006; Berton was acquired by FIAT automotive in 2009; Heuliez was unable to sustain their business due to high design and development costs in 2010 and closed the business; Williem Karmann automotive business was asset stripped and sold off to VW; Valmet Automotive and other automotive organisations in 2010. Valmet automotive acquired CAE automotive in 2012 to expand their PDD capabilities; EDAG a large German ESP acquired Rücker in 2013 to globalise and expand their PDD capabilities within automotive vehicle development; Tata Technologies acquired Cambric in 2013 to support their one billion dollar growth ambition and grow the breadth of their capabilities; EDF GmbH was acquired by QuEST Global in 2015 for PDD capability and entrance into the EU market and Valmet/RLE International in 2015 developed a partnership to increase their working relationships on the PDD activities.

A number of significant developments have taken place within the ESP segment and more importantly organisations are outsourcing and offshoring their PDD which is not publicly known. The acquisitions within the ESPs were of critical essence for the automotive organisations to develop capabilities through inorganic growth than developing these capabilities organically. The acquisitions also consisted of these organisations to merge and outsource and offshore their PDD activities.

The impact within FTSs consisted of Continental AG acquiring the Automotive Electronics Business of Motorola in 2006 and further acquired Veyance in 2014; Johnson Controls acquired their final stake from Tata in 2013 due to management misalignments when offshore outsourcing; ZF Friedrichshafen acquiring TRW automotive in 2014; Bosch acquires ZF Lenksysteme (steering systems) GmbH to strengthen their capabilities and Lear acquired Eagle Ottawa in 2014.

The FTSs segment consisted of acquisitions to strengthen their core capabilities through inorganic growth than developing capability organically. The acquisitions have resulted in these organisations to outsource and offshore their PDD activities which has not been disclosed in the public domain as it could be perceived negatively. The global automotive industry has presented new challenges for the FTSs when outsourcing and offshoring their PDD activities compared two decades ago where these activities were conducted internally and not globally.

The acquisitions, developments, partnerships in general have profiled the automotive sector amongst all three segments (OEMs; ESPs and FTSs). Historically, the last two decades did not present new challenges as the automotive organisations had been constrained to a single country of operation and very minimal PDD activities were outsourced and offshored.

These changes are not only forcing organisations to reduce costs, but to assign new global PDD strategies (Gottfredson *et al.* 2005) and to disperse PDD to further reduce costs (Eppinger and Chitkara 2006) using low-cost countries to produce frugal engineering design.

The automotive sector has seen radical changes in terms of outsourcing and how organisations have globalised their operations (Ghemawat and Ghadar 2000, Sturgeon 1999). In particular, design outsourcing has not received much scholarly attention (Palm and Whitney 2010) and because vehicle design is multifaceted there is an increased risk of failure even before outsourcing or offshoring has been attempted (Maxton and Wormald 2004). Adding to the recipe of complexity, an automotive vehicle contains around 10,000 to 15,000 components (Oliver *et al.* 2008) and around 50% to 60% of the total cost of components comes from outsourced suppliers (Bresnen 1996, Lee and Oakes 1996).

The engineering design global spend is currently estimated at $750 billion per year and around $10-$15 billion is currently being offshored with a strong projection this will increase (Hamilton 2006). However, by 2020 the estimated global engineering design offshoring market is predicted to reach approximately $150 to $225 billion, as the sector is expected to grow rapidly over the next few years (Hamilton 2006).

Outsourcing and offshoring has become a well-recognised business tool where organisations can obtain competitive advantage through outsourcing/offshoring products or services to external service providers where the services can be executed efficiently and effectively (McCarthy and Anagnostou 2004, Penter *et al.* 2009). It has attracted the attention of researchers and practitioners due to its sustained trends over several years (Lacity *et al.* 2009, Loebbecke and Huyskens 2009, Oshri 2009, Willcocks *et al.* 2011).

Outsourcing and offshoring of white collar activities (knowledge intensive activities) has surfaced but researchers have not paid a great deal of attention to this area due to its complexities (Amiti and Wei 2005). Outsourcing of services can lead to positive impacts on organisational performance and cost reductions (Barthelemy and Adsit 2003, Burdon and Bhalla 2005, Dibbern *et al.* 2004), enables the organisation to concentrate on its core competencies/operations (Mullin 1996, Prahalad and Hamel 1990a, Quinn 1999, Willcocks *et al.* 1995a), and increase flexibility and remain competitive (Jennings 2002, Quélin and Duhamel 2003).

An organisation deciding to outsource or offshore their PDD has four available options (Eppinger and Chitkara 2009). These options include develop PDD activities in-house; outsource locally to an external organisation; offshore outsource to an external organisation or develop a wholly owned subsidiary. The four options have strategic implications and organisations in the automotive industry struggle to identify which option is most appropriate for their business model.

Becker and Zirpoli (2003) concluded from their study that outsourcing of engineering PDD is a complex and difficult segment for an organisation to disseminate their engineering and product knowledge to external service providers which is the most challenging to perform in contrast to outsourcing of information technology, business processing and manufacturing.

Brown and Eisenhardt (1995) identified from their study that PDD activities are central to an organisation's core competencies and careful decision-making is required when outsourcing or offshoring these services to external organisations. However, despite the literature brushing these topics, organisations are making poor decisions which requires significant changes to their business model and causes disruption.

Automotive organisations across the three segments have different options when outsourcing and offshoring their PDD activities. Utilising learnt knowledge from the manufacturing sector which has outsourced and offshored raw materials, subassemblies, and complete assembles to offshore locations, automotive organisations are still facing difficult challenges when outsourcing and offshoring their PDD activities. These challenges include; identifying activities that can be outsourced or offshored, identifying PDD activities which are core and non core, does the organisation develop a wholly owned subsidiary or engage with a third party service provider, how are the PDD activities managed, how much of the PDD processes can be outsourced or offshored, what is the criteria for making decisions and what are the consequences of implementing such strategies. When an organisation makes a decision it must be sustainable over the period of the outsourcing or offshoring journey and a short-term or long-term strategy must be decided upfront than mid-flight changers.

The literature suggests many of the previous research studies within automotive PDD lack analysing the three segments and also lack developing a strategic decision making model which can be used by automotive organisations to better prepare them when making key decisions. In general the literature on outsourcing and offshoring of high value activities involving PDD is not well understood (Willcocks *et al.* 2011) whereas De Boer *et al.* (2006) identifies a number of decision-making models have been developed but there is a need to better understand the complexity of outsourcing and offshoring decision-making models which has not received the attention it requires, for instance in automotive PDD.

This research study is designed to examine how automotive organisations are currently managing their PDD activities including to the extent which they are outsourcing, offshore outsourcing and offshoring.

The outcome of the study has developed a five stage decision-making process and associated model to help support management in making key outsourcing and offshoring decisions and the challenges outlined in this section can be answered successfully.

1.2. Building on engineering and management

Over several years management practices along with engineering activities have evolved over time into complex situations (Thamhain 1992). In fact there are few instances where these practices have been aligned (Morse and Babcock 2010).

Without question, when outsourcing, offshore outsourcing or offshoring product design and development (PDD) and engineering management activities a key formula is required for a sustainable and positive outcome.
When an organisation globalises the PDD it involves humans with different cultures, working methods, procedures all contributing to the overall outcome of results and how a typical engineering problem is resolved. From an engineering perspective it involves different technical capabilities and engineering skill which all become a management challenge to ensure they are coordinated in the correct manner.

1.3. Research aims and objectives

The overall aim of this research is to develop a strategic decision-making process and associated model to strategically support management in outsourcing, offshore outsourcing and offshoring of PDD within the automotive industry across three segments (OEMs, ESPs, and FTSs).

There are seven objectives of this research:

Objective 1: To review current literature in the academic field of outsourcing and offshoring using either wholly owned subsidiaries or third parties organisations. The review will map existing trends, and identify different theoretical models used to understand outsourcing/offshoring strategies.

Objective 2: To establish current research methodologies used throughout the literature, understand how these have evolved over time, and to use these as one input for developing the methodology for this research.

Objective 3: To map out how three different organisational segments (OEMs, ESPs, and FTSs) are outsourcing, offshore outsourcing and offshoring their PDD and which delivery models are used i.e. outsourcing, offshore outsourcing and offshoring (to their wholly owned subsidiaries).

Objective 4: To compare the drivers and challenges in outsourcing, offshore outsourcing and offshoring when automotive organisations disperse their PDD activities across the three organisational segments.

Objective 5: To establish routes taken by the three organisational segments when deciding their outsourcing, offshore outsourcing and offshoring strategies and the implications of dispersing their PDD activities.

Objective 6: To analyse the gathered data to determine if outsourcing, offshore outsourcing and offshoring on a global basis can be managed more effectively, and if so, development of a strategic decision making process.

Objective 7: To develop an outsourcing, offshore outsourcing and offshoring strategic decision making model from the empirical data having general applicability but be specifically focused on use within TATA.

1.4. Research question

This research study addresses the following primary question:

How can the management of outsourcing, offshore outsourcing and offshoring of product design and development be enhanced within the automotive industry.

The research question is addressed by conducting an extensive literature review to understand current models and theories already used in other disciplined areas, followed by an empirical research study on outsourcing, offshore outsourcing and offshoring of PDD within the three automotive industry segments.

To answer the research question primary and secondary data was collected from automotive organisations from all three industry segments;

1. Original Equipment Manufacturers (OEMs).
2. Engineering Service Providers (ESPs).
3. First Tier Suppliers (FTSs).

These organisations were in the process of making decisions or had already engaged with outsourcing or offshore outsourcing service providers or developed their offshore wholly owned subsidiary (OWOS) for PDD.

Firstly, primary data consisted of field interviews with decision makers responsible for making key decisions including post senior management, Chief Executive Officers (CEOs), Managing Directors (MD), Vice Presidents (VP), Presidents and Directors. Additionally, senior management and engineers who were involved with outsourcing, offshore outsourcing and offshoring of PDD activities were also interviewed from a delivery perspective.

Secondly, secondary data was collected from organisations and external sources in the format of books, magazines and other media postings.

The outcome of this research study has developed a model for enhancing the strategic decision-making process for organisations to outsource or offshore their PDD activities. Additionally the research provides a strategic model for automotive organisations that are either new to outsourcing, offshore outsourcing or offshoring their PDD, in the process of making key organisational decisions or are facing challenges when moving their PDD activities conduced internally to external organisations.

The research supports managers in making key managerial decisions when outsourcing, offshore outsourcing or offshoring and more importantly guides practitioners where the academic literature is inadequate. The research also provides practitioners the support they are lacking in this dynamic and complex area of outsourcing, offshore outsourcing and offshoring through the use of a decision-making model to develop an automotive organisations' PDD strategy.

Further, scholars in the academic community also confirm current literature is lacking in decision-making models and further research is required to address this gap and advance our knowledge in this under researched area.

1.5. Tata Group[1]

The Tata group is a global organisation with products and services in over 150 countries and employees over 580,000 employees and operates in over 100 countries. In 2013 the group revenue was $96.8 billion and in 2014 the revenue increased to $103.27 billion with 67 per cent of revenue generated in geographies other than India. The Tata group has a vision for improving the quality of life of the communities they serve and provide long-term stakeholder value creation which is based on leadership with trust.

The top five largest companies within the group are the following;

1. Tata Consultancy Services with revenues of $83.73billion.
2. Tata Motors (Inc. Jaguar Landrover (JLR) and Tata Technologies (which is 72.3 per cent owned by Tata Motors) with revenues of $25.94 billion.
3. Tata Steel with revenues of $5.39 billion.
4. Titan Company with revenues of $5.70 billion.
5. Tata Power with revenues of $3.40 billion.

Tata Motors is recognised as India's largest automotive manufacturing organisation by revenue with headquarters in Mumbai, Maharashtra, India. Tata motors consist of a number of partially/wholly owned subsidiaries with a diverse global portfolio as illustrated in Figure 1.1.

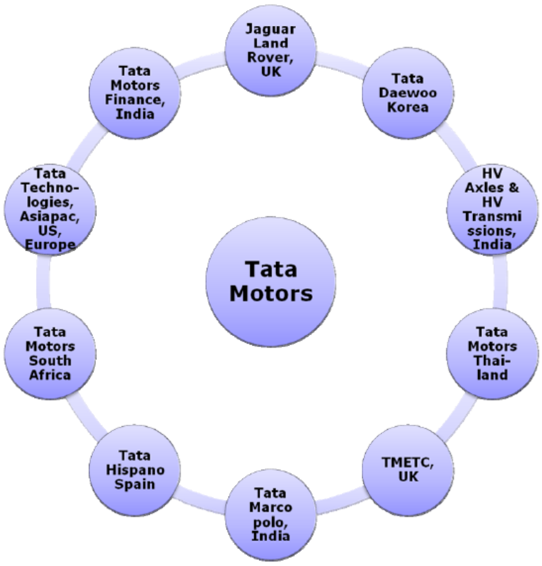


Figure 1.1.Tata Motors Global Subsidiaries (source: Tata).

This research study is subsidised by Tata Technologies and further access to JaguarLandrover to examine in-depth outsourcing, offshore outsourcing and offshoring of PDD activities across these two organisations. However, the research study is not constrained within the two organisations

[1] Some of the information contained here within on the Tata group has been taken from internal confidential sources and all referencing to this material is based on intellectual property rights of the Tata group.

but an additional 48 automotive organisations have been examined in depth to understand outsourcing, offshore outsourcing and offshoring off their PDD activities.

TATA Motors acquired JLR in 2008 from Ford Motor Company for $2.8 million and now a wholly owned subsidiary as indicated in Figure 1.1. Since the acquisition of JLR the organisation has gone through a transitional stage of transferring the organisations assets.
When JLR was under the Ford Motor Company its systems and processes had been used across the group which involved mass production of vehicles. The World Motor Vehicle Production (2013) reported Ford Motor Company produced over 3.3 million vehicles whereas JLR produced 374, 636 thousand vehicles. Therefore, the systems and processes which were antiquated and adapted for a high volume production business model had been transferred to JLR causing difficulty and challenges during the transfer.

In 2014, JLR started to migrate their own systems and processes which were transitioned from Ford Motor Company. However, migrating new systems and processes within the organisation could take a few years despite the outsourcing contracts already agreed and executed. Using these systems and processes added additional challenges for the outsourced organisations that were responsible for that PDD activities

Moving these challenges to one side, JLR is currently going through an aggressive growth trajectory in developing new vehicles, new technology and adding additional derivatives to the current family of products. The current growth trajectory requires the business to expand and develop a robust infrastructure where the management attention and focus is to develop a flawless launch as the product range is rapidly increasing and the organisation is expanding and an increasing amount of employees are joining the business.

A flawless launch within the automotive industry is heavily underpinned by the upfront PDD activities and this stage will determine how a vehicle is integrated and launched. Increasing the number of vehicles or projects, requires additional engineering resources throughout any organisation. Thus, JLR is taking advantage of the low-cost engineering development centre based in India where transactional PDD activities are offshored to allow additional onshore resource capacity which is allocated to other onsite programs.

However, with offshoring the PDD activities and the number of new vehicles being developed required further additional engineering resource. Therefore, outsourcing/offshoring the PDD activities either on a vehicle program level or a turnkey solution would enable JLR to meet its objectives and deliver new products into the market. The research has developed a strategic decision-making model for outsourcing, offshore outsourcing and offshoring PDD activities within the automotive industry across all three segments OEMs, ESPs, and FTSs and supports these key decisions within the industry.

1.6. Scope, Assumptions and Limitations

This section reviews the scope, assumptions and limitations used for the study.

1.6.1. Scope

This research study has been based on a timescale of three years initially, starting in April 2012 and finishing in April 2015. The research involves meeting key milestones throughout each research phase and each deliverable corresponding to Coventry University's PhD assessment checklists to deliver a sound thesis that successfully answers the research question, aim and objectives.

The research will initially start off with examining the outsourcing literature in general to explore the current developments within the broader field, what can be learnt from the existing literature and success/failures that have driven organisations to implement such strategies. The research spectrum on outsourcing and offshoring is then limited to examine the current developments within the automotive industry and understand which delivery models such as outsourcing, offshore outsourcing and offshoring are used when automotive organisations decide to outsource, offshore outsource and offshore their PDD activities.

In total three automotive segments are included within the scope of this research study as shown in Figure 1.2.

1. Automotive OEMs that were outsourcing, offshore outsourcing and offshoring PDD activities or in the process of evaluating their proposition.
2. Automotive ESP that were outsourcing, offshore outsourcing and offshoring PDD activities or in the process of evaluating their proposition.
3. Automotive FTSs that were outsourcing, offshore outsourcing and offshoring PDD activities or in the process of evaluating their proposition.

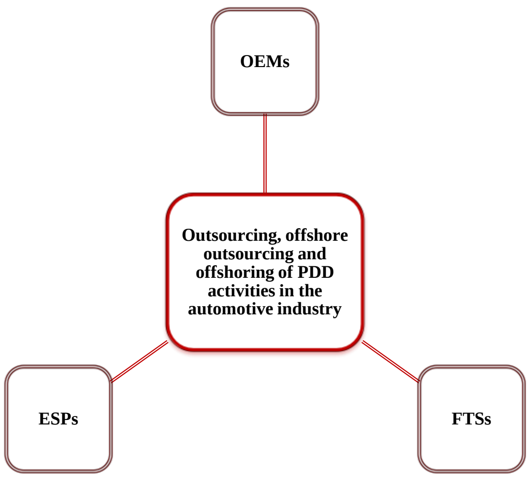


Figure 1.2. Automotive three industry segments

This scope of this research study further concentrates on the body engineering element for the OEMs regarding the vehicle development phase, the largest portion and most complex activity consisting of a commodities and interactions with other areas of the vehicle. The research also focuses on PDD activities within ESPs and FTSs.

A typical body engineering group structure is presented in Figure 1.3 where in some OEMs the structure is grouped as interiors and exteriors of a vehicle.

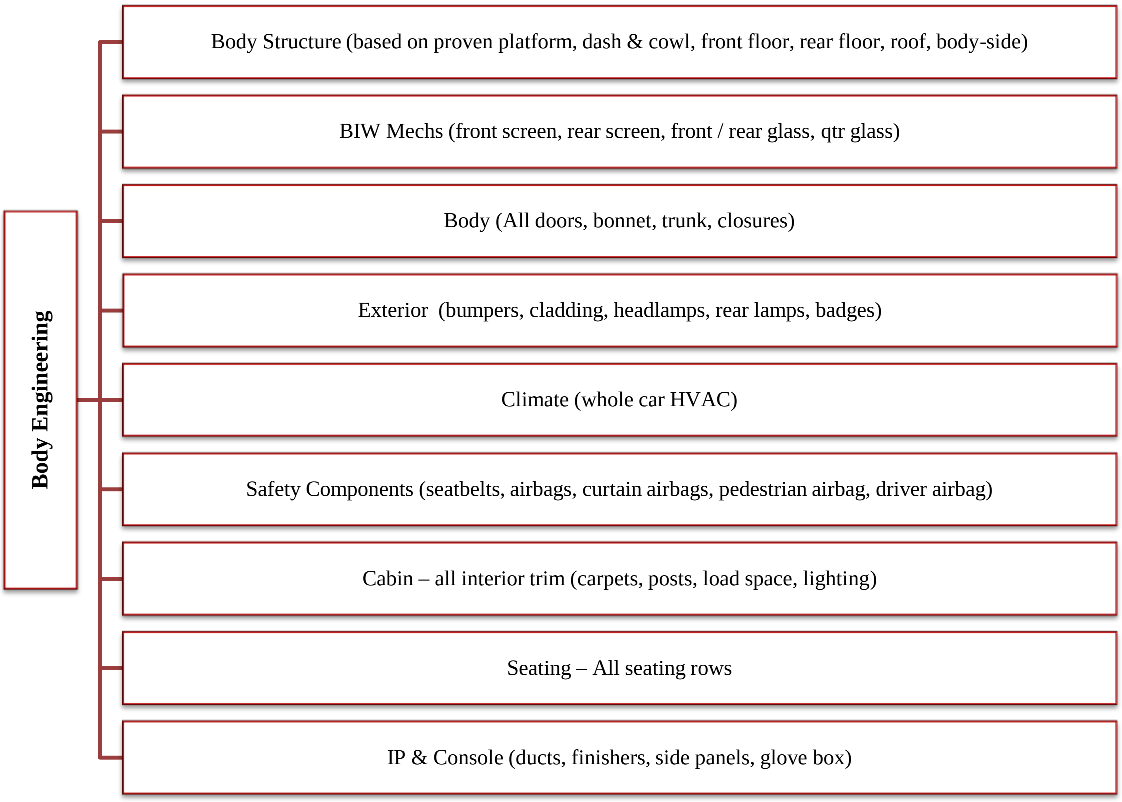


Figure 1.3. A typical OEM body engineering group structure (source: author).

To put this into perspective the exterior development can be grouped into Bumpers, Body, BIW (Body in White) Mechs and Interior Development can be grouped by Safety components, Cabin, Seating, IP and Console. However, segregating the body engineering functions into separate segments still remains and belongs to the body engineering function.

To ensure a trend can be established, outsourcing journals will be reviewed from 1990 till the end of the research. Reviewing more than two decades will provide sufficient depth and breadth in outsourcing and offshoring. A further examination on conference papers and completed research dissertations allows the researcher to understand current developments and work in progress in the research field and ensures that a useful, novel and coherent contribution to knowledge is made.

The research will use empirical data focusing on organisations that are either outsourcing or offshoring engineering PDD or in the process of dispersing these activities. Further, the research will examine how outsourcing and offshoring on an operational level is managed and the daily challenges these organisations experience during this journey.

The result from the research has developed a strategic decision-making model that will have general applicability and can be specifically implemented within the TATA group.

1.6.2. Assumptions

The following assumptions are recognised in the research study:

1. Assumes a typical OEM engineering structure consists of body engineering, chassis engineering, powertrain, electrical systems and a developing area still relatively new called hybrid. It is assumed the elements within the body engineering contribute most to vehicle development and a typical OEM engineering structure is illustrated in Figure 1.4.

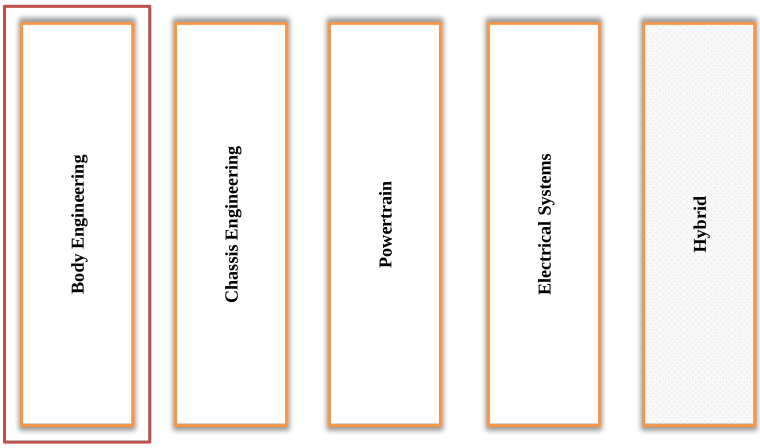


Figure 1.4. Typical OEM engineering structure (source: author).

2. Assumes the automotive organisations have already identified or selected an outsourcing or offshore outsourcing organisation. The selection has been conducted through the use of their internal procurement department and an advanced screening/evaluation has already been completed for PDD activities to ensure these organisations are capable of delivering the requirements.

3. Assumes the interviewees understood and comprehended each interview question and their responses to the questions are accurate. All means were used to ensure the participants had read the interview transcripts and sufficient time was allocated for corrections before the transcripts were used for coding. A pilot study was conducted to validate the field work before field data was collected and these results were used to develop the interview questions.

4. The study also assumes the decision-making process used for each stage is influenced by the organisation's internal and external driving factors. The decision-making process includes multiple stakeholders involved before a decision is made where industry is failing to achieve a decision based on best practices learnt in the field.

Therefore, this research study has the advantage of providing high value to automotive organisations as outsourcing, offshore outsourcing or offshoring of PDD activities has not been analysed over a large scale and across the three organisational segments. The strategic decision-making model is developed to allow automotive organisations to make key decisions whether they retain the core competencies in-house, outsource the near core activities, offshore outsource non core activities or offshore non core activities which previously were core activities but a gradual evolution shifts these activities to non core.

1.6.3. Limitations

The research limitations are outlined below:

1. The research study is limited to the automotive sector across all three segments and further generalisability of the results in other fields and low-cost countries should be done with caution.

2. The research study is based on an inductive approach with the use of in-depth case studies, which provides a sound basis for a further development of a qualitative study as it allows the variables to be related to a specific phenomenon (Miles and Huberman 1994) or making use of quantitative methods in different ways (Eisenhardt 1989, Yin 1994a).

3. The coding of data was based on the analysis from the interviews which was conducted at a particular point in time and after the interviewing participants learned more on outsourcing, offshore outsourcing and offshoring.

Given these limitations which are outlined for this research study, the aim off the thesis also increases our knowledge of this significant, yet inadequately researched area on outsourcing, offshore outsourcing and offshoring of PDD activities within the automotive industry.

1.7. Structure of the thesis

The thesis is constructed into eight individual chapters each leading onto another. The chapter breakdown and explanation is illustrated in Figure 1.5.

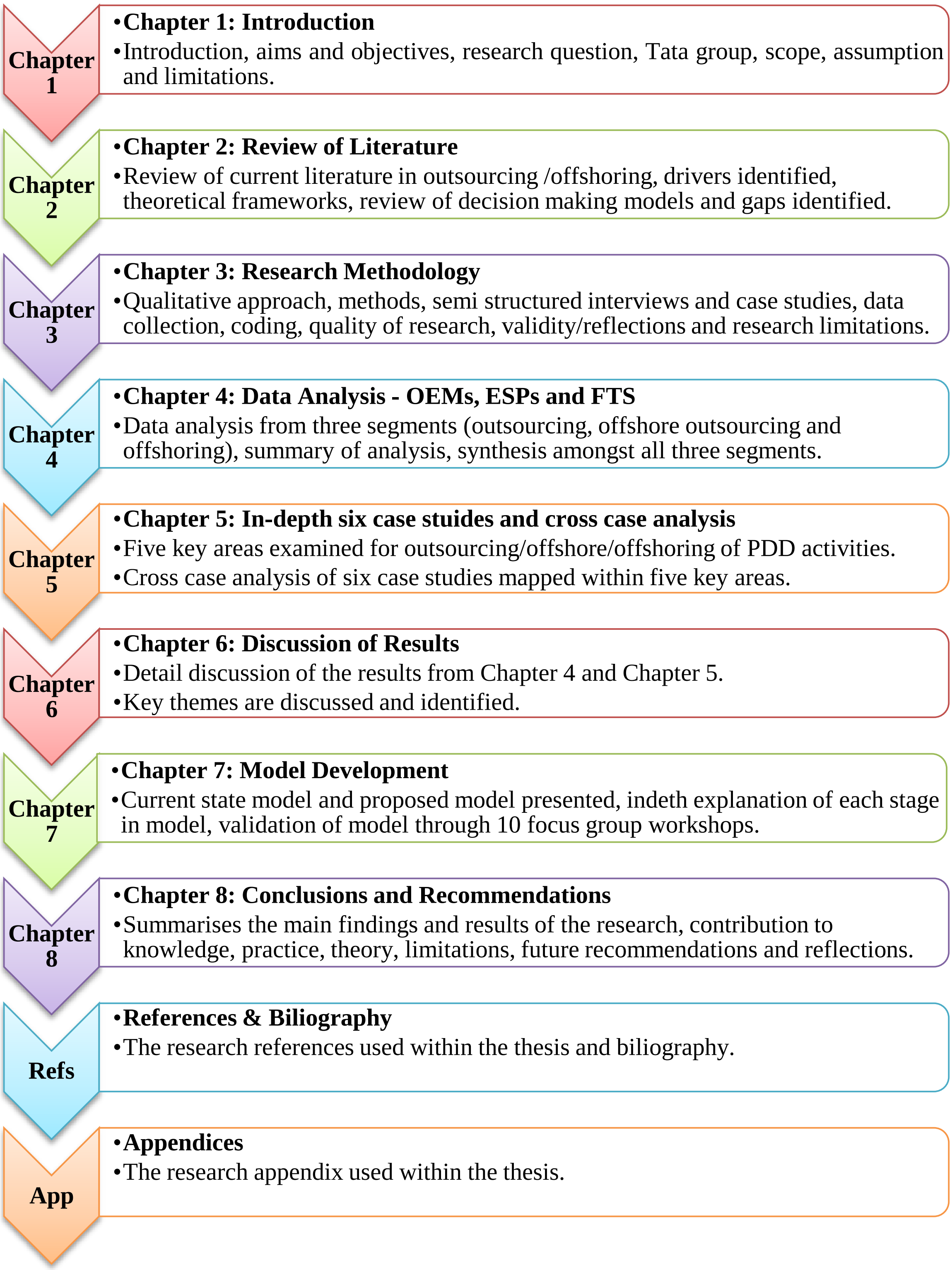


Figure 1.5. Thesis structure and flow.

1.8. Summary

This study focuses on both engineering and management practices and aims at developing a strategic decision making model to support management when deciding to outsource, offshore outsource or offshore the PDD activities. This may include organisations developing new propositions or existing organisations that are facing challenges with current outsourcing or offshoring activities.

The research question is answered through the seven research objectives that are identified for this study; see section 1.3. The outsourcing and offshoring literature is examined to understand developments within the automotive industry and other sectors.

The scope of the study concentrates on the OEMs body engineering vehicle development phase and extending to ESPs and FTSs where the study has a focus on the PDD activities.

In total 50 automotive organisations took part in this study and were from three different segments. The first segment consisted of 20 OEMs; second segment consisted of 17 ESPs and third segment consisted of 13 FTSs.

The assumptions and limitations are identified for this study and the thesis structure is presented in section 1.6.3 and 1.7.

Chapter 2 . Literature Review

Quote:

“Your backroom is someone else’s front room. Backrooms by definition will never be able to attract your best. We converted ours into someone else’s front room and insisted on their best. This is what outsourcing is all about.

Jack Welch. Ex. CEO of GE.

2.1. Introduction

This chapter is structured to ensure continuity of the literature review and consistent flow of each section specifically focusing on the aim, objectives and research question. When conducting the literature review the procedure on how the literature was retrieved and the methods used are documented to demonstrate good research practice.

Over the last few years, outsourcing and offshoring has gained a remarkable interest from industry practitioners, worldwide media and in particular the researcher community all who have been focusing in this area to understand the current and future developments. Organisations are seeking to utilise external resources located in offshore destinations to outsource PDD activities for cost reductions and improvement in time to market. The research will focus primarily on the automotive sector; this being the most complex and difficult to manage and analyse (Maxton and Wormald 2004).

The automotive industry has suffered significantly over a number of years with many OEMs, ESPs and FTSs facing difficulty in competing due to globalisation, economics and low competitive labour rates from offshore destinations (Oliver *et al.* 2008). In fact, the automotive sector is the second largest industrial sector in the world and has attracted a considerable amount of academic attention (Taylor and Taylor 2008, Turnbull *et al.* 1996). In offshore outsourcing, and offshoring there is a lack of research attention towards high value-added services such as PDD (Willcocks *et al.* 2011). The automotive industry is split into two categories; commercial vehicles and passenger vehicles (Taylor and Taylor 2008); this research concentrates on the latter.

The chapter starts off with an overview of outsourcing in general followed by quotes used by a number of academic describing this phenomenon, followed by offshoring and how these terms are interchangeably used throughout the literature causing confusion amongst researchers. A further in-depth analysis to understand how automotive organisations review services which are either onshore outsourcing, offshore outsourcing, offshoring and in-house explained by using through a two by two matrix.

This literature review has identified that the drivers behind outsourcing and offshoring are to reduce costs followed by concentrating on core activities and accessing new talent in different countries.

Outsourcing and offshoring disadvantages are highlighted with actual case studies and examples of real life organisations experiencing this phenomenon. With any offshoring activity risks are present and have been identified and explained throughout this chapter.

Theoretical frameworks have been identified pertinent to outsourcing and offshoring within PDD and how they could affect organisations. A total of 11 outsourcing frameworks and decision models are discussed and contrasted to provide conclusions on their strengths and weaknesses.

To fully appreciate the complexity of outsourcing and offshoring different disciplines such as Information Technology Outsourcing (ITO), Business Process Outsourcing (BPO), Engineering Service Outsourcing (ESO) and Manufacturing Service Outsourcing (MSO) are reviewed.

The offshoring literature is taken one step further and analysed in the context of PDD and how culture, teams, language barriers, strategic decision-making processes contribute to the challenges an organisation experience when offshoring outsourcing or offshoring their PDD activities.

To conclude gaps in the literature have been identified followed by a conclusion of the chapter.

2.2. Literature retrieval

A number of methods can be utilised in retrieving academic and published material but consistency and creditability of each paper read or cited must be of value and relevant to the research (Ellis 1989).

The world has changed significantly since the first academic journal was published in Philosophical Transactions of the Royal Society in 1665 (Oldenburg 1665) as many journals have become available electronically enabling readily available material. The journals that were paper subscriptions are also available digitally, making them viewable to the wider public depending if subscription is required.

To ensure efficacy during searching for literature, a number of different methods have been explored, but the following seven were most beneficial as illustrated in Table 2.1. The method used below has provided immediate access to high quality academic papers and reliable sources of information such as high impact factor journals, peer reviewed journals and credible comprehensive documents.

EBSCO	Recognised as the world's foremost source of references to literature. The database consists of more than 750,000 records dating back to 1969.
Ebrary	Diversified of information available with excellent advanced searching option. The database contains over 530,000 records with e-books that are instantly available.
Google Scholar	Freely available to anyone who is in possession of an online (World Wide Web) connection. Academic material that has not formally been found through conventional searches (library, online databases, etc.), has been located utilising Google scholar which is a freely available tool and linkable to Refworks (Gavel and Iselid 2008). Google scholar uses web crawlers that have access to databases of well-known scholarly publishers and University articles (Haigh and Hardy 2011). It also provides citation counts, most reviewed articles, date search with an advanced search feature (Bosman *et al.* 2006, Harzing 2008) and has been praised for its speed through searches compared to other online academic databases.

Google search	Freely available to the public and is becoming synonymous when doing research (Bell 2004, Brophy and Bawden 2005, Mostafa 2005). Libraries are not agile enough for people who require immediate data, quick search options (Brophy and Bawden 2005). This has led Google to compete against the academic libraries (Bell 2004). Academic material not located in relevant databases has been retrieved by searching Google. This approach has saved at least seven days which is the estimated time taken for an article to be returned from British Library i.e. Coventry University document supply approach.
Ethos	Many PhD dissertations are no longer supported by inter library loans as they were several years ago. The use of ETHOS (Electronic Thesis Online) has been extremely powerful as there are over 300,000 dissertations to review. It requires the user to register and accept terms and conditions with data readily available. Many of the dissertations are either available online, immediate download, or can be requested manually which can take up to 30 days.
Impact Factor	The Impact Factor is a measure of the frequency on how many times an article has been cited in a particular journal. It must be noted that the impact factor measures the average number of citations. Using Thompson Reuters Journal citation report has allowed journals to be categorised in terms of highest and lowest impact factor scores. However, all journals have been reviewed even those with a low impact factor.
Peer Review Journals	These are high quality journals that are peer reviewed by a panel before being published. Peer reviewed journals are used throughout the dissertation.

Table 2.1. Literature retrieval process.

The literature retrieval process on the surface seems relatively simple but beneath the surface it underpins this chapter. The literature retrieval method used in this research study enabled the following tangible benefits;

1. Reduction of time to retrieve documents by using a number of multiple searches and databases rather than concentrating on a single source.
2. Increased speed when reading and obtaining further documents by understanding what current research has been undertaken in the subject area using the impact factor and peer reviewed journals to ensure credible citations.
3. Keyword searches to retrieve articles, with up-to-date information ready in digital format (Odlyzko 1997).

2.3. Outsourcing and offshoring academic disciplines

The literature on outsourcing, offshore outsourcing and offshoring has been predominately dispersed across three main academic disciplines (Maskell *et al.* 2007);

1. *Strategic Management* focusing on core competencies, firm boundaries, and decision-making.
2. *International Business* focusing on geographic locations, labour arbitrage.
3. *Supply Chain Management* focusing on distribution logistics, time zones, value chain unbundling.

The three academic disciplines will provide a stream of outsourcing and offshoring information and the theories used to examine the phenomena. Academic theories are borrowed from the three different disciplines to better explain outsourcing and offshoring within the automotive industry.

2.4. Definition of outsourcing

Outsourcing has attracted the attention of researchers and practitioners due to its sustained trends over several years (M. C. Lacity *et al.* 2009, Loebbecke and Huyskens 2009, Oshri 2009, Willcocks *et al.* 2011).

Kotabe (1993) and Venkatraman (2004) have defined that outsourcing is not a new concept and the existence has spanned a number of years. Management practices are increasingly concentrating in-depth on outsourcing and using it as a common tool (Fill and Visser 2000).
The outsourcing hype started with manufacturing and blue collar jobs[2] (Lewin and Peeters 2006). In order for business to reduce costs there were certain aspects of manufacturing or assembles that were moved to low-wage countries or developing countries. This is reviewed further in the section 2.14.4 on Manufacturing Services Outsourcing (MSO).

The term outsourcing has been around for decades with a number of authors/scholars using a variety of definitions over a period of time to describe the phenomena.
To grasp the fundamental understanding of outsourcing, the different approaches used to describe this phenomenon will be outlined.

Barthélemy (2003), Freytag *et al*. (2012), Lacity and Hirschheim (1993), Quélin and Duhamel (2003) have described outsourcing referring to the practice of *"the operation of shifting a transaction previously governed internally to an external supplier through a long-term contract, and involving the transfer to the vendor"*. The definition of a transaction is widely dispersed across a simple paper exercise to a highly skilled activity that may lead to a long term contract usually consisting of a clear roles and responsibility matrix for the client and vendor to agree responsibility on activities. Ultimately in an outsourcing agreement the organisation (third party) is responsible for delivering the activities on time.

[2] Blue collar jobs is defined as manual labour i.e. production, construction, physical work. This type of work is often hourly paid or salaried per monthly, and billed against the project.

Ellram and Billington (2001) take this one step further relating the outsourcing definition to production and goods and define *"outsourcing is defined as the transfer of the production of goods or services that had been performed internally to an external party"*. This definition refers to outsourcing manufacturing activities which may include internal services (processes). It clearly defines that outsourcing activities will be performed by an external party which is not attached to the organisation. There is no clear definition about the geographical location of the third party.

Ågerfalk and Fitzgerald (2008) and Olsson *et al*.(2008) refer to outsourcing as *"governance: when an activity is outsourced, it is performed by another organisation, a third party - as opposed to in-house by the organisation itself"*. The definition has been categorised by defining that an external organisation performs the outsourcing activity which was previously conducted in-house.

Rothery and Roberson (1995) describe outsourcing as "*the act of turning to an external organization to perform a function previously performed in-house. It entails the transfer of the planning, administration and development of the activity to an independent third party"*.

The outsourcing definitions described in this thesis are different in scope and scale, but have been described at the time of defining the meaning. Historically, there are over several hundred definitions that have been defined by authors and practitioners since the birth of outsourcing.
Outsourcing has become a dominating topic in today's business, but outsourcing definitions within the academic literature especially management literature is still relatively unclear (Bragg 2006, Gilley and Rasheed 2000, Greco 1997).

Outsourcing as a definition is very broad in terms of relating this to products or services, and cannot be defined simply as a procurement transaction between two parties namely client and the organisation (Gilley and Rasheed 2000).

Each variation of a definition conveys the complexity of the subject area and shifts in perspective of outsourcing, how these definitions have evolved over a period of time and most importantly pertinent to this thesis. The outsourcing definitions identify explicitly that services are provided by an external organisation.

In conclusion to the above, one could ask the question; how is outsourcing defined in today's world and particular for the context of this research study? The current literature generally states that *"outsourcing refers to the use of external resources to carry out functions that were previously governed in-house"*.

The outsourcing definition used for this thesis is: *"PDD activities that were conducted in-house are now carried out by a third party based onshore with a transfer of ownership"*.

2.5. Definition of offshore outsourcing

There has been much confusion in the academic literature and practitioner fields in regards to outsourcing and offshore outsourcing. The two terms have been used interchangeably causing confusion amongst readers and management within organisations (Grossman and Rossi-Hansberg 2006, Olsson *et al.* 2008, Patki and Patki 2007). When researching offshore outsourcing the importance of these definitions must be explicit from the start in order to avoid further misunderstanding sand ensure that the complexity of the subject field is completely understood. By adding another term namely *offshore* creates further complexity in outsourcing as the services are delivered remotely from a far destination (Chakrabarty 2006). The arrival of Year 2000 (Y2K) has added another brand offshore outsourcing. For example Patki and Patki (2007) informed the Institute of Electrical Electronic Engineers (IEEE) and Association of Computing Machinery (ACM) that both organisations have been using outsourcing and offshoring interchangeably without understanding the underpinning fundamentals. In 2014 the literature still defines both terms still widely diffused amongst each other.

Offshore outsourcing has been around for several years, but in terms of researching its development is still relatively new (Mohiuddin 2011) and less attention has been devoted to the dynamic effects of offshoring on innovation and growth within organisations (Naghavi and Ottaviano 2009).

Offshore outsourcing was first recognised in a seminal work of Kotabe and Omura (1989) which was then developed by Kotabe and Swan (1994) using empirical evidence on organisation's concentrating on offshoring from the US predominately the multinationals that increased the use of manufacturing offshore with cost being the main driver.

Stack and Downing (2005) use *"Offshoring occurs when organisations transfer jobs abroad for work that has traditionally been done in their home country".* This definition is broad and exists on a surface level, where these authors have not defined which services were transferrable abroad.

Ågerfalk and Fitzgerald (2008), Olsson *et al*. (2008) define offshoring as *"The relocation of some activities of an enterprise beyond the limits of its origin".* These authors state that their definition is changing as activities are relocated to low-cost countries rather to any geographical location. However, offshoring of activities does not always involve low-cost countries as an organisation based in China offshoring to UK involves a higher cost base.

Oshri *et al*. (2011) states that "*offshoring reflects to value chain activities that are shifted overseas (located in a different country and time zone) or to an independent service provider".* A more narrow approach clearly defining that value chain activities are reviewed and then relocated in a different country, with a time zone differential compared to the parent organisation for example located onshore. An independent service provider is usually a third party organisation with the expertise of providing either onshore or offshore services.

Offshore outsourcing for this thesis is defined as *"PDD activities are conducted externally by a third party organisation that is located in an offshore country with increased cultural complexity.*

2.6. Definition of offshoring

The term offshoring within the literature has been used interchangeably with offshore outsourcing, causing confusion amongst academics and practitioners (Grossman and Rossi-Hansberg 2006, Olsson *et al.* 2008, Patki and Patki 2007). Therefore, this thesis has defined the two terms independently to ensure clarity and consistency with the literature and to avoid any misunderstandings. The two terms are significantly different and there implications to an organisation are substantial.

Manning *et al*. (2008) reviews offshoring as *"Offshoring refers to the process of sourcing any business task, process, or function supporting domestic and global operations from abroad, in particular from lower cost emerging economies"*. This definition is related to services and how domestic (referred to onshore) is supporting global operations. There is a clear distinction that offshoring occurs to low-cost emerging economies and a surface level definition is defined.

Lewin *et al*. (2008) define *"Offshoring refers to the process of sourcing and coordinating tasks and business functions across national borders".* This definition is somewhat broad in terms of offshoring is not define whether it includes subsidiaries or third party outsourcing of activities.

The offshoring quotes within the literature are not compatible with this study in the automotive sector and therefore requires a further explanation.

A study by Norwood *et al.* (2006) highlighted there is no clear definition of what constitutes offshoring. However, organisations based in UK that offshore to China are offshoring these activities to a low cost region. In contrast, an organisation based in China that offshores to UK is also classified as offshoring but to a developed country associated with higher costs. Therefore, the offshoring definition defined for this thesis is pushed to it limits providing a more in-depth view in contrast to the literature; *"Offshoring is where PDD activities are transferred to a wholly owned subsidiary located in another country to provide services to the parent organisation with increased cultural complexity".*

2.7. Definition of nearshoring

Nearshoring occurs when an automotive organisation outsources their services to a country within one or two time zone difference (for example US to Canada or Mexico) (Ellram *et al.* 2008, Oshri *et al.* 2011) and the likelihood of greater cultural compatibility. The benefits of nearshoring compared with offshoring or offshore outsourcing is the close geographic proximity; reduced travel costs and a reduction in time zone differences (Trampel 2004). For a UK based organisation a nearshore location would be Ireland, Poland and Hungary for instance. As identified in section 1.6.1 this study excludes nearshoring of PDD activities.

2.8. Definition of Backshoring

An automotive organisation backsourcing their PDD activities is based on two factors. The first factor is where a contract period has been fulfilled and services are no longer required. The second factor relates to an organisation experiencing challenges which are complex in scope and depth that required the PDD activities to be backsourced after exhausting other areas of improvement. In some instances these challenges drive companies to face major difficulties in maintaining productivity, efficiency, profitability, and not meeting the outlined targets for an offshoring project.

Hirschheim and Lacity (1998), Kern and Willcocks (2001), define backsourcing as *"pulling back in-house [previously outsourced] activities as outsourcing contracts expire or are terminated".*

Backshoring is a costly process, heavily resource intensive and involves losses to the outsourcing organisation. Before an organisation reviews the business plans to backshore an activity other routes normally are explored such as extending, renewing, re-tendering contacts.

Other forms also do drive organisations to backshore. For instance Bank One, backsourced their operations from IBM Global Services and AT&T in 2002 as they experienced challenges that was costing the organisation additional time and money. The CIO made a decision to backsource the services. A large German premium OEM backsourced their offshore engineering PDD in 2008 from an Indian ESP as the program resulted in no ends of delays and lack of offshore management support.
General Motors in April 2013 decided to backsource IT related activities to gain control and instil new creativity within their organisation which was lacking with an external service provider.

Organisations backshoring do not make the wider public aware of their inefficiencies and this data is not available within public domain, as these organisations are not in agreement with making their failures transparent. Thus, this data can be retrieved through collecting primary data through direct interviewing with key stakeholders from the industry in question.

2.9. Drivers of outsourcing and offshoring

The exhaustive literature review conducted for this study has identified key drivers of outsourcing and offshoring which are reviewed independently to ensure consistency and continuity throughout the thesis. There are a number of drivers that lead organisations to outsource or offshore certain activities which were once conducted internally. These drivers are attached to certain industries but overall there are common factors that motivate organisations to make decisions on outsourcing and offshoring. Table 2.2 and Table 2.3 identify the drivers for outsourcing and offshoring respectively from the literature review.

2.9.1. Drivers of outsourcing

Outsourcing has become popular within organisations to reduce costs and improve efficiency (Burdon and Bhalla 2005). A large number of studies, media awareness, have identified that cost reduction is a key driver for organisations to outsource services followed by outsourcing of non-core activities in order to concentrate on value adding services to remain competitive. The drivers of outsourcing are identified in Table 2.2.

Driver of outsourcing	**Examples**
Cost reduction	(Arnold 2000, Aubert *et al.* 1996, Barthelemy and Adsit 2003, Bienstock and Mentzer 1999, Burdon and Bhalla 2005, Crone 1992, Dibbern *et al.* 2004, Dubbs 1992, Embleton and Wright 1998, Jurison 1995, Kakabadse and Kakabadse 2000, King and Malhotra 2000, Levina and Ross 2003, Norwood *et al.* 2006, Quélin and Duhamel 2003, Quinn and Hilmer 1994, Slaughter and Ang 1996, Vining and Globerman 1999, Willcocks and Currie 1997, Willcocks *et al.* 1995b, Winkleman *et al.* 1993).
Review core and non-core activities, focus on value adding activities (core)	(Arnold 2000, Barthélemy 2003, Crone 1992, Dess *et al.* 1995, Hendry 1995, Kakabadse and Kakabadse 2000, Kakabadse and Kakabadse 2000, Kotabe and Murray 1990, McIvor 2000a, Mullin 1996, Prahalad and Hamel 1990a, Quinn 1992, Quinn and Hilmer 1994, Quinn 1999, Venkatesan 1992b, Willcocks *et al.* 1995b).
Increase speed	(Dubbs 1992, Jennings 1997a, Kakabadse and Kakabadse 2000, Quinn and Hilmer 1994).
Access to new talent	(Jennings 1997b, Lankford and Parsa 1999, Moran 1997, Willcocks *et al.* 1995b).
Shortage of capacity	(Anderson and Joglekar 2005, Narula 2001).

Knowledge transfer	(Kotlarsky and Oshri 2008).
Strategic perspective	(McIvor 2000a).
Time to market	(Holcomb and Hitt 2007, Power *et al.* 2004, Quinn 1999).
Flexibility	(Campbell 1995, Jennings 1997b, Kakabadse and Kakabadse 2000, Quinn and Hilmer 1994, Quinn 1999, Willcocks *et al.* 1995a)

Table 2.2. Outsourcing drivers.

2.9.2. Drivers of offshoring

Offshoring within the literature is perceived as low cost labour located in developing countries with a time zone difference. The literature is examined to identify the main drivers that attract organisations to move their activities that were conducted internally to offshore locations. For an organisation to offshore their services there must be incentives or motivations otherwise it would be meaningless to execute such activities.

The literature review from this study has identified cost savings was as a key driver when organisations offshored and was also the most cited within the literature (Jahns *et al.* 2006, Khurana 2006, Maskell *et al.* 2007, Norwood *et al.* 2006).

Offshoring is also imperative when an organisation seeks to access skilled talent available globally, which is not normally available locally due to skills scarcity (Anon 2007, Lewin and Peeters 2006). The drivers for offshoring are further analysed in Table 2.3.

Driver of offshore outsourcing	**Author**
Cost reduction	(Beverakis *et al.* 2009, Corbett 2004, Dibbern *et al.* 2008, Duvivier and Peeters 2011, Farrell 2005, Hätönen and Eriksson 2009, Jahns *et al.* 2006, Jiang and Qureshi 2006, Khurana 2006, Krishnamurthy *et al.* 2009, Levina and Ross 2003, Lewin 2005, Lewin and Peeters 2006, Maskell *et al.* 2007, Norwood *et al.* 2006, Quélin and Duhamel 2003, Ramamurti 2004, Sharma and Loh 2009).
Access to new talent (skilled)	(Anon.2007, Bunyaratavej *et al.* 2007, Couto *et al.* 2006, Farrell *et al.* 2006, Kotlarsky and Oshri 2008, Lewin and Peeters 2006, Lewin *et al.* 2008, Manning *et al.* 2008, Mcfarlan and Nolan 1995, Quinn and Hilmer 1994, Thondavadi and Albert 2004).

Competitive pressure	(Bals *et al.* 2013, Coucke and Sleuwaegen 2008, Farrell 2005)
Tapping into local markets	(Amaral *et al.* 2011, Gassmann and von Zedtwitz 1999, Meyer-Krahmer and Reger 1999)
Location approach	(Jussi 2009, Kotlarsky and Oshri 2008)

Table 2.3. Offshore drivers.

A study conducted by the Offshoring Research Network (ORN) on the strategic drivers of offshoring for organisations track the offshoring developments and drivers every six months. The database is managed by Lewin and Peeters (2006) and consists of several hundred organisations that take part in the study to identify a number of strategic drivers as shown in Figure 2.1.

A survey conducted by Lewin and Peeters (2006) demonstrated that 93% of respondents cited cost reduction was the major driver for organisations to offshore. This was followed by competitive pressure to survive in their current industry. The third and fourth driver for offshoring was ranked very closely to improve service levels and accessing qualified personnel as highlighted in Figure 2.1.

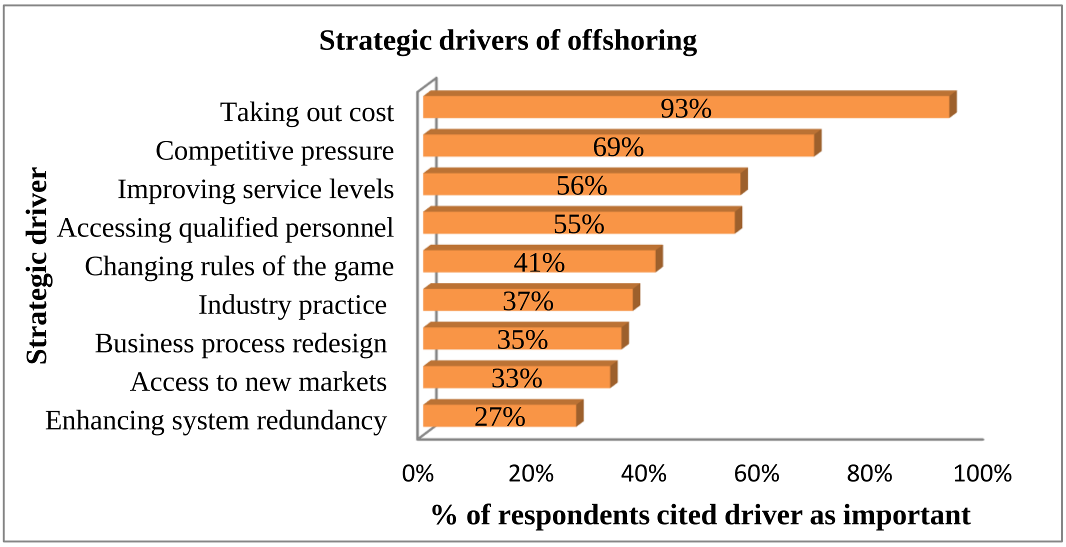


Figure 2.1. Strategic drivers when offshoring. Source. (Lewin and Peeters 2006).

Further data was obtained from ORN[3] to understand how the survey was constructed. In fact only 2.4% of the respondents were from the automotive industry which was split between software and engineering design. However, the automotive organisations were motivated to reduce cost and gain access to qualified personnel in low cost regions.

[3] The data was received directly from ORN in November 2013 in database format illustrating the spilt between each sector and response rates.

The underpinning drivers for organisations to offshore were based on cost reduction as identified in Table 2.3. However, moving offshore also provides an organisation to tap into the local market and swiftly move up through the value chain (Kenney *et al.* 2009).

2.10. Advantages and disadvantages of outsourcing and offshoring

Globalising PDD activities that were once conducted internally develops additional complexities and challenges than retaining these activities within HQ or outsourcing to external organisations. To examine the outsourcing and offshoring phenomenon, the advantages and disadvantages are identified for this study (Domberger 1999). Outsourcing is one of the most discussed management topics at board level to reduce costs within organisations and has over the last few years become a very controversial subject (Kakabadse *et al.* 2004).

The advantages of outsourcing and offshoring are only applicable when implementation is conducted with management accepting a cohesive alignment to the overall business strategy, a decision making produce is developed or followed and the organisation is aligned with their objectives. However, organisations are still falling into the inefficiency trap (Paz-Aparicio and Ricart 2013) with decisions being make sporadically causing other costs to be inherited during an outsourcing or offshoring agreement (Penter *et al.* 2009).

The literature review highlighted that an OWOS provides exponential savings compared to offshore outsourcing where 50 per cent of OWOS have failed which included multinationals that experienced extreme challenges in the area of PDD; this area consists of inadequate studies (Oshri 2009). The advantages and disadvantages can be categorised as strategic or tactical, short-term or long-term and tangible or intangible as discussed further in sections 2.10.1 and 2.10.2.

2.10.1. Advantages

The literature review has identified that cost reduction was a great advantage when organisations outsourced and offshored their services as illustrated in Table 2.2 and Table 2.3.
For example, a study conducted by Farrell (2005) indicated that American companies save around $0.58 on every dollar spent by moving jobs offshore in particular to India, and over a multiyear contract agreement (usually five years) savings are over millions of dollars. Outsourcing contracts targeted around 15 per cent cost savings and in some instances over twenty to thirty per cent (Kakabadse and Kakabadse 2000, Lankford and Parsa 1999).

Access to new talent globally is also another advantage for organisations to seek educated employees at lower rates compared to their onshore employees (Mcfarlan and Nolan 1995, Quinn and Hilmer 1994). Organisations based in Westerns countries are facing difficulties in recruiting as talent is becoming scared and these organisations are taking advantage of seeking new opportunities outside their home countries.

Organisations are pursuing to take advantage of outsourcing to reduce costs and move fixed costs into variable costs (Alexander and Young 1996, Anderson 1997). Thus, outsourcing or offshoring benefits the organisation by converting fixed costs into variable costs, thus increasing their economies of scale and reducing the cost of operations (Corbett 2004, Ellram *et al.* 2008).

A study conducted by Kakabadse and Kakabadse (2002) contrasted US and Europe organisations and identified that US organisations adopted a more strategic approach than companies based in Europe. These organisations concentrated on cost reduction and developing economies of scale which provided more advantage over their competitors.

The advantage of outsourcing non-core activities focuses an organisation to concentrate on the core business (Barthelemy and Adsit 2003, McIvor and McHugh 2000). Non-core activities are performed efficiently by an external organisation, and at a reduced transactional cost as these activities are usually mastered by these organisations (Quinn 1992). The literature review also revealed that organisations are offshore outsourcing/offshoring their engineering services to reduce time to market of software development through the utilisation of a time zone differential.

2.10.2. Disadvantages

Offshore outsourcing has disadvantages associated within its practice and these have been identified from the literature review. When organisations are not performing in outsourcing and on the road to failure, many occurrences are kept extremely confidential as making them public could damage their reputation (Sitkin 1992). There are only a limited number of cases that degrease the fundamental reasons on how automotive organisations have failed with outsourcing and offshoring.
When organisations engage with outsourcing or offshoring, the supply chain increases which creates additional challenges and further adds cultural difficulties which become difficult to manage and control (Dieter and Schmidt 2009). According to Jackson *et al*. (2001) approximately twenty to twenty five per cent of outsourcing agreements fail within two years.

Landis *et al*. (2005) discovered that over one third of organisations who have been aiming to achieve lower costs in fact incurred hidden costs within their processes. The study by Landis *et al*. (2005) also identified there was an enormous amount of complacency from the outsourcing service provider that eventually led to delivery and quality challenges. Organisations that are offshoring have identified that managing a globally dispersed location is more difficult and costly than initially expected (Bals *et al.* 2013).

Furthermore, Barthelemy and Adsit (2003), define seven reasons for outsourcing failure. These failures have been named *'seven deadly sins'* that consist of;

1. Do not outsource activities that should not be outsourced.
2. Selecting the wrong organisation.
3. Developing a poor contract.
4. Overlooking personnel issues.
5. Losing control over the outsourced activity.
6. Overlooking hidden costs not known to the organisation.
7. Failing to plan an exit strategy.

The disadvantage of engaging with a third party service provider is the danger of an external organisation gaining product knowledge which then could be used to develop a new product for a competitor (Prahalad and Hamel 1990a). However, when an organisation develops an OWOS the risk of losing product knowledge to a competitor is very minimal but a multiple customer site may exist within an offshore engineering centre. This would require additional control and mechanisms to protect data infringement across these organisations

A case study on FIAT Automotive conducted by Becker and Zirpoli (2003) also highlighted the fact the outsourcing of design leads to an organisation losing product knowledge and product development outsourcing is more difficult to implement than ITO and BPO.

Outsourcing has attracted many organisations that have developed engagements and has resulted in these organisations to not have a clear understanding on the real benefits available (Smith *et al.* 1998). However, an outsourcing agreement is between two parties who both have inevitably different interests (Lacity and Hirschheim 1993). For example the outsourcing organisation endeavours value for money while the service provider is pursing net benefits and maximum profits through maximum utilisation.

Internal activities which are classified as low value-added will be scrutinised resulting in greater pressure for these to be outsourced and also relocated to low-cost countries to achieve a maximum cost reduction (Belussi and Silvia 2010). However, in some instances organisations fail to understand that low value-added activities may actually contribute more financially than activities of high value.

The literature review has identified that outsourcing does not reduce costs, when both parties do not share the same business objectives or when organisations decide to outsource when profit margins are not met (Beaumont and Sohal 2004, Hirschheim and Lacity 2000).

A survey conducted by Rayner (2005) highlighted that design outsourcing is slowly increasing and managing this type of outsourcing or offshoring is more difficult than those companies originally anticipated. It also was noted that outsourcing of design is not a panacea and poor communication was seen as a negative impact on deciding what these organisation could outsource.

A study conducted by Amaral and Parker (2008) and Mokhoff and Wallace (2005) identified that design outsourcing projects are frequently late, over budget and requirements are not fully met and no reasons within the literature are documented.

Outsourcing PDD activities on the Boeing 787 design phase were late and cost the organisation over $2.5 billion causing a delay of three years (Peterson 2011, Quinn 2009). One big lesson learnt was globalising engineering PDD was more difficult than expected, it required an increased resource demand of local management, and offshore competencies were below the required threshold than expected (Hiltzik 2011). The Boeing 787 outsourcing is a good learning mechanisms for engineering organisations to be aware of when developing outsourcing or offshoring engagements.

2.11. Outsourcing and offshoring challenges

Globalising the product development process inevitably involves moving services to an offshore location where challenges are inherited throughout this process.

The literature review has identified that outsourcing and offshoring challenges have been identified for none automotive industries where there is little literature and studies conducted in the automotive sector.

An organisation that decides to outsource or offshore activities is faced with challenges regarding certain risks and also hidden costs that are not immediately apparent (Barthélemy 2001). The hidden costs are deadly and many organisations have fallen into this trap without understanding why they exist and are not aware of them. Thus, hidden costs explain the complexity of offshoring or offshore outsourcing and how they erode the business model.

The typical challenges experienced when an organisation offshores consists of language barriers between two organisations, cultural differences in working methods and reporting structures, transfer of knowledge between sites and a lack of employee retention (Carmel *et al.* 2009, Rottman and Lacity 2008).

A further study conducted by Iacovou and Nakatsu (2008) reviewed risks/challenges associated with offshore outsourcing of development projects involving information technology. After screening the qualifications of 57 individuals, there were 15 selected who participated in 135 projects with nine related to offshore outsourcing. The study by Iacovou and Nakatsu (2008) identified the top 10 risks defined in Table 2.4. These risks have been discovered in the ITO literature.

No.	Risk Factor
1	**Lack of top management commitment** Support required from top management to ensure commitment and when challenges arise they can be resolved swiftly.
2	**Original set of requirements is miscommunicated** Both onshore and offshore team members must have a consistent understanding of the requirements. This is a challenge as the face to face communication is reduced and more effort is put towards a conference or email method.
3	**Language barriers in project communications** This makes project communication difficult in particular when talking with other parties offshore. When both parties are speaking English, there still may be differences due to cultural assumptions. For an offshore project communication is much more difficult and a challenge.
4	**Inadequate user involvement** The involvement of the user in a project is critical especially to the success.
5	**Lack of offshore project management know-how by client** Offshoring is relatively new to many companies. Many client organisations have no in-house expertise on offshore and how the work is to be organised. The lack

No.	Risk Factor
	of understanding in how to manage an offshore project can lead to cost and time overruns.
6	**Failure to manage** This occurs when users are not in direct contact with developers.
7	**Poor change controls** Changes to work packets can cause delays, overruns and other problems if not correctly managed. Furthermore offshore locations may not consider a change in the same urgency as onshore so extra effort is required to push changes through.
8	**Lack of business know-how by offshore team** In some instances offshore locations might not have the full domain capabilities to develop requirements from the onshore team.
9	**Lack of required technical know-how by offshore team** In some instances the skills and knowledge of offshore resources are misrepresented by an outsourcing organisation and the depth and capability could be limited.
10	**Failure to consider all costs** Not all organisations consider all the costs associated with offshore outsourcing. There are many hidden costs.

Table 2.4. Offshore outsourcing challenges adapted from Iacovou and Nakatsu (2008).

Table 2.4 identifies risks from a study conducted by Iacovou and Nakatsu (2008) when organisations offshore outsource project work which recently has gained momentum. Carmel and Beulen (2005) identified that knowledge transfer has become a significant contributor to why organisations fail within a few years of outsourcing or offshoring. A study by Aron and Singh (2005) identified that many organisations involved with offshoring have not met the expected financial benefits and the risks are vaguely understood. This is one of the main reasons why many organisations experience such difficulty and up to half of the outsourcing agreements are terminated (Weidenbaum 2005).

Indications in this field also highlight that offshoring decisions may over a period of time actually be less cost effective and beneficial than anticipated due to challenges experienced during the journey (Dibbern *et al.* 2008, Massini *et al.* 2010, Stringfellow *et al.* 2008).

Offshoring or offshore outsourcing of PDD activities requires an individual to have specialised knowledge about the subject matter and a degree of judgement is required otherwise difficulties will be experienced during the journey (Stringfellow *et al.* 2008).

Polyani (1966) defines knowledge either as being explicit which is explainable and implicit being retained within people. PDD knowledge can be classed as explicit and implicit which is transferable/non transferrable amongst people through training and coaching. These types of knowledge streams create invisible costs for an organisation (Stringfellow *et al.* 2008). Activities taking place globally are classed as effective interaction distance contributing to hidden costs when offshoring or offshore outsourcing (Stringfellow *et al.* 2008).

2.12. Theoretical frameworks for outsourcing and offshoring

There are several reasons why a theoretical framework methodology is important and should be included in this study as identified below (Wacker 1998).

1. It provides a framework for analysis. This proves useful when taking into account different opinions, since most researchers do not agree on certain factors.
2. It presents a robust method for further field development through delivering efficiency and reducing errors in problem solving by building upon current and relevant theories.
3. It relates theory to practice and therefore to what is happening in the world today. In other words the applicability or parasitism of the theory when introduced to real world scenarios.

Offshore outsourcing has become a complex multi-dimensional business strategy with theoretical theories used from other fields as noted in section 2.3. Using an offshore outsourcing strategy allows organisations to improve their performance, reduce cost and focus on core competences (Arnold 2000, Duvivier and Peeters 2011, Hendry 1995, Javalgi *et al.* 2009, McNally and Griffin 2004). The theoretical field used within each reference is from different academic disciplines to explain offshore outsourcing, outsourcing and offshoring.

Core competencies are critical for an organisation's survival, and by concentrating on these activities an organisation will begin to invest in those activities that create the most value. A number of theoretical frameworks have been utilised in similar studies, but the most commonly used when outsourcing and offshoring which relate to this study are Transaction Cost Economics (TCE), Resource Based Review (RBV) and Resource Dependency Theory (RDT) (Chibba and Rundquist 2009, Javalgi *et al.* 2009, Jiang *et al.* 2007). This warrants an explanation of the three theoretical frameworks and helps to understand why organisations are outsourcing, offshore outsourcing and offshoring.

2.12.1. Transaction Cost Economics (TCE)

The transaction cost theory was introduced by seminal work of Coase (1937) and then further developed by Williamson (1975) viewing automotive organisations and market as separate commodities. TCE assumes that transactions are determined by production economics and the most effective transaction is utilised (Barney and Hesterly 2006).

A transaction is a cost that occurs in making an economic exchange between two parties.
The nucleus of transaction cost economics is the 'make or buy' decision where if the cost of doing a transaction is lower than the cost of using the market then there is an opportunity to outsource or offshore.

Granf and Mudambi (2005), Ellram *et al*. (2008) state that an outsourcing decision simply starts with a make or buy theoretical analysis.

Williamson (1985) defines three environment factors which increase transaction costs and are characterised by;

1. Uncertainty – Environmental volatility and unpredictability in the market. When the markets are uncertain, organisations will not outsource activities (Vidal and Goetschalckx 2000).
2. Frequency – This is reviewed as the number of transactions representing the total cost of transactions, the more transactions involves higher costs (Maltz 1994).
3. Assets specificity – This type of asset has a lower value in any alternative use. For example if an outsourcing contact requires high specific assets but without any alternative use, it is rare that an investment transaction will occur (Klein *et al.* 1978, Masten *et al.* 1991).

Since the development of the 'make or buy' decision it has attracted many authors, for example Embleton and Wright 1998, Gilley and Rasheed 2000, Sanders *et al.* 2007 all of whom noted the complexity of outsourcing as a concept, this leading to the outsourcing phenomenon being either mislabelled or even misunderstood (Grossman and Rossi-Hansberg 2006, Olsson *et al.* 2008, Patki and Patki 2007).

The make or buy decision boils down to whether an automotive organisation should continue activities in house (make) or acquire resources from an external organisation (buy) which are driven by environmental pressure and intensifying global competition (Farmer and van Weele, 1995). Thus, it is important that ad hoc short term decisions (non-strategic) are avoided as this may cause financial difficulties and risk of the core competencies being fragmented (McIvor and Humphreys 2000).

2.12.2. Resource Based View (RBV)

RBV has been around for twenty years and is both widely used and citied in mainly strategic management and international business areas. In offshore outsourcing the RBV theory is where an automotive organisation creates value through its internal resources (Wernerfelt 1984). Value is benefited, created, only if resources are available, the characteristic of such resources (Barney 1991) and has often been used in offshore outsourcing (Hätönen and Eriksson 2009). When resources are employed in strategic ways, it creates competitive advantage for automotive organisations (Barney 1991, Prahalad and Hamel 1990a).

The roots of RBV were originally developed jointly by authors (Doh 2005, Penrose 1959, Ricardo 1817, Schumpeter 1934). The concept of reviewing automotive organisations broader set of resources goes back to the seminal work of Penrose (1959). The term resource is a strength or weakness of an automotive organisation either tangible[4] or intangible[5] assets according to the seminal work of Caves (1980). Authors such as (Grant 1991, Prahalad and Hamel 1990a, Rumelt 1991, Wernerfelt 1984) fully developed the theory.

[4] Tangible assets are fairly easy to distinguish, for example financial and physical assets and are easily quantifiable (Grant 1996).
[5] Intangible assets are difficult to measure that include for example technological, human, etc.

Barney (1991) has identified resources of an automotive organisation from seminal work of Becker (1964), Tomer (1987) and Williamson (1975) which have been categorised in three forms;

1. Physical capital resources – Organisations equipment, geographic location, and access to raw materials.
2. Human capital resources – Training, experience, judgment, intelligence, relationships and talent of the organisation's workforce.
3. Organisational capital resources – Reporting structure, informal and formal planning, controlling.

Outsourcing can be viewed from another perspective by using the RBV theory to identify which PDD activities are retained in-house or outsourced/offshored (Espino-Rodríguez and Padrón-Robaina 2006, McIvor 2009). The RBV theory can provide an automotive organisation with competitive advantage, to the outsourcing landscape by reviewing which resources and capabilities are necessary for the organisation (Colotla *et al.* 2003). Resources within an organisation have different values and this affects how decisions are made (Barney 1991). Organisations have spent thousands of hours developing their internal resources and are more inclined to keep these resources in-house (Grant 1991). This is argued by Duncan (1998) who states that if these resources are outsourced it would impact the competitive advantage.

RBV theory goes one step further by analysing that an automotive organisation can exploit resources that are outside their boundary by means of contracts (Barney 1991, Grant 1991), and the organisation does not need to rely on internal resources, but can acquire resources geographically (Argyres 1996). In this context of RBV outsourcing, decisions are viewed strategically and affect how resources are allocated within an organisation (Quélin and Duhamel 2003).

2.12.3. Resource Dependency Theory (RDT)

The RDT argues that an automotive organisation's survival is the ability to maintain its resources (Preffer and Salancik 1978). It has become one of the most influential theories in organisational theory and strategic management (Hillman *et al.* 2009).

RBV theory identifies the internal resources and capabilities of an automotive organisation, whereas RDT focuses on external factors (environment and competition) of organisations behaviour as stated in the seminal work of Preffer and Salancik (Preffer and Salancik 1978)(Preffer and Salancik 1978)(merged) building insights from seminal work of Thompson (1967). The behaviour of an automotive organisation is based on the content i.e. resources, competences, technology and how they operate (Aldrich and Pfeffer 1976).

In terms of onshore/offshore outsourcing, external resources onshore can be procured through engaging with organisations whereas offshore resources can be procured at a cost-effective price and the external resources will contribute to the organisation's behaviour and success. It must be noted that when resources are borrowed from offshore locations (offshoring) they are still owned by the parent organisation but situated in a different location. The three theories discussed in this literature review are in the context of outsourcing that is commonly used and unique in terms of their applicability. Table 2.5 categorises each of the theories into a more holistic approach to understand further the outsourcing decisions and how they differentiate based upon each theory. The three theories have provided a different insight into the outsourcing phenomena which has been recognised globally and more dynamically with organisations that are developing this method.

Table 2.5 also identifies how outsourcing for cost reduction moves towards gaining resources from external factors to build capability but this region involves a higher risk.

Table 2.5. Outsourcing decisions based on TCE, RBV, and RDT. Source: Tsang (2000), Grant (1991), Javalgi *et al.*(2009).

2.13. Outsourcing decision models/frameworks

The literature review has identified 11 outsourcing models/frameworks developed over several years to support organisations during the decision-making process. The models/frameworks discussed in this study along with other models available lacked the comprehensiveness to address organisations within the automotive industry when outsourcing or offshoring their PDD activities. Westphal and Sohal (2013) classify these models being incomplete or too simplistic for organisations to use. The models/frameworks can be used as a general guide and are discussed with a summary presented in Table 2.6 which identifies the key topics of all 11 models/frameworks.

Simon (1960) decision making model was adapted by Dibbern *et al*. (2004) who developed a five-stage IS outsourcing model to enable practitioners and researchers to further understand outsourcing decisions. The five-stage model has caused confusion amongst authors where Wiener *et al.* (2010) suggests to streamline the five-stage decision into four stages by integrating the ‘which’ stage with the ‘how’ stage enabling a reduction in errors that can be made during the decision process (Jennings 1997b). The four-stage decision model is shown in Figure 2.2.

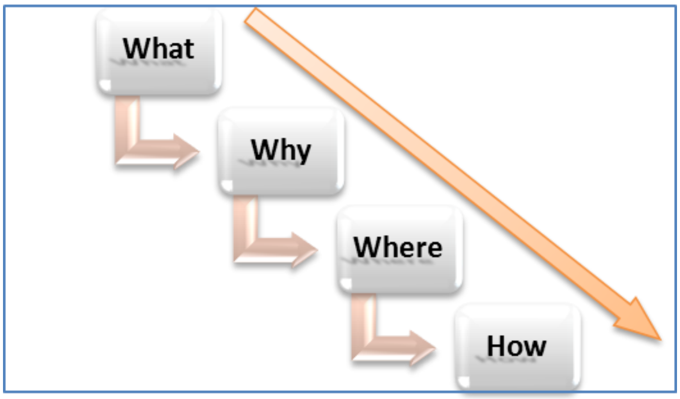


Figure 2.2. Four stage outsourcing decision model. Adapted from (Jennings 1997b).

To understand the complexity of outsourcing and offshoring in PDD the four-stage model is explained further, in detail.

2.13.1. What can be outsourced?

When an automotive organisation is outsourcing the WHAT to outsource must relate to the overall business objective and strategy. Any activity that involves a transaction can be outsourced, to either onshore or offshore destinations (Williamson (1981). In this study non core, near core and core activities are defined distinctively and have strategic implications and complexities for organisations (Gilley and Rasheed 2000, McIvor 2000). The non core, near core and core activities are shown in Figure 2.3.The literature is slowly shifting its view from simple call centre activities to more complex activities such as R&D.

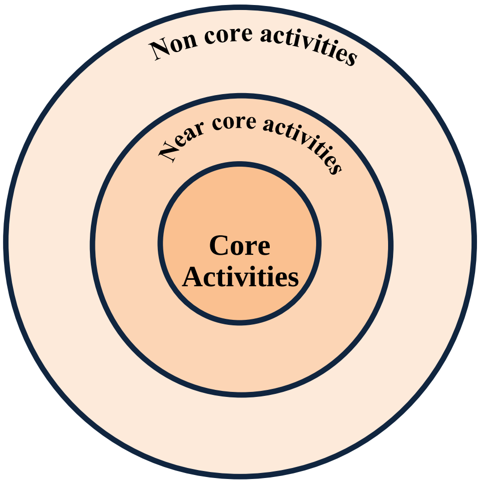


Figure 2.3. Model showing Core, Near Core and Non Core. Adapted from Quinn (1999).

2.13.1.1. Non core activities

Outsourcing of noncore activities allows an organisation to concentrate on the core segment of the business by leveraging competitiveness to retain their innovative position in the market (Barthelemy and Adsit 2003, Tiwana and Keil 2007). Noncore activities are those activities that can be performed efficiently by an external organisation at a reduced transactional cost as these activities are usually mastered by service providers (Quinn 1992). Non core allows an organisation to concentrate on its core competencies (Mullin 1996, Prahalad and Hamel 1990, Quinn 1999, Willcocks et al. 1995), and increase flexibility and remain competitive (Jennings 2002, Quélin and Duhamel 2003). The non core activities of an organisation is represented in Figure 2.3, adapted from (Quinn 1999).

2.13.1.2. Near core activities

Near core activities are present in automotive organisations that contain a high level of innovation and technology such as R&D and other high-tech areas. The complexity of outsourcing and offshoring within PDD adds another dimension to non core and core termed near core as represented in Figure 2.3. Near core activities are close to an organisation's core activities and outsourcing or offshoring these activities can lead to a risk of the core activities being exposed to an external organisation (Bettis *et al.* 1992, Gilley and Rasheed 2000) and fragmentation of the competitive advantage.

A strategic approach to outsourcing and offshoring will enable organisations to lower their long-term capital investments and leverage their key competencies (Quinn 1999) where inadequate studies are conducted within the automotive industry across the three segments (OEMs, ESPs and FTSs).

Seminal authors such as Michael Porter, Gary Hamel, Peter Drucker and others also steer the view of core competencies is a key business requirement for survival. There is limited research in this area on non core, near core and core competencies of an automotive organisation when outsourcing, offshore outsourcing and offshoring the PDD.

2.13.1.3. Core activities

Core competencies are critical for an organisation to survive and concentrating on these activities will create the most value. The core activities defined by Quinn and Himler (1994) are critical activities that add unique value to the customer based on a key and unique skills set. Ellram and Billington (2001) define that an organisation's core competencies are its sources to leverage the value chain. Brown and Eisenhardt (1995) define that product development functions are at the heart of core competences of an organisation and careful decision-making is essential when outsourcing or offshoring these activities. For instance, companies such as Honda, Apple, and Merck build organisational strategies based around their core competencies (Quinn and Hilmer 1994). Core activities of an organisation are represented in Figure 2.3.

2.13.2. Why outsource?

The automotive industry is becoming rather complex, dynamic and more competitive with pressure on these organisations to reduce costs and improve the Return on Investment (ROI). One known method is for an organisation to outsource or offshore activities that are conducted in-house to reduce costs or deployment of employees on to other activities. Organisations will expand their global operations through outsourcing to remain competitive and reduce costs further (Harmancioglu 2009). One of the most cited drivers for offshoring or offshore outsourcing was driven to reduce costs within the business, see Table 2.3.

Clott (2004), Pfannenstein and Tsai (2004) define outsourcing of services to offshore locations can be performed cheaper, better and faster. The types of services identified in their studies were typically ITO and BPO activities. However, as PDD activities within the automotive industry are complex and multi-dimensional they had been overlooked.

The literature analysed as part of this research has identified a scarcity of studies focusing on the automotive industry which are not comprehensive or in-depth to understand the phenomenon. Therefore, it is imperative to analyse the drivers within the automotive sector when organisations are outsourcing and offshoring.

2.13.3. Where to outsource – geographic location

This is becoming increasingly important for organisations and suppliers that are looking to offshore services. In fact, geographic location has become a key research question (Palvia 2004). Where to outsource dates back to the seminal work of Dunning (1998) where location decisions were decided upon internal production.
Organisations that based their offshore models on reducing costs will select locations geographically reflected to labour arbitrage and low cost.

A framework by Farrell (2006) details six factors to consider when offshoring and looking for a geographic location. These include costs, skills, business and living environment, quality of infrastructure, risk profile, and market potential.
Tax incentives are also attracting organisations globally to develop new vertical integrated units in Special Economic Zones (SEZ). This type of motive is forcing organisations to build wholly

owned subsidiaries in zones that benefit from exemption of income tax, customs and duties, divined distribution tax. Emerging markets such as China and India offer reduce costs and are becoming dominating destinations for organisations to setup wholly owned subsidiaries (Carmel 1999, Deavers 1997, Lewin and Peeters 2006).

2.13.4. How to outsource – what type of model

Organisations are experiencing challenges when identifying and selecting an outsourcing or offshoring model. There are four types of models that can be used; Offshore outsourcing, offshoring, onshore outsourcing or retain in house (Eppinger and Chitkara 2009). This is further discussed in section 2.15. It is imperative the outsourcing and offshoring model is aligned with the overall strategic vision of the organisation and the literature lacks guidance for automotive organisations when making key decisions.

2.13.5. Review of outsourcing decision models/frameworks

The outsourcing decision making models/frameworks are discussed to examine and understand the complexity of a decision-making process when automotive organisations outsource, offshore outsource and offshore their activities.

Venkatesan's (1992b) model on outsourcing decision-making was developed during the early stages of outsourcing and proposes a make or buy decision model in the supply chain management discipline. The approach taken is underpinned by the work carried out by US engine manufacturer Cummins, and is based on personal experiences. An organisation's product is spilt between strategic and non-strategic, where all strategic components of an organisation are not outsourced and the model links components into family capabilities.

Welch and Nayak (1992) develop an outsourcing framework from their experiences in the manufacturing sector from organisations based in USA and expand the work developed by Venkatesan (1992b) that would help practitioners decide sourcing decisions. The framework uses three main dimensions, process technology for competitive advantage, maturity of process technology, and competitor position comparison in technology.

Probert (1996) developed a four-stage, decision-making model leading to the make or buy decision applied to six cases consisting of manufacturing engineering organisations based in aerospace, automotive and laboratory sectors. The four stages include;

1. An initial business appraisal to understand the company's position and which strategic concerns they have.
2. An internal/external analysis to understand manufacturing product families, competiveness and importance of products to the business.
3. A review of the evaluation of strategic options identified from stage two developed from the analysis during stage one.
4. Selection of the optimal strategy based on financial decisions which underpins the organisation's model used.

Cox (1996) developed an outsourcing framework based around understanding organisation’s critical internal resources and maps them against critical assets. The framework starts by identifying that high-asset specificity skills are retained internally, medium-asset specificity skills are outsourced through close external reliance’s and low-asset specificity skills are outsourced through non-close external contracts also shown with a ladder approach for external and internal relationships. The skills are mapped through a cost analysis that provides an understanding of the interaction or value they can provide an organisation.

McIvor’s (2000b) outsourcing framework is a four-stage outsourcing decision approach as outlined;

1. Distinguish between core and non-core activities of an organisation.
2. The core activities are benchmarked against external provider’s capabilities who could deliver those activities.
3. Total cost analysis is used against the core activities if they were provided externally.
4. A decision is made whether these activities are performed internally or strategically outsourced based on supplier threat or an analysis of little future competition.

Fill and Visser (2000) developed a composite decision-making model based on three main composite components and a nine-question approach based on Beulen *et al.* (1994). The first component concentrates on contextual factors involving internal and external conditions which require further examination. A quantifiable and non-quantifiable criterion is applied consisting of costs, increased fixed costs and the latter’s strategic interest, linkage with operations and dependence on suppliers. The second component concentrates on strategic and structural implications when outsourcing. The third component concentrates on costs by applying the make or buy strategy where these costs consist of production costs which are lower when outsourcing and coordination or transaction costs which can be high due to the customer managing the supplier.

Zeng (2003) developed an outsourcing model for the procurement process and a logistical analysis based on global sourcing process. The model consist of a five-stage outsourcing process initially starting with investigation and tendering, evaluation, supplier selection and development, implementation, performance measurement and continuous improvement. Initially the model begins with identifying the core/non-core activity of the organisation following a stage approach which ends up with continuous improvement by monitoring the supplier’s performance and identifying problems that need resolving. However, the two aerospace companies where this model was applied were based in America and their joint venture was with China.

Hong *et al*. (2004) developed an outsourcing model for knowledge-sharing in integrated product development process. The model captures the customer requirements and understands the organisation’s manufacturing capabilities using shared knowledge, suppliers, and internal capabilities mapping these against the performance. In summary, the product development performance is measured through teamwork and development productivity and concludes that knowledge-sharing should be adequately shared amongst team members during the designing process.

Bragg (2006) developed an outsourcing framework based on the manufacturing industry. The framework is rather simplistic, showing the relevant activities and low cost of products within an organisation and their customers and suppliers. However, the model does not go into further detail.

McIvor (2009) developed a prescriptive framework for outsourcing evaluation based on the transaction cost and resource base view theory of an organisation based in the manufacturing sector. The outsourcing evaluation is based on three measures; contribution to competitive advantage, relative capability position and the opportunism associated with outsourcing. The logic behind the framework is that each measure should be considered as well as the relationship between each other where the parts are an unimportant means of validating the outsourcing framework.

Chen *et al*. (2011) developed a logistic outsourcing selection process using the analytical hierarchy process which finds the best solution when forming a partnership through the supply chain. The process uses trade strategies between different suppliers and the research was used only for external suppliers that were compared against each other with no consideration given for in-house operations. The logistical outsourcing selection process requires good negotiation mechanisms and uses that analytical a high priority process to find the suitable selection for partnership. However, the process was developed using a clothing supplier.

In total 11 outsourcing models/frameworks have been discussed and were unable to fulfil the research question for this study. In fact the examination highlighted there was no model/framework that captured the necessary elements without additional research or further work in the area of outsourcing and offshoring of PDD. The models have a range of contexts which limit the usefulness in finding an overall ‘best fit’ solution (De Boer *et al.* 2006, Penter *et al.* 2009).

In conclusion to the outsourcing decision-making models which are very similar and rather limited in scope and depth and the number of steps they employ; there is no decision-making model that is complete or detailed comprehensively (De Boer *et al.* 2006). A decision-making model combined with outsourcing and offshoring is significantly different than using a pure outsourcing model which organisations fail to understand that leads to significant consequences (Mohiuddin 2011).

Table 2.6 provides a summary of all 11 decision-making models highlighting the key points and identifying the limitations.

Authors	Key Points	Limitations
Venkatesan (1992b)	• Based on authors personal experience on make buy in supply chain management and concentrated on physical products. • Focus on key components an organisation is good at and only outsourcing is reviewed. • Outsourcing is used to increase employee commitment to improve manufacturing performance.	• Does not provide detail to the process (McIvor 2000b). • For components and manufacturing the model does not identify clearly which manufacturing capabilities should be retained internally and by Cummins (McIvor 2000b). • Approach does not look at offshoring as the model then becomes rather complicated.
Welch and Nayak (1992)	• Based on US manufacturing organisations and from work developed by Venkatesan (1992b). • Sourcing decisions based on a generic framework using three main dimensions, process technology for competitive advantage, maturity of process technology, and competitor position comparison in technology.	• The model has no practical evidence that benefits have been achieved from implementation and is based on manufacturing analysis without analysing internal PDD (McIvor 2000b).
Probert (1996)	• Uses the make or buy decision through a four stage process. • The make or buy methodology was applied to six manufacturing organisations and commented they received positively usefulness. • Use of Venkatesan (1992b) methodical approach by breaking down product architecture into sub systems and generates a methodologies to break down products to address this limitation in the model.	• Uses a methodology matrix that focuses on accessing manufacturing technologies (Cánez *et al*. 2000). • Rather complex to follow methodology and lacks comprehensiveness. • The model is grounded in the make or buy decision and does not take into account other factors when outsourcing or offshoring.
Cox (1996)	• The framework argues that a decision relies on an understanding of asset specific which is embedded in an entrepreneurial than a realistic/productive view of the organisation. • Core skills are identified as activities which sustain the margin and these are preformed internally. • Activities which are low asset are outsourced using arm length outsourcing.	• Framework does not detail how an organisation can conduct each step and in fact there are elements of lean manufacturing used to further complicate the process (McIvor 2000b). • Framework assumes non-core activities are automatically considered for arm length outsourcing without taking into account strategic alliance, short term, long term strategies and different business model. The framework does not clearly distinguish where these asset specific skills are positioned.

Authors	Key Points	Limitations
		• Framework is developed more corporately than addressing the make or buy decision for an organisation.
McIvor (2000b)	• Framework involves a four stage generic approach based on make vs. buy. • Framework divides strategic and non-strategic elements.	• Framework assumes all non-core activities are outsourced and very high level (Westphal and Sohal 2013). • Framework is highly aggregated and only outsourcing as an option is considered (Cánez *et al.* 2000). • There is scarce information about offshoring in general, but more emphasis on activities that capable to the business and are retained onshore.
Fill and Visser (2000)	• Adoption of Ewaldz (1991) nine questions when deciding strategic information. • Make or buy theory used for analysis.	• Model does not take into account if activities are not outsourced and each component models are not linked. • Use of Beulen *et al* (1994) approach that bias the model to use outsourcing more. • Five interviews were conducted with managers a small sample no in-depth study.
Zeng (2003)	• Five-stage model, investigating, evaluation, supplier selection & development, implementation and performance measurement & continuous improvements. • Model starts with identifying core activities and finishes with continuous improvements.	• Model based on materials, product sourcing and logistics to develop a total logistics cost process. • Model is limited to one US Company and a JV in China, and not applied to other organisations.
Hong *et al*. (2004)	• Model uses customer's requirements and knowledge of engineering and the organisations manufacturing capabilities. • The mode used structural equations and demonstrated that specific knowledge sharing common components enhanced NPD process.	• Model based on teamwork and sharing knowledge where the output criteria for performance of product development process are measured in teamwork and productivity.
Bragg (2006)	• Framework built on manufacturing industry showing the activities and products mapped against the customer and supplier.	• The framework lacks detail and does not take into account other factors of outsourcing apart from manufacturing activities and products.

Authors	Key Points	Limitations
McIvor (2009)	• Framework is bases on transaction cost and resource based view of an organisation. • Concentration to outsourcing performance	• Framework is developed on prescriptive accounts and has not been tested with a limited number of case studies employed. • Drivers and challenges are not presented and framework is difficult to follow.
Chen *et al*. (2011)	• Uses the AHP method for comparing different vendors. • Requires fundamental use of negotiation strategies when reviewing the sourcing process.	• Difficult to follow framework for both research purposes and more importantly practitioners who will carry out the implementation. • Model developed and is grounded in the logistical area.

Table 2.6. Comparison of outsourcing decision models/frameworks.

2.14. Outsourcing and offshoring industries

This section reviews four outsourcing industries to provide a comprehensive review in terms of their historical background and their current presence within the outsourcing and offshoring literature.

2.14.1. Information Technology Outsourcing (ITO)

ITO roots dates back to 1963 when Ross Perot's, organisation called Electronic Data System agreed a contract with Blue Cross of Pennsylvania to outsource data processing services (Lacity and Hirschheim 1993). This was the start of a roadmap demonstrating to other companies the tangible benefits of cost reduction and productivity improvement. ITO has mainly been down to reducing costs from the organisation (Apte and Mason 1995, Rottman and Lacity 2004).

Kodak followed in 1989, where they decided to outsource the entire information technology to IBM, and now many companies have developed this mantra, either adapting a strategic business prospective or me too strategies for outsourcing their IT services. Companies in both sectors, public and private, have outsourced significant portions of their IT functions (Willcocks and Lacity 2009).

The ITO phenomenon has attracted substantial attention from researchers (Carmel and Agarwal 2002, Hurley 2001), management attention (Carmel and Agarwal 2002) and over the last 15 years academic research on ISO has evolved rapidly (Dibbern *et al.* 2004). This led to the first academic published material on ITO in the year 1991 by (Applegate and Montealegre 1991, Huber 1993). Firstly, it involved Kodak outsourcing their IT data centre operations, personal computer support to IBM and the latter involved Continental Bank outsourcing their 'Crown Jewels' to Integrated Computer Sciences Corporation (ISCC) consisting of IT and other back office work. The size of an organisation for ITO/software product development did not affect what should be outsourced (Nicholson and Sahay 2004).

Between 1994 and 2000 a further 79 academic studies were published by Dibbern *et al*. (2004) with the rate of published studies increasing. Today, ITO amongst BPO is the most researched and advanced academic topic, but on a practical level BPO is outpacing ITO, mainly due to executives realising that outsourcing back office activities can be done quicker and at competitive rates compared to their internal employees (Willcocks and Lacity 2009).

In 1994, Xerox and EDS signed one of the biggest megadeal contracts in IT totalling to $3.2 billion. One of the main drivers for this deal was the shortage of skills and internal expansion to the organisation.

Everest Research Group a consultancy organisation has been tracking and analysing the ITO global market share for providing business leaders insights. In collaboration with Everest, Figure 2.4 has been derived from the data set. This shows that the ITO market size is growing and becoming one of the most dominating outsourcing sectors. From 2007 to 2009 the market size did not expand due to the sector becoming further matured. In 2013, the estimated compound annual growth rate of eighteen per cent is expected to reach just under $100 billion dollars.

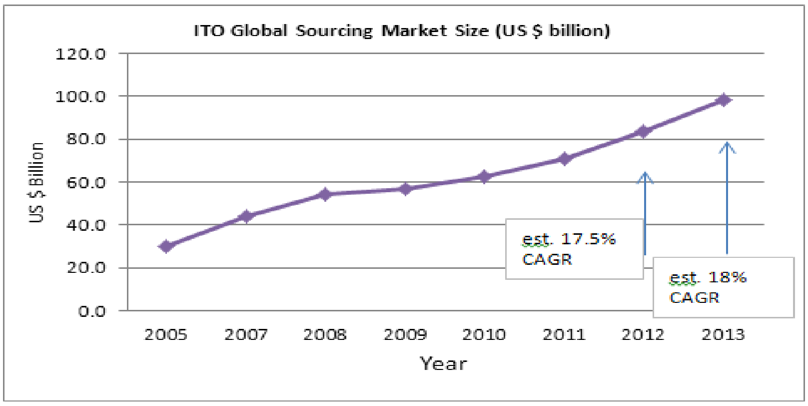


Figure 2.4. ITO global sourcing market size (US$ Billion). (Source: Everest Research Group).

The ITO global sourcing market depicts its size in US billion. However, this does not show the location of the global organisations. Figure 2.5 was developed in collaboration with Everest research group that identifies India in 2011 as one of the top destinations for offshoring of ITO followed by Brazil, Latin America and other destinations.

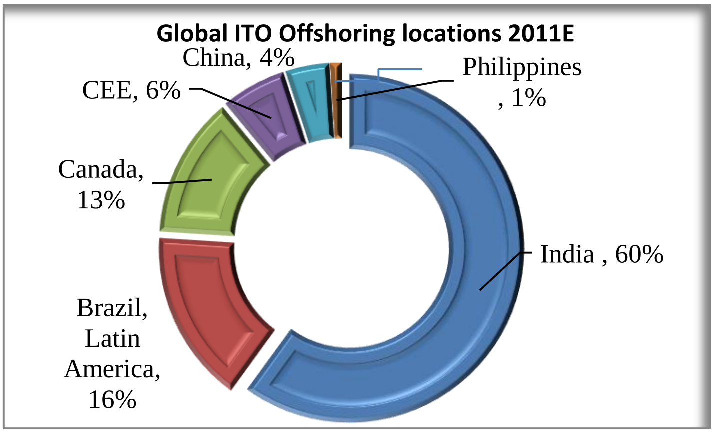


Figure 2.5. ITO offshore locations. (Source: Everest Research Group).

2.14.2. Business Process Outsourcing (BPO)

BPO is another form of outsourcing which has grown internationally but not as rapidly compared to ITO in terms of a researched industry. BPO is categorised as back office activities that can be outsourced or offshored to reduce an organisations cost (Willcocks and Lacity 2009). When BPO activities are outsourced or offshored, an outsourcing agreement is developed and consists of *"a third party provider is responsible for performing an entire business function for the client organization"* (Dibbern *et al.* 2004).

Penter *et al.* (2009) identified that BPO literature on wholly owned subsidiaries in offshore locations is a least-researched model that requires more research to understand the developments. Typical BPO jobs include mortgage applications, call centres, payroll, simple administrative tasks which cannot be compared with PDD or engineering work streams. Further, offshore outsourcing business process activities gives an organisation the opportunity to concentrate on core competencies (Mouhalis 2006), access talent at a reduced cost (Finlay and King 1999, Quinn and Hilmer 1994), and improve quality of services at reduced rates (Mouhalis 2006).

In collaboration with Everest research group, the BPO sector has been mapped from 2005 to 2013 with an estimated figure of twenty two per cent compound annual growth rate as shown in Figure 2.6.

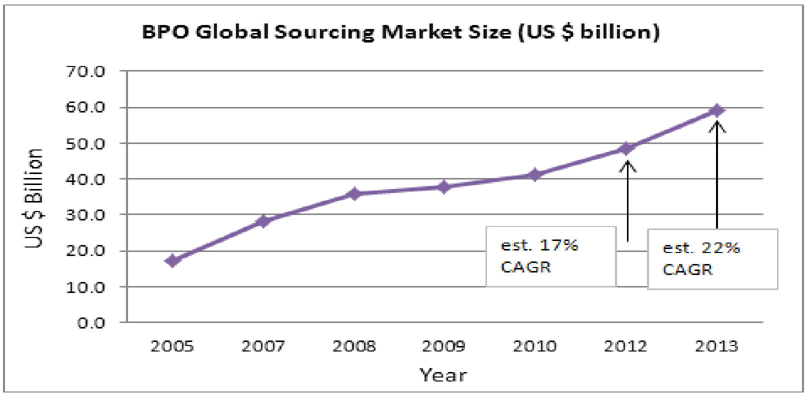


Figure 2.6. BPO global sourcing market size (US$ Billion). (Source: Everest Research Group).

2.14.3. Engineering Services Outsourcing (ESO)

Outsourcing and offshoring of engineering services is still developing compared to ITO and BPO. Organisations that are dispersing engineers globally and utilising geographical locations has been increasing over the years (Anderson *et al.* 2007). The offshoring of engineering services covers mainly automotive, aerospace, industrial machinery and construction[6]. Offshoring of services has dominated manufacturing only because of digital IT, allowing people to work in remote locations (McIvor 2010).

The annual spend on ESO is currently estimated at $750 billion per year, of this estimate only $10 – $15 billion is offshored (Hamilton 2006). However, by 2020 the estimated engineering PDD offshoring market will reach approximately $150 – $225 billion, with the sector growing rapidly in the next few years (Hamilton 2006). Research conducted by Duke University in 2005 found that thirty six per cent of organisations had sent engineering services to offshore locations, with sixteen per cent offshoring their design activities as further discussed in Section 2.15.

The ESO initially began with reducing the labour wages in developed countries by utilising resources from offshore locations. For example General Motors offshored a number of

[6] Official information received from NASSCOM (12/10/12).

departmental work activities/large programs including PDD solely for reducing cost within the organisation. This enabled the employees at General Motors to concentrate on other activities within the organisation. In contrast to the General Motors approach, Toyota's perspective to offshoring is tapping into the local market where they develop their centres of competence, build the local knowledge over a number of years and improve quality of services and a target to decrease the time to market of products.

However, both organisations are outsourcing and offshoring for various reasons and this study has an aim of developing a strategic decision making model for automotive organisations when outsourcing or offshoring their PDD activities.

2.14.4. Manufacturing Services Outsourcing (MSO)

In today's competitive globalised environment, organisations need to reduce in-house costs, improve quality, and increase product complexity to maintain competitiveness and attract customers. Offshore outsourcing of manufacturing production services has been on-going for around three decades and has become increasingly popular in terms of business strategy (Brandes 2008). In actual fact the outsourcing of manufacturing goods is far more advanced than in services (Contractor *et al.* 2011).

MNCs have been the main focus on research for manufacturing outsourcing, but there is an increasing number of SMEs that are also engaging in outsourcing and offshoring of manufacturing (Buckley and Mucchielli 1997, Pennings and Sleuwaegen 2000).

Geographic destinations such as China, India, Brazil, and Eastern Europe have seen a dramatic increase of organisations setting up and producing parts and taking advantage of labour arbitrage (Coyle *et al.* 2008, Kumar *et al.* 2009). Organisations that take advantage of developing countries will benefit from twenty to forty per cent cost reduction. However, the cost benefit is not visible until 12 or 16 months of operation. The literature has identified that many outsourcing organisations expect to see cost reductions within the first few months of operation.

The first instance of manufacturing offshoring occurred in the United States when an organisation outsourced to source material to access foreign markets (Kogut 1984). This has opened the eyes of many organisations who have also decided to adopt 'me too' strategies on outsourcing their manufacturing operations to offshore locations. A manufacturing organisation can access offshore production capacity by utilising a buyer and seller contractual relationship (Kotabe and Murray 1990).

The offshoring procedure initially started with organisations sending small production activities of their value chain that either required full assembly or just sub assembling (semi-finished products). The products would then be packaged and shipped back to the home location for final assembly.
In the automotive industry BMW a famous German vehicle manufacturer outsourced their production facility to a contract manufacturer called Magna Steyr based in Graz, Austria, where

an ad hoc plant manufactured vehicles from initial raw material to final dispatch to the customer (Edmundson 2003, Harrison 2004).

Organisations have been slicing up their value chain and outsourcing parts of their manufacturing processes globally either for full production or assembly in another country (Mudambi 2008). Once a process is outsourced the value chain would be classed as fragmented and resources are then managed outside the organisations boundaries. Manufacturing outsourcing drivers are; access to new markets, reduction in costs, access to talent not available locally and improved efficiency (Dicken 2003, Ferdows 1997).

To distinguish, Stack and Downing (2005) have identified that manufacturing is different to services, as illustrated:

1. Manufacturing workers do not require a university education, as many service jobs require some level of higher education.
2. The proficiency of English is becoming a standard language in developing/emerging countries with low-labour costs offshore.
3. It has taken decades for the global trading community to reduce tariffs on imported goods, whereas this does not have an impact on the service sector as services are delivered through communication and information technologies.

Organisations that have outsourced their manufacturing have gained experience and this development has led to opening a new door for outsourcing and offshoring PDD services.

2.15. Outsourcing and offshoring of product design and development

Organisations are becoming more global and are expanding in all areas of offshore outsourcing from simple back office services to more complex knowledge-based activities such as new product development (Anderson *et al.* 2007, Eppinger and Chitkara 2006, Willcocks *et al.* 2011) and engineering design (Pedersen and Pyndt 2006, Simplay and Hansen 2013, Simplay 2013). Product development is fundamentally unique and cannot be associated directly with manufacturing (Clark and Fujimoto 1991, Thomke and Fujimoto 2000, Wheelwright and Clark 1992) and the two topics are researched individually due to their unique nature. Outsourcing key phases of design reduces design cycle times and lowers cost (Quinn 2000).

Outsourcing and offshoring of PDD is still relatively new and an area which is under researched (Burdon and Bhalla 2005), driving companies to reduce costs, improve time to market, and shorten development cycle times (Simplay 2013). Roth and Menor (2003) identify that offshore outsourcing of services requires further research to fully understand the phenomenon and the complexity involved.

Globalisation is a complex phenomenon and when organisations are globalising their PDD activities/process, they are faced with extreme challenges which normally don't occur when outsourcing locally to external organisations (Graber 1996). Product design is classified as a knowledge-based activity and generates most of the value in services and manufacturing (Quinn 1999). These areas of an organisation are dominated by value added.

For an organisation to reduce the design cycle time will strengthen their competitive advantage and reduce costs by developing a shorter development cycle (Chiesa 2000, Thondavadi and Albert 2004). Rapid developments and changes in the market are pressurising organisations to assign new global strategies (Gottfredson *et al.* 2005) and to disperse global product development and design to reduce costs (Eppinger and Chitkara 2006, Eppinger and Chitkara 2009). Due to the global economy growing hastily the world is becoming connected (Friedman 2005) and driving organisations to diversify product development beyond one location.

In order for an organisation to remain competitive, different tools such as concurrent engineering (Backhouse and Brookes 1996), centres of excellence (Reger 2004), collaborative engineering (Willaert *et al.* 1998) and virtual teams (Powell *et al.* 2004) have been used to improve time to market of products and develop a global resource footprint.

Product development in the automotive industry has witnessed radical changes in design and styling, offshoring of work packets, outsourcing of PDD to enable organisations to meet their product demand, reduce costs and have better access to a wider talent pool. PDD is widely discussed as being a complex system (Sussman 2002) involving a larger number of components having many interactions. This alone describes one element of complexity involved within PDD. When a body engineering function (this refers to an entire interior and exterior) is outsourced it is regarded as a complex engineering product due to it consisting of thousands of components (Tripathy and Eppinger 2007). For instance, an automotive vehicle contains around 10,000 –

15,000 components (Oliver *et al.* 2008) and around fifty to sixty per cent of outsourced components make up the total cost (Bresnen 1996, Lee and Oakes 1996).
Engineering design is the activity of finding solutions to technical problems by applying insights from natural and engineering sciences, simultaneously ensuring that current conditions and constraints are taken into account (Pahl and Beitz 1996). The design process is highly intellectual in terms of synthesising different types of information, ensuring that robust ideas have been generated and then finally crafting a solution. In a typical situation, a designer and engineer would normally meet and sketch rough ideas to start a concept and initial thinking about the problem (Ullman *et al.* 1990). However, when PDD activities are dispersed offshore this increases the need to collaborate and communicate remotely through each design phase (Sabherwal 2003). A product development process can be defined as a large mathematical sum that involves over thousands of tasks required to cohesively be coupled between teams, organisations and individuals to achieve a robust and deliverable outcome (Adler *et al.* 1996, Fujimoto and Clark 1991, Von Hippel 1988).

Global product development requires a global culture that is implemented at the roots of an organisation before the engineering design and innovation stage. Outsourcing of engineering design services still causes concerns with quality of work, and sending these services offshore creates another complexity layer for organisations to manage (Zirpoli and Becker 2011).

For a customer to become confident with offshoring of services, a pilot project is first outsourced, and upon the success of this project further services will then be distributed to the organisation (Willcocks *et al.* 1995a, Willcocks and Cullen 2003).

To be competitive in the global market automotive organisations are moving up the value chain, looking to reduce operating costs and improve product development cycle times (Chiesa 2000, Cooper and Kleinschmidt 1994, McDonough *et al.* 2001, Sánchez and Pérez 2003) and positioning themselves better against their competitors (Lewin 2005). In particular, OEMs are reviewing their current business models to reduce the fixed costs from the organisation into variable costs. A method to reduce fixed costs consists of outsourcing or offshoring the PDD activities to either a third party (Khurana 2006) or OWOS a strategic business proposition (Eppinger and Chitkara 2009).

To understand how an organisation can outsource or offshore their PDD activities a two by two matrix is developed to explain this phenomenon as shown in Figure 2.7.

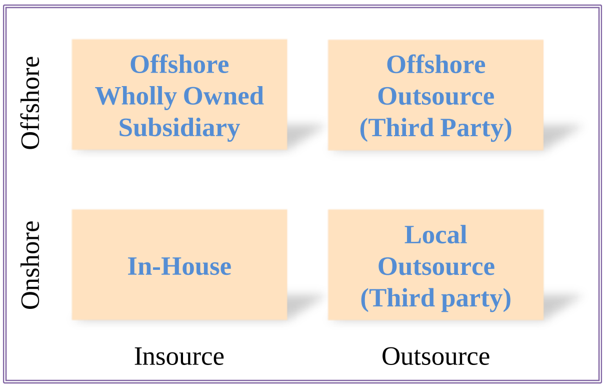


Figure 2.7. Global Product Design Outsourcing Model (Source: Adapted from (Eppinger and Chitkara 2009)).

The outsourcing models were originally designed for ITO to allow organisations to disperse their activities in different proximities and different countries. These models have been around for over three decades with subtle seminal context change, i.e. some models include risk, perceived disintegration advantage (Kedia and Mukherjee 2009) coordination requirements (Tripathy and Eppinger 2011).

The ITO models were then reviewed by further researchers who by this time discovered rapid growth and maturity of the ITO sector. These models were then adapted to the BPO sector, looking at lessons learnt from the ITO work streams and global dispersion.

Figure 2.7 is further explained to ensure the complexity of PDD is captured across multiple locations where research studies require further in-depth analysis for the automotive industry.

1. In-house – Mostly used where PDD activities are sensitive and core elements are retained onshore. An in-house operation is where multiple project teams are located in different countries that provide services autonomously. This type of arrangement has high costs associated as activities are carried out in developed countries.
2. Local Outsourcing – Outsourcing to local providers also known as third party outsourcing. This arrangement is usually good for accessing local specialised skills, or meeting temporary capacity requirements. Automotive organisations such as BMW, AUDI and others have outsourced PDD activities to third party providers capable of supplying specialist skills and capacity required.
3. Offshore wholly owned subsidiary – Developed from the ITO/BPO sectors still relatively new in automotive PDD. Services are provided from an offshore location (in a developing country) where an OWOS provides services to the parent organisation.
4. Offshore Outsourcing (using third party) – This is common when an organisation is offshore outsourcing small work packets initially and services are provided to onshore locations. It involves less capital, minimal commitments than to establish an OWOS, but there could be risk of breaching data confidentiality and Intellectual Property (IP) rights.

Offshoring in global product development started around 1990 and is still in the early days of developed (Eppinger and Chitkara 2006). Global product development versus the traditional product development is decoupled as the latter does not include a dispersed team across different locations, different time zones and differences in culture (Eppinger and Chitkara 2006).

Figure 2.8 shows the approach on moving simple product development tasks or commodities offshore as an initial starting phase (this could be a pilot project to understand the complexity of outsourcing, competence and core capabilities of the organisation) ending with a complete global product development model outlined in stage five. The model initially starts off with third-party offshore outsourcing followed by an OWOS model as shown (ultimate goal stage five).

Figure 2.8. Offshore Process for Global Product Development (Eppinger and Chitkara 2009).

To become a global hub for PDD activities requires a robust strategy, this area in automotive PDD has been inadequately researched. Stage five in Figure 2.8 consists of new global product development platforms being developed in an OWOS located in a low cost country. This is the ultimate goal for organisations to achieve, where the literature examination has discovered that no automotive organisation has reached this stage.

Further, Eppinger and Chitkara (2009) outline ten key success factors required for global product development as illustrated below;

1. Management priorities require strong commitment
2. Process modularity requires a methodology to segregate the work packages.
3. Product modularity requires interfaces to be defined clearly between modules and separate development.
4. Core competencies are where the non- core business is outsourced and core identified
5. Intellectual property has been clearly identified.
6. Data quality is where one system consisting of a database is used as a “source of truth” especially when offshore locations are contributing to the product development.
7. Infrastructure should be unified to allow a global approach and information is readily available regardless of bandwidth or location constraints
8. Project management alone is complex and further multifaceted dealing with another time zone. Detail project planning is critical.
9. When globalising the culture must be collaborative across all layers of the business.
10. Changing the management approach from local to global requires education of staff.

The heart of any product development process is the project team, who are responsible to execute the work, from initial brainstorming into new design and solutions (Brown and Eisenhardt 1995). Communication in the product development design process is extremely important to ensure team members capture full requirements and to rule out any misunderstanding during the design phase, as this is one area of rework design[7] (Dougherty 1992, Eisenhardt and Tabrizi 1995, Jassawalla and Sashittal 2000, Keller 1986).

While undertaking design and engineering activities, the ability to communicate effectively working in a cross functional team is critical for designers and engineers (De Mozota 2003, Press and Cooper 2003). A study conducted by Sosa *et al*. (2004) identified that communication between two engineers developing one design will achieve a positive outcome, but communicating from two different places caused a degree of difficulty, mainly in offshoring.
For instance many OEMs are shifting design knowledge to suppliers in order for them to develop such black box items to meet the client's general specifications (Fujimoto and Clark 1991). Some typical designs including cockpits, seating, instrument panels and many other products have become more dispersed through the supply chain than before (Becker and Zirpoli 2003). This creates new PDD challenges for ESPs and FTSs.

Shifting the design process offshore does not always result in a smooth transition. The offshore design teams require a different approach and additional skills compared to their counterparts in western countries where the services are conducted within the boundaries of the organisation (Larsen and McInerney 2002, Maccoby 1999). For example Sharifi *et al*. (2001) identify that when design services are in offshore locations (remote), culture, information exchange, face to face interactions, resource sharing and visibility are further complicated and organisations face challenges with ensuring these do not affect the productivity or quality of work.

Amaral and Parker (2008) reviewed 100 outsourced platform design projects belonging to Fortune 1,000 companies and identified these organisation struggled or failed due to misaligned objectives within the organisation, unexpected rivalry, poor version control of documentation. A further study conducted by Amaral *et al*. (2011) found that design outsourcing does not create additional revenues and fails to meet costs savings.

In design outsourcing the complexity and difficulty is determined by the size of a project and a larger scaled project is more difficult to manage and control to ensure tangible benefits are received (Ulrich and Eppinger 2004).

[7] Rework design consist of remodelling design solutions due to lack of understanding or misinterpretations.

2.16. Gaps found in the Literature

The automotive sector has experienced radical changes in terms of outsourcing and offshoring and how organisations have globalised their operations (Ghemawat and Ghadar 2000, Sturgeon 1999) in particular outsourcing and offshoring of PDD which has not received much scholarly attention (Palm and Whitney 2010, Willcocks *et al.* 2011).

For organisations to disperse their PDD activities requires different thinking, behaviour and decision-making models to be used creating new challenges, new drivers, and new management complexities. However, since the evolution of outsourcing and offshoring there is still confusion on how researchers developed the outsourcing phenomenon. Conducting an exhaustive literature review for this study has identified gaps in outsourcing and offshoring of PDD, which are discussed below.

Outsourcing and offshoring research is still dispersed across three research fields (Maskell *et al.* 2007, Mohiuddin 2011). These are identified as;

1. International Business (IB) literature relating to low cost countries, labour arbitrage, low cost locations. The IB literature has noted that organisations have been progressively outsourcing services offshore (Beulen *et al.* 2005). There is a need to create new theories and studies in IB (Andersen 1993, Buckley and Lessard 2005, Ford and Leonidou 1991).

2. Strategic Management (SM) literature relating to cost benefits, make or buy decisions, resource base theory, core competencies of organisations.

3. Supply Chain Management (SCM) literature relating to global organisations value adding activities, value chain unbundling, time zone economies, outsourcing using distribution/logistics.

It is evident that practices are called in from the three different research fields. The bottom line is that outsourcing and offshoring is a one off decision and implementation that an organisation completes. The decision making models in automotive PDD using various methods of delivery is unexplored in the academic literature and the literature lacks various stages required for an organisation to make concrete decisions when outsourcing or offshoring (Dekkers 2011, Quinn 1999).

The literature review has identified that outsourcing and offshoring has been predominately executed for cost advantages, followed by tapping into local markets and access to qualified labour. Longsdale and Cox (1997) identify that many organisations are making outsourcing decisions based solely on reducing headcount and costs without factoring other inputs to the offshoring phenomena. Offshore outsourcing of services (PDD for instance) still remains an area where there is a gap in the literature and the research community has only paid limited attention to this important phenomenon (Anderson *et al.* 2007, Kenney *et al.* 2009, Ramamurti 2004, Roth and Menor 2003). Not only does offshoring of PDD remain a gap in the literature but it also creates additional challenges for organisations as the level of interaction increases with added complexity by using multiple cultures and geographical locations (Bartlett and Ghoshal 1999, Rilla and Squicciarini 2011).

From a strategic and operational perspective, there is a lack of research reviewing outsourcing and offshoring of PDD in the automotive sector. Approaching offshoring from a strategic angle could influence an organisational decision as to whether to send services offshore or retain within the organisation’s boundary. The decision-making process requires further attention and research as acknowledged by Lacity and Hirschheim (1993) stating that organisations have jumped on the outsourcing and offshoring bandwagon where the decision-making process in current literature does not represent a true picture of what actually takes place as more resources are added to projects when the expected benefits are not being achieved.

Probert (1996) identified there is a scare occurrence on outsourcing make or buy strategy and McIvor (2000) after reviewing the literature and conducting interviews with senior management concluded a lack of practical outsourcing decision making frameworks that address the decision making process.

Willcocks *et al*. (2011) suggests that literature on offshore outsourcing of high value knowledge activities such as product development and innovation for example would be an extremely fruitful research topic to advance our understandings and the management relationships between the two organisations (onshore and offshore) is not well understood. This also identifies another gap that has not been addressed in the body of knowledge on outsourcing and offshoring. In actual fact research on offshoring in general is extremely low due to the complexities involved (Penter *et al.* 2009).

Further, Boehe (2008) who suggests future research should concentrate on outsourcing and offshoring and what other additional factors can be used to explain offshoring of PDD by developing new theories to allow further understanding of the phenomena. Brown and Eisenhardt (1995) also identify that there are a whole realm of models to assist managers during new product development process, however they are all localised models and there is a lack of attention given to outsourcing/offshoring of PDD within the automotive industry.

Finally, Brown and Eisenhardt (1995) identify the essence of outsourcing, offshore outsourcing and offshoring of PDD is still a black art and this research is intended to flesh out how automotive organisations, whether an OEM, ESP, or FTSs, can make more precise decisions through the use of a decision-making model rather than powerful decision makers taking a sole approach without appreciating the implications of their decisions which are made ad hoc. De Boer (2006) identified a number of decision making models non in the area of PDD within the automotive industry but concluded there is a need to better understand the complexity of the outsourcing decision making process which has not received the attention it requires. The research aims to develop a strategic decision making process and associated model to help support management in making key outsourcing and offshoring decisions for PDD either on a short term or long term perspective.

Chapter 3 . Research Methodology and Data Collection

3.1. Introduction

This chapter maps out the research methodology and methods implemented in the research study. The management model developed by Easterby-Smith *et al*. (2012) underpins this chapter, creating a robust methodology for the outsourcing and offshoring of PDD in the automotive industry, as illustrated in Figure 3.1.

On a deeper level, various philosophies are used to analyse ontology as assumptions about nature and reality, while epistemology is used to comprehend different forms of inquiry in order to better understand the research study. Finally, social constructionism has been selected as a philosophy based in reality and is used to identify and grasp a true understanding of the research study. These approaches address the outsourcing and offshoring of PDD phenomena.

This research approach fulfils the research aims and objectives based on a qualitative (inductive) approach building rich descriptions, meanings and explanations in order to fully explore outsourcing and offshoring of PDD (Corbetta 2003, Minzberg 1979, Shah and Corley 2006). The methodology used for the inquiry engages a case study approach; thus contributing to the research with in-depth analysis and theory generation in order to answer 'how' and 'why' questions pertinent to the study. There are two case study types used to achieve a coherent examination. An exploratory case study explains various successes, failures and motivations; a descriptive case study describes the phenomenon to understand how outsourcing and offshoring are conducted, the motivations behind globalising product development activities and other critical factors.

Rich empirical data (primary data) has been collected by the researcher through semi-structured interviews, direct observation and document analysis, all of which collectively comprise the main research methods used to ensure quality in the case studies. Related tactics developed by Yin (2003) have been followed.

An in-depth two-stage pilot study was initially conducted to reduce error, improve the overall quality of the interviews and enable the completeness of the aims and objectives to be answered. Figure 3.5 illustrates the pilot study process undertaken for this research study, which consisted of 99 in-depth semi-structured interviews being conducted across multi-disciplinary organisations, namely OEMs, ESPs and FTSs. All organisations were based in the automotive industry. Figure 3.4 illustrates the overall data collection process followed within this research.

Triangulation has been used to enhance the credibility and quality of the data collected by using multiple sources to provide a greater understanding of the phenomena under analysis. A full ethical summary is provided that complies with Coventry University's guidelines and present this study to start the fieldwork process. The final section of this chapter closes with the research methodology limitations.

3.2. Research Methodology

The research methodology, which is also termed research design, provides justification for the technical decisions taken during this study. Adopting this methodological approach ensures credibility and validity, which safeguards the tactics taken during the research planning stage (Blaikie 2000).

The methodological outline delivers a sound and robust investigative research study since a clear distinction helps to form a construction that includes both data collection and analysis, therefore addressing specific situations that develop a conclusion that pertains to outsourcing (Creswell 2003, Easterby-Smith *et al.* 2002). This conclusion justifies both the aim and the theoretical framework that solidify the findings associated with this study.

Therefore, the aim of this research methodology and design is to form a theoretical framework for an inquiry into a specific research design that addresses the outsourcing and offshoring of PDD. The research results introduce new knowledge to the field of outsourcing and therefore explain a phenomenon that builds the foundations for the research discovery. This discovery endeavours to enhance current theories that surround the outsourcing and offshoring of PDD by adding depth of analysis and new insights to the field as they pertain to engineering PDD (Yin 1991).

This research study builds new insights for researchers and practitioners based on previous studies, which have been limited either due to unavailability of data in the field or due to studies being based solely on anecdotal work conducted in the areas of outsourcing and offshoring in PDD. While the overall intentions behind outsourcing have been around for decades, in terms of the theoretical context that this research study proposes large amounts of research exist within the context of ITO, BPO (as discussed in Chapter 2, Section 2.12), thus exemplifying the need for further research in this field.

Yin (1994a) states that *"every type of empirical research has an implicit, if not explicit, research design"*. The research design has explicitly identified strengths, implications and limitations used throughout the research methodology journey. In addition, this has guided the researcher in the process of collecting data, analysing data, and interpreting data collected from the field to build a fruitful and concrete framework.

When viewing outsourcing or offshoring through a managerial lens, it has become a key organisational strategy that organisations are adapting to become globally competitive, and to dominate the market in order to survive.

Thus, the overall research on outsourcing from a practical lens should increase our understanding and knowledge about this field and how this phenomenon has developed most importantly how to do it efficiently and effectively.

To understand the outsourcing and offshoring phenomena in a perspective for OEMs, ESPs, and FTSs the management research model developed by Easterby-Smith *et al*. (2012) is followed which underpins the methodology as shown in Figure 3.1.

Figure 3.1. Tree metaphor of research process. (Source Easterby-Smith *et al*. (2012)).

This cross-sectional model consists of four rings, the ontological aspect is represented by the nucleus (heart of operation) where the researcher used reality to understand this phenomenon, the epistemology uses positivism or hermeneutics (social constructionism), the methodology consists of different methods coupled to support a holistic inquiry for the research study, and finally methods and techniques which were used specifically for data collection and analysis. These methods can consist of interviews, observational, surveys and many others.

The four rings from Figure 3.1 are further analysed throughout this chapter and applied to outsourcing and offshoring of management studies which are deemed to be unique and complex involving certain parameters and individuals.

Marshall and Rossman (2010) argue that when conducting a literature review, it either identifies gaps for contribution or expansion of existing theory. The literature review for this research study has identified gaps where there is little research conducted in the field, making this thesis a contribution for academic study in outsourcing and offshoring of PDD within the automotive industry.

3.3. Purpose of the Methodology in research

Jankowicz (2000) and Robson (2002) have defined research methodology as being extremely important to ensure the research aims are met through conscious, consistent and valid methods rather than taking an ad-hoc approach that could lead to a derailed methodology.

Thus, the researcher was aware of the different methodologies, in terms of the different approaches, (e.g. qualitative or quantitative methods) when conducting the literature review and retaining this information when crafting the research methodology chapter (Zikmund *et al.* 2008). Therefore the methodological construct of this research study is qualitative investigation into outsourcing and offshoring of PDD. Offshore outsourcing in itself is complex, highly dynamic and difficult phenomenon to understand (Halinen and Törnroos 2005). The constructs for this

study requires diligent effort to critically identify the importance how the theoretical framework and concepts have been applied in the research study (Jonker and Pennink 2010).
The subsequent pages map the research methodology transparently using the theoretical framework underpinning this research study.

3.3.1. Philosophical approach and theoretical framework

There are many different approaches on how the world can be viewed and this underpins the research approach that has been adopted (Kuhn 1962). Thus, there is mileage in reviewing the paradigms[8] before attempting to continue further. Therefore, to understand the offshore outsourcing phenomena, a holistic understanding of both approaches, qualitative and quantitative, must be explicitly understood to fully satisfy the research questions of this study.

Building on Figure 3.1, ontology is a branch of philosophy studied as being and existence of the world. Ontology is based on the researcher's assumptions on nature of reality. In summary realism and nominalism are among the two most heavily discussed in research for management studies (Easterby-Smith *et al.* 2002).

Epistemology relates to how an inquiry for this study can be implemented in ether a physical or social perspective format. A philosophical approach consists of two main contrasts in terms of epistemology; positivism and social constructionism[9] (also called hermeneutic) paradigms which have been summarised in Table 3.1.

	Positivism	**Social constructionism**
The observer	Must be independent from the research (external view)	Researcher is nucleus of research (internal view)
Human interests	Are irrelevant for the research	Are the main drivers of science and investigation
Explanations	Must demonstrate causality connections	Aim to increase understanding of outsourcing and offshoring phenomena
Research progresses through	Hypothesis and deductions reasoning only	Gathering rich empirical data from which new ideas/concepts are induced
Concepts	Need to be operationalised so they can be measured	Incorporate key stakeholder perspectives
Units of analysis	Should be reduced to simplest terms	Includes the complexity of 'whole' situations and not simple streams
Generalisation through	Statistical probability	Theoretical abstraction

8. Patton (1990) defines paradigm as a world view, with a general perspective and a way to break down the complexity of the real world.
9. This term has been used instead of 'social constructivism' which is preferred by Guba and Lincoln (1989) and (Knorr-Cetina and Mulkay (1983).

Sampling requires	Large numbers selected randomly	Small numbers of cases chosen for specific reasons

Table 3.1. Positivism and Social Constructionism paradigm. (Source: Easterby Smith *et al.* (2002)).

Furthermore, positivism and social constructionism are further analysed and detailed in section 3.3.2 and 3.3.3 respectively.

There are differences in ontological, epistemological, methodology, methods and techniques as outlined and how they are implemented in research studies. In actual fact these are the main drivers that steer researchers to fragment between different methodologies over others and to satisfy the research questions and study (Rowland 1995).

3.3.2. Positivism

Positivism is coupled with objectivism in terms of looking at organisations and society (Crotty 1998, Travers 2001), concentrating on providing explanations of the status quo, social order consensus, social integration, solidarity, need satisfaction and actuality (Burrell and Morgan 1979) where outsourcing and offshoring viewed through a lens of a positivistic viewpoint lacks social interaction the key ingredient necessary for theory building (Eisenhardt 1989). In a positivistic sense, the world exists externally with properties being measured objectively rather than subjectively and the observer is independent as illustrated in Table 3.1 Burrell and Morgan (1979) emphasise that researchers use this approach to understand equilibrium and stability and how these are sustained in society and organisations.

Obtaining credible knowledge is a key factor and achieved through scientific means, with other knowledge that is not obtained through this method defined as metaphysics (ontology). The term ontology has been defined by Crotty (1998) as positivist realism.

Realism assumes that the world is concrete, external and that science can be progressed only through observations that have direct correspondence to the phenomena being investigated. There are no subjective perceptions of the world as to how an individual would perceive it, leading to a positivistic approach describing the social world by using patterns and relationships between humans.

Saunders *et al*. (2003) stress the point that a positivistic approach reflects the principles of a natural scientist where knowledge is only derived through experimentation, measurements and observations. Knowledge in this sense can only be measured and observed in the world of positivisms, and when other social interaction/interfacing knowledge is called upon the positivism theory lacks creative thinking that goes beyond the boundaries of existing ideas. Thus, other philosophies based on a subjectivist approach are used to provide a reality perspective which is determined by humans than by objective and external factors.

Positivism is a scientific characteristic consisting of;

1. Hypothesis testing.
2. Reductionism.
3. Repeatability.
4. Refutation.

Further, a positivism approach to social sciences has the primary use of quantitative methods consisting of surveys and mathematical modelling using a deductive method, focuses mainly on hypothesis testing developing quantitative propositions that are then converted into mathematical formulae as illustrated Table 3.1.

3.3.3. Social Constructionism

Social constructionism[10] has been around for half a century and was initially developed in contrast to positivist social science, where the world is viewed in opposite to the positivism approach; both should be studied independently as they consists of different paradigms (Patton 2002).

Crotty (1998), defines social constructionism as

> *All knowledge, and therefore all meaningful reality as such, is contingent upon human practices, being constructed in and out of interaction between human beings and their world, and developed and transmitted within an essentially social context.*

The philosophy is based on reality, in context to the nature of the world can be revealed by observations (or people) as illustrated in Table 3.1 and what occurs is what we perceive to exist (Burr 2003). Social constructionists are driven to understand that knowledge and meanings are acts of interpretation, and the knowledge from an objective point of view is decoupled from the human perception (Gephart 1999) as illustrated in Table 3.1 that highlights the differences between positivistic and social constructionism.

Social constructionism draws knowledge amongst people which becomes fabricated over a period of time and there are no objective facts that exist where spoken language is extremely important as individuals create knowledge through social interactions and modelled through personal experiences (Burr 2003, Raskin 2002). There is not really a honing down at an individual level, but idioms are created on humans' collective expressions (Gergen and Gergen 1991).

This research study uses a social constructionist approach to completely understand outsourcing and offshoring of PDD within the automotive industry and enables the researcher to apply a reality and knowledge perspective view to gain in-depth data and contribute to theory building (Crotty 1998, Easterby-Smith *et al.* 2012, Eisenhardt 1989). As identified by Shadish (1995) the social constructionism constructs knowledge about reality and not construing reality.

This approach not only challenges positivistic methods, but oversees a typical view of reality in a positivistic world. In actual fact it provides alternatives; methodological, theoretical and practical approaches on researching management and organisations (Gephart 1999).

From a management and strategic business perspective, this research study is classed as complex, multidimensional, involving key individuals within an organisation who are part of this phenomenon (Saunders *et al.* 2003).

In contrast with positivistic and social constructivist approaches used during complex research, studies involving humans are analysed through conversations (communications) and dialogues between the researcher and the organisation (Easterby-Smith *et al.* 2002, Gummesson 2000). This positions the researcher to become internally involved and provides a central focus with the phenomenon developing a novel and in-depth conclusion as outsourcing and offshoring are

[10] Social constructionism and constructivism are two terms used interchangeably (Gergen 1985).

complex studies involving for instance multiple stakeholders, different time zones, cultures and organisations (Willcocks *et al.* 2011).

In addition, social constructivism is widely used in management research studies to generate new theory, resulting in a natural rather than artificial conclusion that illuminates a research study (Easterby-Smith *et al.* 2012). A natural approach is derived through a qualitative approach and implies using a case study methodology to develop in-depth synthesis to further our understandings on the phenomena of outsourcing and offshoring through the use of data collection methods such as interviews and document analysis (Burr 2003, Byrne 2001, Miles and Huberman 1994).

3.3.4. Research Approach

Research approaches in management and social sciences are classified into two groups, Qualitative and Quantitative (Creswell 2003, Easterby-Smith *et al.* 2012, Edmondson and McManus 2007).

Saunders *et al*. (2003) further defines the two approaches which are applicable to a research study:

1. Inductive (Qualitative) approach where data is collected from the field and theory is developed based on your data analysis.
2. Deductive (Quantitative) approach is defined where a hypothesis is developed and then tested using some research questions.

There are transparent differences between the two approaches highlighted, but they also share common features that are applicable to a study, but both in their own right are multi-dimensional and contain elements of complexity (Morgan and Smircich 1980). In some instances both approaches can use the same methods (Miles and Huberman 1994, Silverman 1993).

For example, this research study based on outsourcing and offshoring of PDD involves the researcher in developing a comprehensive plan of how the research is conducted, what type of research methods are employed for data collection, ensure ethical principles are followed at all times, and appropriately use data analysis methods to accomplish the research aims and objectives. Therefore, no research approach is free from weaknesses; both qualitative and quantitative have strengths and weakness, depending on which approach fits the research question and study (Creswell 2003, Denzin and Lincoln 2005, Easterby-Smith *et al.* 2012, Patton 2002).

For instance, a known strength of quantitative approach is the use of numerical data collection making it easier to analyse the data. Guba and Lincon (1994) have identified a primary weakness with quantitative due to its lack of attention to meanings in terms of developing quantified measures of social phenomena and especially interactions with reality and lacking the ability to compare meaningful comparisons across different organisational contexts.

Qualitative and quantitative approaches are summarised in Table 3.2, which has been adapted from Easterby-Smith et al. (2002). A further in-depth analysis on which approach is applicable for this research study is discussed in section 3.3.5.

Elements of Methods	Qualitative	Quantitative
Aims	Invention	Discovery
Starting Points	Meanings	Hypothesis
Designs	Reflexivity	Experiment
Technique	Conversation	Measurement
Analysis/Interpretation	Sense-making	Verification/Falsification
Outcomes	Understanding	Causality

Table 3.2. Methodological implications of qualitative and quantitative approaches. (Adapted from Easterby-Smith *et al*. (2002).

3.3.5. Justification of research approach

Management research is complex with widespread debate on which research approaches, qualitative or quantitative, are most suited solely relies on the overall research question, objectives and the phenomenon being investigated. Easterby-Smith *et al*. (2002), Morgan & Smircich (1980) and Yin (1990) have identified these approaches as being complex and multidimensional when conducting management research.

A common fact in research methodology is that a quantitative approach is objective based (positivistic as per section 3.3.2), whereas a qualitative approach requires a more rigorous case, but both approaches are used to examine different inquires in research studies.

Maanen (1983) reiterates the point that there are two main approaches used in research but the fundamental underpinning decision is based on the research objectives and research questions as outlined below:

(1) Qualitative approach is used when the researcher looks for meanings, explanations, and understanding, discussed in Table 3.2.
(2) Quantitative approach is used where frequencies and fundamental laws are of essence, testing of hypothesis. However to construct a valid justification one cannot just rely on these means, a more holistic approach is outlined and discussed in Table 3.2.

Both qualitative and quantitative in their own right have different perspectives and different approaches with regards to methodology and research methods. Oakley (1999) takes this one step further by comparing and contrasting the two approaches as illustrated in Table 3.3.

Qualitative	**Quantitative**
Concerned with understanding the phenomenal	Seek positivistic results
Naturalistic and uncontrolled observation	Obtrusive and controlled measurement
Subjective	Objective
Close to the data, ‘insider’ perspective	Removed from the data, ‘outside’ perspective
Grounded, discovery-oriented exploratory, expansionist, descriptive, inductive	Ungrounded, verification oriented, reductionist, hypothetic-deductive
Process-oriented	Outcome-oriented
Valid: real, rich, deep data	Reliable: hard and replicable data
Holistic	Particularistic
Assume a dynamic reality	Assume a stable reality

Table 3.3. Contrast of qualitative and quantitative paradigms (Adapted from (Oakley 1999).

Table 3.3 contrasts qualitative and quantitative approaches that are used typically in research studies where explanations are related to this research and how they are applicable.
When conducting a qualitative approach the researcher is concerned with understanding the phenomenon of an event whereas the positivistic approach seeks conclusions based on scientific measurements. A phenomenal understanding provides a reality of social constructivism as defined in section 3.3.3 rather than absorbing external factors (Easterby-Smith *et al.* 2012). To provide a holistic understand on outsourcing and offshoring of PDD, requires the researcher to be connected (close) to the data especially when collecting empirical data from the field. Using such approach involves the researcher in capturing a true organisational ‘insider perspective’ and fully understanding the phenomenon being studied rather than a quantitative approach that positions the researcher to observe data from an outside perspective (Sandelowski 2000).

Creswell (2003) defines two approaches of theoretical theory, inductive generating new theory from data and deductive that develops hypothesis from existing theory to test, prove and verify hypothesis. Outsourcing and offshoring of PDD in the automotive industry is lacking empirical data studies and therefore minimal attention and work has been done making this research valuable in contributing to the body of knowledge and also adding new insights from the empirical data collected. Thus, an inductive approach generates new theory and contributes to the existing body of knowledge on outsourcing and offshoring of PDD providing a holistic viewpoint for practitioners and researchers.

Outsourcing and offshoring of PDD involves many risks to an organisation especially when learning by doing and adapting an outcome-oriented approach that could drive organisations to implement a strategy not fulfilling the business objectives. Consequently, this could impact organisations’ outsourcing and/or offshoring decision model and may financially lead to either additional costs not originally associated with a contract, possibility of backsourcing work activities or terminating a contract. To examine the stage before dependent variables requires an in-depth understanding of outsourcing and offshoring of PDD critically requires real life context and rich qualitative data to examine this phenomenon (Patton 2002).

Furthermore, the dichotomy between qualitative and quantitative provides rich descriptions to the phenomenon being studied, able to uncover themes, generate new patterns, and present results in a richly descriptive manner (Merriam 1998).

In addition to the theoretical principles, a qualitative approach for management studies in outsourcing and offshoring of PDD serves further practical benefits. For instance, in a qualitative approach there is much more flexibility for getting closer to the object, take advantage of rich data collected and obtain results which are tangible to the research (Flick 2004, Patton 1987).

Ethiraj and Levinthal (2004) highlighted that outsourcing and offshoring of complex systems requires well considered, in-depth analysis, and when researchers apply quantitative approaches (scientific) the conclusions form the study are not optimum.

Outsourcing and offshoring in itself is complex, highly dynamic and difficult to understand (Halinen and Törnroos 2005) as it also involves complexity coupled with individuals, multiple organisations, cultures, time zones all which have different operating disciplines.

Researchers have been driven from the beginning until today to adapt qualitative methods to understand complex outsourcing and offshoring phenomenon. As defined by Creswell (1998) a qualitative approach is implemented when the researcher is investigating a complex issue and the detail is achieved only by having conversations with people.

In conclusion to the justification, researchers have been driven down a qualitative route for several decades to understand the complex phenomenon of outsourcing and offshoring by contributing to the body of knowledge. A qualitative approach provides rich descriptions, in-depth understanding and overall comprehensiveness (Corbetta 2003, Minzberg 1979, Shah and Corley 2006) which is being applied in management research (Lee 1999).

For example, there is an increase in the body of knowledge that uses a qualitative research approach in outsourcing and offshoring as part of the research methodology. These cited references are diversified across different sectors but identify the dispersed use of qualitative studies (Amaral and Parker 2008, Baden-Fuller *et al.* 2000, Beulen *et al.* 2005, Ellram *et al.* 2008, Eppinger and Chitkara 2006, Eppinger and Chitkara 2009, Freytag *et al.* 2012, Jussi 2009, Kotlarsky *et al.* 2008, Lacity and Hirschheim 1993, Mortensen 2012, Oshri *et al.* 2007, Oshri 2010, Penter *et al.* 2009, Quinn and Hilmer 1994, Sanders *et al.* 2007, Tate *et al.* 2009, Tate and Ellram 2009, Tayles and Drury 2001, Willcocks *et al.* 2011, Zhang *et al.* 2007).

3.3.6. Qualitative weaknesses

According to Creswell (1998) there are weaknesses when using a qualitative approach in a research study. These are defined below:-

1. Time consuming – Data collected from the field takes time and could become time consuming if not managed correctly (Cassell and Symon 2004, Creswell 2007, Patton 2002). This weakness has been addressed by representing a hunting strategy on which organisations have been targeted for this research study. A detailed semi structured interview guide was developed to guide the researcher when conducting interviews which has been fleshed out in section 3.5.2.2. The researcher is fully committed to this study and this approach according to Delamount (1992) is suited to people who care.

2. Data analysis is complex and time consuming – The time it takes to analyse data and sorting through large amounts to generate a few themes can become very time consuming. This is addressed by using NVivo 10 software dedicated for qualitative research allowing the researcher to group and create nodes to simplify large data into manageable segments (Bazeley 2007). In addition NVivo 10 is powerful to create searchable annotations and uses a hierarchical catalogue system (Bazeley and Richards 2000).

3.4. Research methods/design

This section provides the relevant methods that are used for this study and also the individual techniques adapted for collecting and analysing the data (Jonker and Pennink 2010, Zikmund *et al.* 2008). Before the journey of data collection was executed this section has been crafted to understand and critically analyse different methods available when implementing a qualitative approach.

A philosophical approach has been adopted for this research study when combined with the research question to identify the appropriate methods which are further detailed in the followings section.

3.4.1. Justification of using the case study approach

Over the years there have been a number of books published to give guidance to researchers who are conducting qualitative studies, for example (Bryman and Burgess 1999, Creswell 1998, Denzin and Lincoln 2000, Flick 1998, Gummesson 1988, Miles and Huberman 1984). Utilising published material has helped craft a robust and sound approach to the overall methodology which has been supportive in justifying the approach.

The use of case studies originated in social sciences but has widely adapted to other sectors (Tellis 1997) and excels at bringing us to an understanding of complex issues (Dooley 2002). According to Yin (1989), when dealing with complex management issues, the use of case studies has become extremely popular. The development of case studies has positioned them amongst several empirical methods making them suitable for other discipline areas including management and engineering studies (Flyvbjerg 2006).

A case study approach is used when generating theories which are developed and then built into a model (Eisenhardt 1989). This is further enhanced by Wacker (1998) who emphasises on abstraction in theory and how it scales from *high;* meaning a general theory which is used in whichever situation, *medium;* theories that are limited in sets of phenomena, but are used to develop other theories either with medium or higher levels of abstraction, *low;* theories have very limited scope and are used to identify simple relationships. However, theory abstraction does not provide any scope or advantages to academics that are looking at developing a medium abstraction theory. To develop theories Wacker (1998) has identified four key parameters which are illustrated in Table 3.4.

Table 3.4. Theory building procedure. (Source: Wacker (1998)).

Thus, this research has examined the phenomena in the context of outsourcing and offshoring of PDD using multi-disciplinary organisations (OEMs ESPs, FTSs), and holistically ensuring all research objectives and question are answered. The research framework developed has used a middle level of abstraction that has been selected to generate new theory on outsourcing and offshoring of PDD within the automotive industry. In addition, the research has provided a different perspective based on the data collected on how organisations and practitioners can successfully outsource and offshore product design and development.

It is appropriate to use case studies in cases when theory and research are still developing (Benbasat *et al.* 1987, Eisenhardt 1989) and when there is limited or prior knowledge (Eisenhardt 1989, Yin 1994a).

Further, as there is minimal literature on outsourcing and offshoring of PDD in the automotive industry, Hartley (2004) recognises that case studies can be tailor-made to explore areas where little is understood and when focusing on building theory, case studies provide rich data for a qualitative approach (Eisenhardt 1989, Meredith 1998, Yin 2003).

Case study research is becoming increasingly accepted as a scientific tool in management and engineering research disciplines (Flyvbjerg 2006, Gummesson 2000). In fact the management field has benefited from the use of case studies as they have provided most ground-breaking insights (Chandler 1962, Penrose 1960, Prahalad and Hamel 1990a).

On the other hand researchers have argued that case studies using a qualitative approach may lead to information that is challengeable. This is argued by Gummesson (1988) who emphasises the primary advantage of using case studies is to provide a holistic view;

> *Detail observations entailed in the case study method enable us to study many different aspects, examine them in relation to each other, view the process within its total environment and also use the researchers' capacity for 'verstehen'.*

The nature of a case study is illustrated by Yin (1989, 1994b), but other authors such as Leonard-Barton (1990), Stake (1995), have also defined the case study as;

> *Empirical inquiry that investigates a contemporary phenomenon within its real-life context when the boundaries between phenomenon and context are not clearly evident blurred and in which multiple sources of evidence is used".*

This quote has been specifically used as it explains transparently that a case study is implemented to investigate a real life phenomenon and providers a deeper understanding of the research being investigated (Morris and Wood 1991). It gives the reader further confidence that adopting this approach is prudent when investigating a real life phenomenon and multiple sources of evidence are necessary to prove its justification. Multiple sources of evidence are highly rated when adopting a case study approach rather than using a single source to further increase the credibility of a study (Yin 1994a). This research has used multiple sources of evidence as illustrated in Figure 3.2.

Figure 3.2. Convergence of multiple sources of evidence (Source: Yin 1994).

A key difference between qualitative methods such as grounded theory and case studies; grounded theory presupposes that all theoretical perspectives are grounded from the start of data collection (Corbin and Strauss 1990, Glaser and Strauss 1967) but this does not provide the correct level of analysis for outsourcing and offshoring of product design and development, as case analysis and real life experiences provide a philosophical perspective (Yin 2003).

A case study has the ability of openness to use theory that guides the research and analysis of data. To further cement the point Harley (2004) argues that without having a robust theoretical framework the researcher can become biased of providing descriptions without meanings.

Yin (1994) compares different research strategies, e.g. case studies, experiments, surveys, archival analysis and historical analysis which are mapped out in Table 3.5.

Table 3.5. Research Strategies (Source: Yin (1981, 2003).

Table 3.5, the experiment strategy requires control over behaviour which is not adaptable with a constructivism paradigm as it does not follow the principles for dialogue or a reality based perspective. Yin (2003) refines the point that case studies interchangeably used with an objectivist approach leads to an incomplete research outcome.

Yin (1989) defines the route for defining a research strategy which is dependent on three conditions; the research question proposed; what control the investigator has over behaviour; and the degree of focus on contemporary events.
Further, Yin (1989, 1994b), Benbasat *et al*. (1987) consider case studies are used when the researcher requires a further understanding of the following:

- The research question starts with 'how' or 'why'.
- The researcher does not have control on the events being investigated.
- The focus is on several simultaneous events.
- The focus is on the real-world environment involving dialogues and conversation.
- Studying a phenomenon in its natural setting.

In addition case studies allow for in-depth examination especially when the phenomenon is dependent on a number of factors (Verschuren 2003). On the contrary, a survey alone or other methods do not have the level of detail that a case study reveals (Yin 1994b). These methods are classed as being static to capture the flow of organisational activity especially fast moving industries such as the automotive industry in particular outsourcing and offshoring (Hartley 2004).

When doing research, in particular selecting research methods, it is imperative for the researcher to understand what type of information and knowledge is required to fulfil the research objectives. Ahmed (2007) maps research methods against information and knowledge as illustrated in Table 3.6. This has been used as a basis to review the number of research methods appropriate for studies using information or knowledge contained within humans.

Ahmed (2007) points out that tacit knowledge cannot be investigated without verbalisation of thoughts, and in terms of explicit knowledge this is investigated with interviews, discourse analysis, observations, participant observations and protocol analysis.

Table 3.6. Research methods mapped against information and knowledge. (Source: Ahmed (2007)).

Building a link with the literature and Table 3.6, outsourcing and offshoring of PDD can be classified as information which is explicit and partially implicit. Hence, interviews, discourse analysis, observations, participant observations and protocol analysis are methods that are used for this research. From these stated methods, interviews, observations, document analysis along with other forms of documents such as company reports, internal documentation and other forms of information all are used for the case study (Robson 2002).

3.4.1.1. Case study weaknesses

There are also some weaknesses when using a case study approach for research. Eisenhardt (1989) states case studies in some instances do not provide a full understanding of the phenomenon when building theory from cases and can be difficult on how these are used. To overcome this Yin (2008) identifies that case studies should be avoided when research questions are of ‘how many’ or ‘how much’ based scenarios. Yin (1994b) further highlights that a frequent complaint about case studies is the amount of data required to provide an in-depth case review. To ensure the correct number of cases have been selected for this research, the researcher has used six cases as defined by Eisenhardt (1989), which is further elaborated in section 3.4.3.

Yin (1989) points out that a common pitfall when using case studies is the lack of support given to Construct Validity, Internal Validity, External Validity, reliability, all collectively discussed in section 3.7 and how the weaknesses are addressed for this research study.

Patton (1990) and Yin (2003) point out that case studies can lack multiple data sources to enhance data creditability. Table 3.6 identifies how multiple sources are used in the research to overcome this weakness.

3.4.2. Different types of case studies

Yin (1981, 2003) defines three types of case studies for research; exploratory, descriptive and explanatory, which are briefly touched upon below.

1. *Exploratory* case study – Aimed at exploring certain areas of interest and investigating when there is inadequate information available.
2. *Descriptive* case study – Provides rich detail descriptions of a phenomenon from observations between people and used to describe what, how, drivers, factors.
3. *Explanatory* case study – Provides casual explanations or investigations on cause effect relationships. According to Gummesson (2000), this type is looked on with scepticism or sometimes even horror.

This research has used an exploratory and descriptive case study approach that allowed the researcher to get close to the object of study, explore the research topic and understand the phenomenon on outsourcing and offshoring of PDD completely rather than conducting an examination on a surface level leading to undeveloped results (Gummesson 2000). When undertaking a descriptive case study the researcher has used good practice to define a well thought robust data collection guide in the early stages of the development, which has been refined throughout to capture all themes and cases.

Further, the researcher used Yin's (1994a) five steps for conducting case research developed as a guide which can be utilised for any type of case study.

1. Define research questions.
2. Case selection and then define data collection and analysis techniques.
3. Conduct the case study.
4. Analyse data.
5. Complete the report writing.

3.4.3. Number of cases: single vs. multiple

Leonard-Barton (1990) and Voss *et al*. (2002) state that fewer cases allow researchers to concentrate on in-depth investigations. On the contrary Eisenhardt (1989), Miles and Huberman (1994) and Voss *et al*. (2002) state that more cases used for research ensures robust generalisability which increases the precision of the research and defines a more methodological rigorous approach than the findings of a single case and the researcher must understand the studies limits and time.

Thus, the use of a single case study allows in-depth investigation of a phenomenon (new development), in contrary where an multiple case study is useful when knowledge is present on the phenomenon but certain segments are still unknown which are then examined further (Eisenhardt 1989) as in the case of outsourcing and offshoring. Adopting a multiple case study approach allows the researcher to replicate findings across cases Yin (2003) where the framework proposed by Yin (1994b) has been followed as illustrated in Figure 3.3.

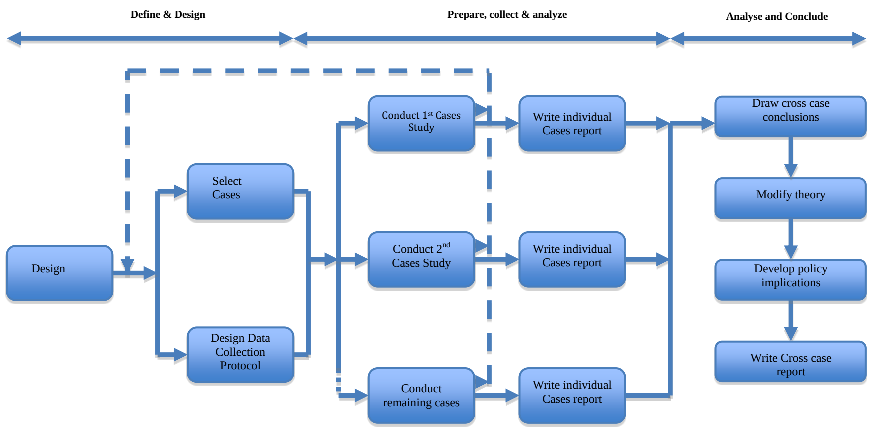


Figure 3.3. Multiple case study method.

There is no ideal number of cases within a given context as the number varies between authors. Eisenhardt (1989) defines that between two and eight multiple case studies are sufficient to build theory, but this requires more resources and further man-hours to complete. Thus, Eisenhardt (1989) further states that there is a natural upper limit on the number of cases that a researcher in a project should use; this being ten cases. Blessing and Chakrabarti (2009) clarify that the number of cases is related to the number of data sets collected. Miles and Huberman (1994) suggested that more than fifteen makes a study unwieldy. This research has used six different cases to explore the phenomenon. The organisations interviewed and case studies conducted are located in Table 3.7.

3.4.4. Case research - challenges

This research implemented a case study approach, which like all research methodologies has its own challenges and requires these to be addressed. There are two main areas of challenges as highlighted below.

3.4.4.1. Obtaining access to organisations

Obtaining access and becoming closer to the object of study within an organisation to conduct research is the principal concern for researchers as outsourcing and offshoring of product development is relatively new and requires the researcher to obtain empirical data and become the epicentre of information within the field (Easterby-Smith *et al.* 2002, Gummesson 2000).

Gaining access to organisations hinders and can delay researchers in conducting their study. For this research gaining access to organisations, people, and resources the researcher has followed the approach suggested by Easterby-Smith *et al*. (2002); "*before organisations are approached personal contacts were the first point of call that helped break barriers"*. As the researcher was working within the automotive sector, there was already a good network link available that helped smooth out the challenge of obtaining access to global organisations in different parts of the world. Thus, the researcher was self-disciplined to ensure that the research milestones were met by contacting people and organisations 12 months prior to obtaining data in the field. Such a dedicated approach allowed sufficient time for the researcher to tap into key people who were involved with outsourcing and offshoring of PDD and in particular decision makers/executives responsible for these activities.

3.4.4.2. Quality of the case studies

Case studies are used for this research involving collecting empirical data from the field. Case studies require a more rigorous approach and in-depth review to ensure high quality, reliability, and validity of data is achieved. While conducting interviews the researcher ensured that information was collocated by following an interview guide and sending out a signed non-disclosure agreement prior to the interview confirming any confidential information exchanged would not be disclosed to third parties and all data if used will be treated with complete anonymity. In addition there was no participation during the interviews from the researcher to ensure bias was avoided at all times, see section 3.7.

3.4.5. Case selection

The cases for this research were selected using the following parameters:-

1. Automotive organisations: OEMs, ESPs, and FTSs. The organisations used for the case selection are predominately based in Europe, with an addition of having organisations based in India, Japan, and China.
2. Organisations that are outsourcing and offshoring product development using OWOS and organisations that decided not to outsource.
3. Decision makers were approached who were responsible for outsourcing/offshore outsourcing and offshoring of PDD. This included post senior management, Chief Executive Officers, Managing Directors, Vice Presidents, Presidents and Directors.
4. Senior management and engineers involved in outsourcing and offshoring PDD working on an operational level.

The case selection parameters have been identified in accordance with the research scope, research objectives, and ensuring they meet real-life objectives such as completing the research on time, working commitments and a manageable research project (Seawright and Gerring 2008).

Table 3.7 illustrates the different organisations that have been selected for this research. For anonymity purposes and to comply with ethical procedures organisations have not formally been identified.

Organisation	Sector	Number of Organisations n =	Organisations used for case analysis n =	Location (HQ's)
OEMs	Automotive	20	2	GER, UK, USA, JPN, FRN, IND, SWD, CHN,CRZ, ITL
ESPs	Automotive	17	2	UK, GER, ITL, FIN, IND, SGA, SWD
FTSs	Automotive	13	2	USA, GER, FRN, UK, CND, SWD

Table 3.7. Summary of organisations used for interviews and case analysis.

In summary, prior to collecting data, automotive OEMs, FSPs, FTSs that are outsourcing and offshoring PDD were contacted to participate in this research. The organisations have been identified and selected as fleshed out in section 3.4.5.

3.4.5.1. Selection of the six case study organisations

A multi case study approach was used and consisted of six in-depth case studies. These were selected from the 50 automotive organisations interviewed which consisted of 20 OEMs, 17 ESPs and 13 FTSs. There were two automotive organisations selected from each segment (OEMs, ESPs, and FTSs) and the selection was based on a representative sample to represent the other automotive organisations in scope and depth. The six organisations are analysed in Table 3.8 highlighting the criteria used for selecting the six case study organisations.
The six representative case studies were also cross examined to ensure full richness of data and a thorough examination of the organisations.

Leonard-Barton (1990) and Voss *et al*. (2002) state that fewer cases allow researchers to concentrate on in-depth investigations and not all 50 organisations in this study could be used for the case study analysis.

Yin (2003) refines the point that case studies should have meaningfulness data for the object of study and this guidance was used when selecting the organisation. As noted by Miles and Huberman (1994) a 15 case study approach would make a research study unwieldy and this was avoided.

Segment	***Selection criteria of six case study organisations***	***Detail of case analysis***
OEM A	Organisation is new to outsourcing and offshoring. Body engineering PDD activities outsourced for the first time to a third party service provider based onshore. Decision making constrained to a single entity and lack of wider organisation involvement. Development of an OWOS.	Section 5.2
OEM C	Implemented an ITO business model in the automotive industry to offshore outsource PDD activities to a low cost country for cost advantages. Complexity of body engineering activities created additional challenges and high value work was backsourced. OEM C failed with offshore outsourcing. Decision making based on cost reduction.	Section 5.4
ESP D	Offshoring outsourcing to a third party failed. Developed an OWOS. Acquisition of ESP to grow organisation for growth and competence. Decision making at executive level with focus on cost reduction and ad hoc decisions.	Section 5.5
ESP L	Not outsourcing PDD activities, the organisation is reviewing to offshore outsource a larger volume of work. Offshore outsourcing to a third party ESP resulted in terminating the contract. No internal requirement for development of an OWOS. Decision making and strategy not transparent with organisation.	Section 5.6

Segment	*Selection criteria of six case study organisations*	*Detail Case analysis*
FTS C	Failed with their offshore outsourcing organisation. Development of three OWOS based to increase internal resources and take advantage of lower costs. Decision making based on cost reduction and quick knee jerk reactions.	Section 5.7
FTS J	Outsourcing and offshore outsourcing to ESPs to increase engineering resources and reduce cost through offshore. Failed with offshore third party provider. Development of an OWOS.	Section 5.8

Table 3.8. Organisations used for case study analysis.

3.4.6. Unit of analysis

Blessing and Chakrabarti (2009), Tellis (1997), and Yin (1989) define the unit of analysis as a critical factor in case study research and is defined as the object of study. The unit of analysis for this research is the product development and engineering departments of an organisation.

3.5. Data collection

The data collection stage for this research occurred from February 2013 to January 2014 inclusively, involving an exhaustive amount of data being collected and fully utilised to fulfil the aims and objectives for this research.

Figure 3.4 illustrates three key phases that occur during the data collection process. These are described as:

1. Data collection stage – Researcher collects empirical data from the field using various methods and relating these back to literature review.
2. Data management stage – Transcribing and coding of interviews with correlation to literature review.
3. Data analysis stage – Triangulation of cases, cross case study analysis and model development.

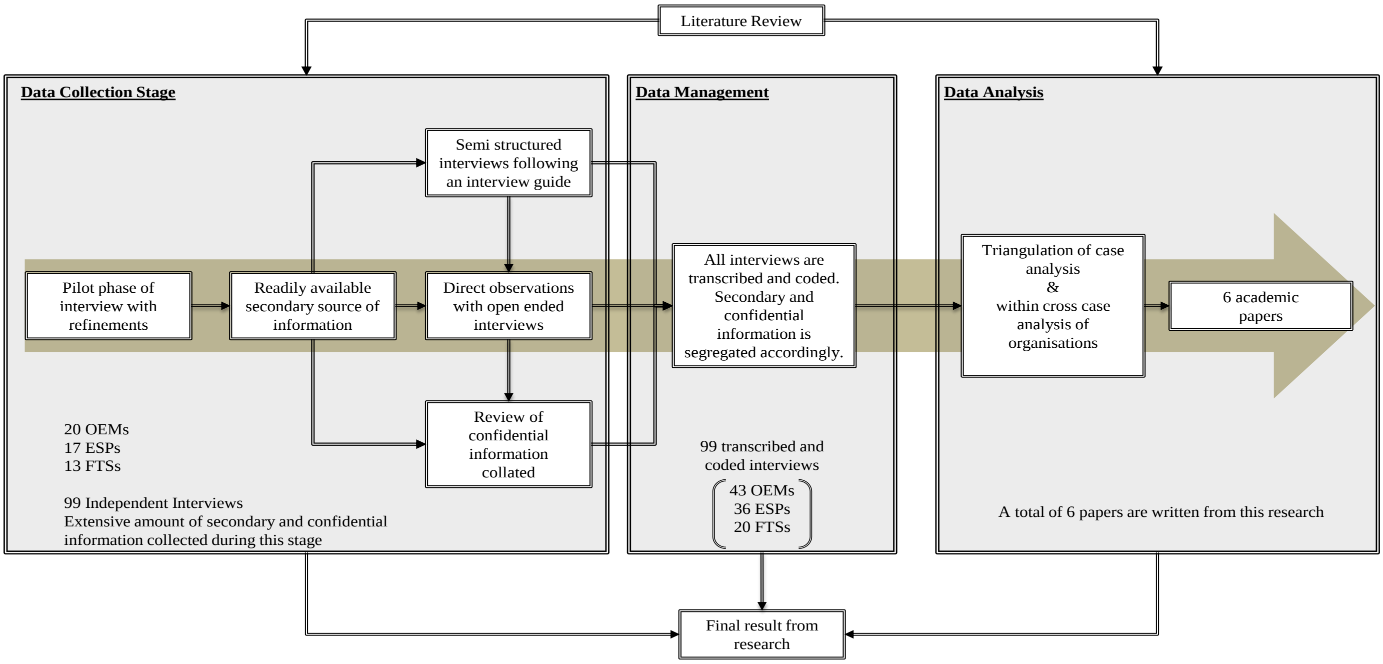


Figure 3.4. Data collection and analysis process.

This research has categorised data collection in two different forms. Firstly, primary data was obtained from interviews, direct observations and other forms of first-hand information, such as company reports, memos, and internal project documents. The value of primary data leads to new insights collected first hand, and explores the research phenomenon to produce a fruitful outcome for this research (Easterby-Smith *et al*. 2012). Hox and Boeije (2005), emphasise that unique research studies entail collecting primary data as the main means of data collection to enrich the credibility and discover new insights.

Kothari (2009), Creswell (2003), Easterby-Smith *et al*. (2012), and Patton (1987) identify several methods on how primary data can be collected for research studies, solely based on the nature of

investigation, scope of inquiry, financial resources, time available for completion and the accuracy required.
This research has used the following primary methods that are most pertinent to the study (Creswell 2003, Gillham 2005, Gummesson 2000).

1. Observational method.
2. Interview method.
3. Telephone interviews.

Secondly, secondary data is readily available, i.e. already collected and analysed by a third party (Frankfort-Nachmias and Nachmias 2007, Kothari 2009). Secondary data in most instances requires further familiarity for the researcher to understand how it was collected, the population size, and its credibility/reliability to cite in further research studies.

Kothari (2009) defines secondary data which is readily available in the following formats:-

1. Books, magazines and newspapers.
2. Reports prepared by research scholars, universities.
3. Unpublished data in terms of diaries, letters, biographies and autobiographies.

The researcher worked in managing a large scale outsourced global product development program consisting of almost half the design and development activities conducted in an offshore location involving multidisciplinary project teams. The researcher's involvement in such a large engineering programme while conducting this research has many added benefits as there were daily conversations with line managers and the extended senior management team. Most conversations internally were taken place between two or three people which is categorised as first hand primary data. The information collated from daily conversations was recoded and documented to ensure complete traceability.

The researcher's daily involvement in conversations provided new insights or developments within outsourcing and offshoring of product design and development.

Additionally, collecting multiple data types through different methods covers the entire spectrum range and results in completeness of the phenomena being studied (Bonoma 1985).

3.5.1. Different types of interviews

Interviews have been growing significantly since the 1980s, and have become an extremely popular method when collecting data in research studies especially epistemological and management research (Gummesson 2000). Interviews used for case studies are an important part of the data collection journey which has directed the researcher to other sources of evidence (Gummesson 2000, Tellis 1997).

The interview method was a primary component of the data collection stage that provided fruitful, conciseness, and depth to understanding the phenomenon. Stake (1995), further enhances that an interview is the main road to multiple realities.

Saunders *et al*. (2003), Flick (1998), Blessing and Chakrabarti (2009), all categorise interviews into three types;

1. Structured interviews.
2. Semi-structured interviews.
3. Unstructured interviews.

Each interview approach is walked through thoroughly and cross examined which leads to the chosen approach for this research study.

3.5.2. Structured Interviews

These are also known as standardised interviews and used in both disciplines, namely qualitative and quantitative research. The objective of this interview creates a common denominator ensuring all interviewees are asked the same set of questions in the correct format that leads to answers that are reliably aggregated. When conducting structured interviews the researcher reads questions in the same voice tone allowing interviewees the advantage of answering each question with freedom (Corbetta 2003, Kvale 1996).

Interview responses received are coded into a standard tubulised format with pre coded answers sometimes called closed ended or fixed choice (Saunders *et al.* 2003). A structured interview has limitations for this research study. Firstly, to understand the research phenomenon, flexibility is required within the interview questions to alter them immediately based on an ad hoc basis followed by further probing of questions. However, structured interviews are limited in the sense they are rigid in terms that the researcher cannot add or change the interview questions so allow no flexibility (Corbetta 2003).

Secondly, the interviewee may not have received sufficient information to answer the questions completely which could lead the researcher to influence the response, creating a biased approach (Bryman and Burgess 1999).

Further, the use of a structured interview does not provide the level of depth and degree of accuracy required to understand the research phenomenon even if used with an open ended approach.

3.5.2.1. Unstructured Interviews

Unstructured interviews are used for research studies that explore a general subject in depth, normally a more casual approach to the interview. Each interview is highly individualised with encouragement to interviewees to reply openly leading to a lengthy interview session compared to the structured or semi-structured interviews (Knight and Arksey 1999). In most cases the outcome of such an interview can be directed in any angle by the interviewee (Easterby-Smith *et al.* 2012). The output of each question generates multiple responses making it extremely difficult to analyse the data systemically and developing patterns from responses becomes rather complicated (Patton 2002).

In reflecting on the above, unstructured interviews are not capable of providing in-depth, holistic approach to fulfil the research objectives.

3.5.2.2. Semi Structured Interviews

Semi-structured interviews are non-standardised and constructed as a two-way communication method allowing exchange of information given and received. This type of interview is most common, especially when using a case study approach (Tellis 1997, Voss *et al.* 2002). In contrast to the structured interview, detailed questions are not prepared beforehand, but general questions around outsourcing and offshoring of product development (the theme) are asked. While conducting interviews in the field, a semi-structured approach enables further development of the interview questions and spin off additional questions that provide greater flexibility for probing to explore new paths and honing key factors allowing for digression (Berg 2001, Gray 2009).

Patton (2002) recommends that probing and asking questions elucidates and illuminates a research study. Further, Berg (2001) notes that probing beyond the standard interview questions leads to the interviewer not anticipating replies. Silverman (1993) clearly states that semi-structured interviews used along with open-ended questions ensure rich meanings are derived from the interviewees and an in-depth explanation compared to the other approaches outlined in this section.

3.5.2.3. Selected Interview type

This research has used a semi-structured approach based on the justifications highlighted in sections 3.5.2, 3.5.2.1, and 3.5.2.2. The additional strengths of a semi structured interview provided unexpected and insightful information, from the interviewees who elaborated upon areas of concern and new insights (Berg 2001, Hair *et al.* 2003).

When conducting semi-structured interviews, the researcher is required to develop an interview matrix. The interview matrix and guide had been implemented before conducting interviews, to ensure consistency, continuity of examination and achieving overall comprehensiveness of the interview as highlighted in section 3.5.2.4.

The interviews were recorded by note taking and tape recording to capture all verbatim speech used which also avoided creating bias during the transcription phase (Patton 2002, Saunders *et al.* 2003). Factually, verbatim interviews that are recorded provide the most accurate and reliable information for researchers when conducing qualitative studies.

All research methods have weaknesses and limitations which requires the researcher to mitigate or completely eliminate them. A semi-structured interview approach requires the researcher to have the ability to think of questions during the interview phase which could become time consuming to digest the essential points where further probing would be difficult (Legard *et al.* 2003). The researcher has many years of interview experience to overcome this limitation and has followed an interview guide developed for this research that improved the limited time available and overall comprehensiveness of all interviews (Patton 1990).

Semi-structured interviews are time consuming and expensive if not conducted correctly (Easterby-Smith *et al.* 2002). The researcher has engineered an interview plan and ensured that a matrix of themes was used prior to starting the interviews.

Kvale (1996) has defined two types of interviews: hypothesis testing or exploratory. The case studies and interviews used for this research are exploratory to understand the outsourcing and offshoring phenomena and align the overall research methodology.

3.5.2.4. Interview methods

Semi-structured interviews have been used as the research method that involved concrete conversations between the interviewer and participant requiring correct deployment of the interview methods.

Thietart (2001) states that when conducting management research interviews, there are two interviewing procedures available. Firstly, a systematic and planned interview consists of multiple subjects which are usually bundled into an interview. This procedure when used with case studies causes great difficulty to analyse due to the sporadic information collected, and examining the phenomenon on outsourcing and offshoring of PDD would be incomplete.
Secondly, a heuristic interview gathers in-depth information to understand a particular field using semi-structured interviews. Furthermore, the post-modern (hermeneutical) interview concentrates on reality, oral discourse and written text (Gubrium and Holstein 2003, Kvale 1996) which has been used for this research.

In association with the theoretical approach to the method of this research, 12 points defined by Kvale and Brinkmann (2009) provide a life world description for interviews which has been followed in this research. Others were reviewed such as Seidman (1998) who emphasises interview questions and techniques during interviews. Rubins and Rubins (2005) concentrate on interview interactions and how to construct conversations and publish research work. Wengraf

(2001) concentrates on conceptual and technical aspects of an interview. Reviewing other available interview methods has demonstrated that Kvale and Brinkmann's (2009) research method is most suited for this study to provide life world descriptions for the interview.

1. *Life world* – The topic of qualitative interviews is the everyday life world of an interviewee.
2. *Meaning* – The interview pursues to interoperate the meaning of central themes in the content of the life world.
3. *Qualitative* – The interview seeks qualitative knowledge expressed in normal language.
4. *Descriptive* – The interview attempts to obtain open nuanced, rich descriptions of different aspects of life worlds.
5. *Specificity* – Descriptions of specific situations and action sequences are used.
6. *Deliberate Naiveté* – The interviewer is open to new and unexpected phenomena.
7. *Focused* – Because the focus is on a particular theme, a semi-structured guide is used.
8. *Ambiguity* – Some statements received in an interview can sometimes be ambiguous, reflecting contradictions in the life world.
9. *Change* – During the interview process could produce new developments and awareness.
10. *Sensitivity* – In some instances different interviews can produce different statements on the same themes, depending on their sensitivity and knowledge of the interview topic.
11. *Interpersonal situation* – The knowledge obtained is produced through the interpersonal interactions in the interview.
12. *Positive experience* – A good conducted interview results in enriching experience for the interviewee on globalising offshore product development.

The interview method outlined above has provided a very detail guide to the researcher when interviews were conducted. As stated in section 3.5.1 interviews have been selected as the main data collection method for this research as they provide in-depth examining of the phenomenon.

This research has followed the interview investigation as illustrated by Kvale and Brinkmann (2009) which is distributed into seven stages and applied to this research. Kvale (1996) has developed this technique due to the lack of qualitative interview guides available for researchers and to advance the interview prior to interviewing. Other interview guides were reviewed but did not provide a comprehensive approach.

1. *Thematising* – The main purpose of investigation and why is it required.
2. *Designing* – Concentrates on planning the design of the study. The seven stages are constructed to ensure the knowledge is discovered before the interview process begins.
3. *Interviewing* – Conducted the interviews based on interview guides created to gain the knowledge sought and with consideration for the interpersonal relation. Patton (1987) points out that any face to face interview is also an observation.
4. *Transcribing* – The interview is transcribed to make it ready for analysing. Care has been taken to transform oral speech to written text as they have different rules. It must be noted that a transcript is not the source material; the spoken interview remains as the primary source. In addition Kvale (1996), Kvale and Brinkmann (2009), Patton (1990), Legard et al. (2003) categorically recommend that using a tape recorder to play back verbatim

speech helps to clarify any ambiguity that may arise when the researcher transcribes the interviews.

5. *Analysing* – Decide on which methods are appropriate to use that underpin the purpose and nature of the interview.
6. *Verifying* – Ascertain the generalisability, reliability and validity of the interview findings
7. *Reporting* – Communicate the findings of the study in such a way to that epitomises upto scientific criteria, taking ethical aspects of the investigation into consideration.

The seven stages have been used for this research study that ensured each stage addressed ethical issues and confidentiality as the interview process is treated as extremely sensitive.

In some instances the information received during an interview could have been misunderstood or incorrectly positioned due to the participant's environment or culture. To reduce this risk the use of a tape recorder and semi-structure interview approach followed with additional probing of questions were applied to all participants. During some interviews the information received was unclear so the interviewee was requested to elaborate on any points that required clarifying. In addition any points that remained unclear after all events, the researcher contacted the interviewees for further clarification and a follow-up review. This process used avoided interpretation errors or any misunderstandings that could lead to incomplete explanations.

The interviews were demanding and required the interviewer to be constantly active throughout the entire duration and ensuring micro and macro detail had been captured to provide an in-depth understanding of the phenomenon being studied.

During the interviews it was imperative for the researcher to ensure strict time management utilising the time allocated efficiently combined with collecting confidential information (Legard et al. (2003). All questions during the interview were asked solely by the interviewer covering the themes involved in this research study.

An interview process can be defined as being complex, with emphasis on the interviewer to ensure bias or pitched questions were avoided that could lead to responses being fragmented. This was overcome by the researcher using a second interviewer where possible who solely concentrated on other tasks than the interview session, for example time management, administration exercises, providing resources as recommended by Eisenhardt (1989).

Berg (2001) opines that a semi-structured interview along with probing of questions ensures digression and stops the interviewee anticipating replies.

The research interview must be efficient and has been based on a dialogue that requires an interviewee time to respond when answering in-depth questions which usually takes some time as this study on outsourcing and offshoring is complex and multidimensional. The interviewer was patient and built upon the response from the interviewee.

Yin (2003) and Legard et al. (2003), suggests that some key skills are required from the researcher when conducting an interview. Only two are pertinent to this research study as outlined below:

a. *Ask good questions during the interview*. Semi structured interviews are used which requires the researcher to prepare a theme prior to the interview followed by further questions that were developed throughout using a pragmatic and systematic approach.
b. *Listen carefully and do not get trapped by preconceptions*. The interviewer has a clear mind creating no bias.
c. *Allow sufficient time for participant to reply*. Moments of silence are acceptable but ensure there are not long pauses.
d. *Never assume*. As an interviewer never assume what someone means if they use special terms. Use the approach of an assumption to be a question.

There are disadvantages of using the interview method outlined; one being the data collated is heavily reliant on the interviewer, which then puts more emphasis on the researcher to deliver a fruitful research study.

Unlike a quantitative interview comprising of numbers, a qualitative interview is hard to repeat in most terms it possibly cannot be repeated, as both the interviewer and interviewee have further enhanced their knowledge since the first interview. Another disadvantage is the data collected requires further analysis that takes a considerable amount of hours to complete (Patton 1987).

A key strength of adapting the interview method was to reinforce the interviewer to obtain an in-depth, detailed and holistic understanding of the phenomenon. The interview demonstrates areas that are of complexity allowing the interviewer to absorb tangible insights from the interviewee life word as described by Kvale (1996), Kvale and Brinkmann (2009).

To avoid the listed disadvantages and lessons learnt through practice of the interview session which required extremely careful planning. Thus, the interview method presented by Kvale (1996) is followed to extract key empirical data for this study.

3.5.3. Pilot study – Pre field interviewing

Yin (2003) suggests that research studies using a pilot approach for the first development stage provide a rich and holistic outcome when collecting data from the field. This suggestion has been applied to this study. The pilot study was used to test ideas; themes in particular which have been customised for this research (Maxwell 1996).

Conducting a pilot study has outlined to the researcher which questions were valid, which required clarity or needed revising that has formulated a foundation for the semi-structured interview used (Blaxter *et al.* 2001).

For the aims and objectives to be answered completed with accurate data, a pilot study was implemented that consisted of a two-phase approach as illustrated in Figure 3.5.

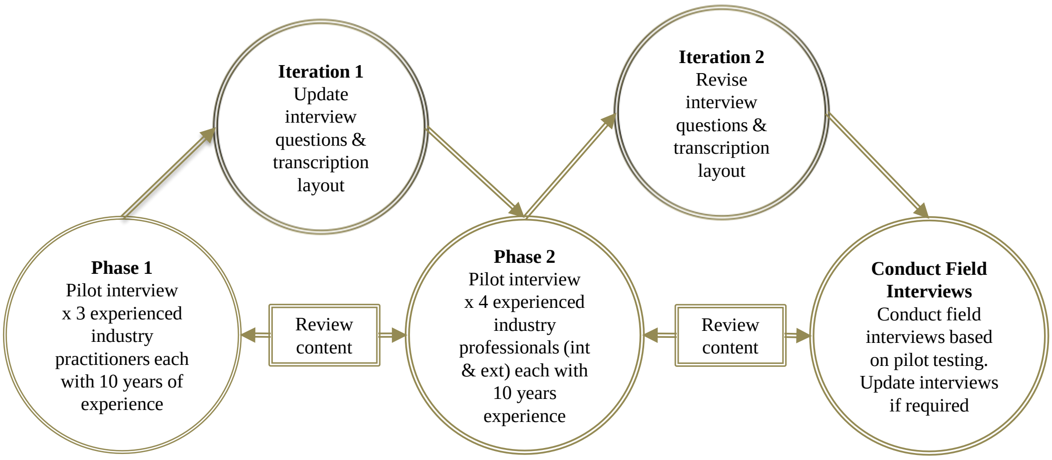


Figure 3.5. Pilot study phases.

3.5.3.1. Pilot study – Phase 1

This first phase consisted of piloting the semi-structured interview with three industry practitioners who had over 10 years of experience between them. Each interview was conducted separately with the practitioners to ensure there was no bias or misunderstandings through the interview process. The first set of interviews lasted over four hours with each practitioner involved in the process. Each interview script was then reviewed against the research aims and objectives. The literature in the research area was reviewed against the topics involved with the interview questions.

Phase 1 of the pilot study identified that there cannot be a generic interview structure for all organisations involved with the research study as OEM organisations have a deeper financial and wider resource base compared to ESPs and FTSs. For example, there are key questions that are only valid for OEMs and not applicable to ESP. All practitioners suggested splitting the interviews into three categories (OEMs, ESPs, and FTSs) to allow continuity and flow when field interviews were conducted. Using such an approach saved time during the interviews and avoided collecting non-value information. A brief overview of each interview category is highlighted below.

Generic approach – Research the organisations background, people employed along with other key information, strategic approach to understand business vision, future plan on outsourcing/offshoring, methodologies used when outsourcing or offshoring product development, how are decisions made along with further information in Appendix 1, Appendix 2 and Appendix 3.

Operational approach – Research positive/negative outcomes when outsourcing/offshoring, managing an outsourced project, outsourcing challenges in communication along with further information in Appendix 1, Appendix 2 and Appendix 3.

Core competency and knowledge – Reviews how an organisation identifies a third party's domain knowledge, how knowledge transfer is conducted, risks of knowledge learnt by external organisations, with further information in Appendix 1, Appendix 2 and Appendix 3.

The first stage of this pilot study was time consuming but identified key areas for this research in particular breaking down the interviews into different categories. As highlighted by Light *et al*. (1990) no research design is complete without a pilot study and is definitely worth the time and effort.

Each pilot interview transcript was emailed to the participants involved to confirm the transcripts did not contain any biased information. Saturation from the first pilot study was achieved by making a number of adjustments to align the interview with the aims and objectives.

3.5.3.2. Pilot study – Phase 2

The second phase consisted of reviewing the revised interview questions and going through the validity/reliability of each transcript. Iterations were conducted to construct and continuously review the research questions. Each industry practitioner along with the researcher agreed that saturation had been achieved with phase one of the pilot study. Phase two involved real field interviews that were piloted with two internal post senior positions (President, Vice President) at the organisation and two external post senior positions (Directors) all who are responsible for outsourcing and offshoring of PDD with over 10 years of experience between them.

This approach was most suitable as the researcher was reluctant to approach interviewees for a pilot research study as they had limited time and the opportunity to re-interview during field interviewing was limited (Blessing and Chakrabarti 2009).

Improvements were made in the time taken to conduct each interview from four hours down to two hours which was then further reduced to 1.5 hours by changing the format of some questions in each category to develop a continuous flow of information which saved on leap frogging back and forth to different interview questions.
The second phase of each interview sessions lasted around 1.5 hours and all questions were explored with real data from organisations. Around 10 questions were reworded to avoid interpretation errors or any misunderstanding that could have advanced during this stage. Both

industry professionals suggested creating another two categories based on interviewing managers and engineers within an organisation to provide further data for the researcher when conducting case studies and triangulation at different levels of the organisation.

Each practitioner was issued with a transcription of the interview (hard copy and also email), which was read together to ensure all information had been captured and responses to each question was valid and reflected the research aims and objectives. Each practitioner was consulted individually regarding further iterations that involved some changes that were necessary to ensure the research aims & objectives were aligned to the interviews.

The practitioners suggest that when transcribing the interviews there is added value to create a section called *"other notes from the interview"* for the researcher to include all other relevant information from the interview that could give some merit when drawing conclusions.

The final stages of the pilot study increased the researcher's ability and experience on how to extract key information when conducting the interviews, in particular with post senior people from organisations. Further, the pilot interviews developed the researcher's ability to understand areas where probing was relevant, identify when the interview was going off track, was able to build extra precautions to avoid inefficiencies during interviewing and having the capability to change the interview structure on an ad hoc basis. The final interview scripts are located in Appendix 1, Appendix 2 and Appendix 3.

3.5.3.3. Direct observation

Automotive organisations based in United Kingdom and key organisations that are advanced in outsourcing and offshoring of product design in Europe (Germany, Finland, Sweden and other countries) were visited personally. Direct observation is used to provide an additional source of information about outsourcing and offshoring of product design and development. This additional method has identified how people interact with each other; identify issues which may escape awareness among people in this type of environment (Patton 2002). However, direct observation is very time consuming requiring additional resources which were are not usually available to the researcher (Gummesson 2000).

An interview process is difficult and a time consuming data gathering technique (Berg 2001, Fontana and Frey 2005). The pilot studies involved estimating the duration required for a semi – structured interview and ensured the objectives were fulfilled. One hour and thirty minutes was derived from the pilot phase study and implemented on all interviews undertaken. In some instances an exemption was applied to interviews which lasted upto two hours due to the complexity and clarity required when the first language was not English.
Thus, the use of pilot interviews was extremely important as senior management time was limited and a professional approach was applied to each interview conducted.

3.5.3.4. Duration of interviews

An interview process is difficult and a time consuming data gathering technique (Berg 2001, Fontana and Frey 2005). The pilot studies involved estimating the duration required for a semi – structured interview and ensured the objectives were fulfilled. One hour and thirty minutes was derived from the pilot phase study and implemented on all interviews undertaken. In some instances an exemption was applied to interviews which lasted upto two hours due to the complexity and clarity required when the first language was not English.
Thus, the use of pilot interviews was extremely important as senior management time was limited and a professional approach was applied to each interview conducted.

3.5.4. Interview strategy

This research study used a semi-structured interview approach which benefits from using both structured and unstructured interview formats. The interview strategy involved using pretested interview questions that were derived from the two stage pilot study concentrating on specific areas and themes which also included extended trial interviews (Silverman 2003, Yin 1994b) detailed in section 3.5.2.2. When conducting such an interview specific, themes and areas were mapped out ahead of time, but participant responses are not fixed allowing them to elaborate further and develop a more fruitful response; enhancing the research study (Berg 2001).

The interviews conducted were mainly explorative because this area of examination has a limited theory base resulting in the phenomenon being fully explored and a case study approach selected for certain organisations to build up knowledge in this field. The use of Kvale and Brinkmann's (2009) twelve stage interview method was followed for real life interviews as detailed in section 3.5.2.4.

To ensure consistency between each interview, a guide was developed and followed as a baseline approach not detailing the particular questions; but all interviews were subject to a semi-structured approach. The interview guide defined themes and areas relevant to this research study to ensure there were no gaps present and leading questions were eliminated to elucidate and illuminate the study (Patton 2002). However, it must be noted that this approach ensured validity during the interview process and when new areas had been discovered these in particular were explored and back flushed into all interviews.
The field interviews were conducted with two interviewers; the researcher who was the driving source leading and asking questions, a research assistant who ensured time management and general administration of the interview (Eisenhardt (1989). Adopting such a structure focused the researcher and the participant to ensure all interview themes, areas, questions and new insights to the phenomenal were successfully answered and recorded.

All interviews for this research were conducted in English and if required additional time was given to participants who did not speak English as their mother tongue. However, these interviews lasted around three hours to ensure there were no misinterpretations.

Figure 3.6 maps out the interviews conducted in the three automotive segments. It walks through the different organisations that were used for the research, the participants involved, number of interviews conducted per group, average interview duration and finishes with the total number of interviews.

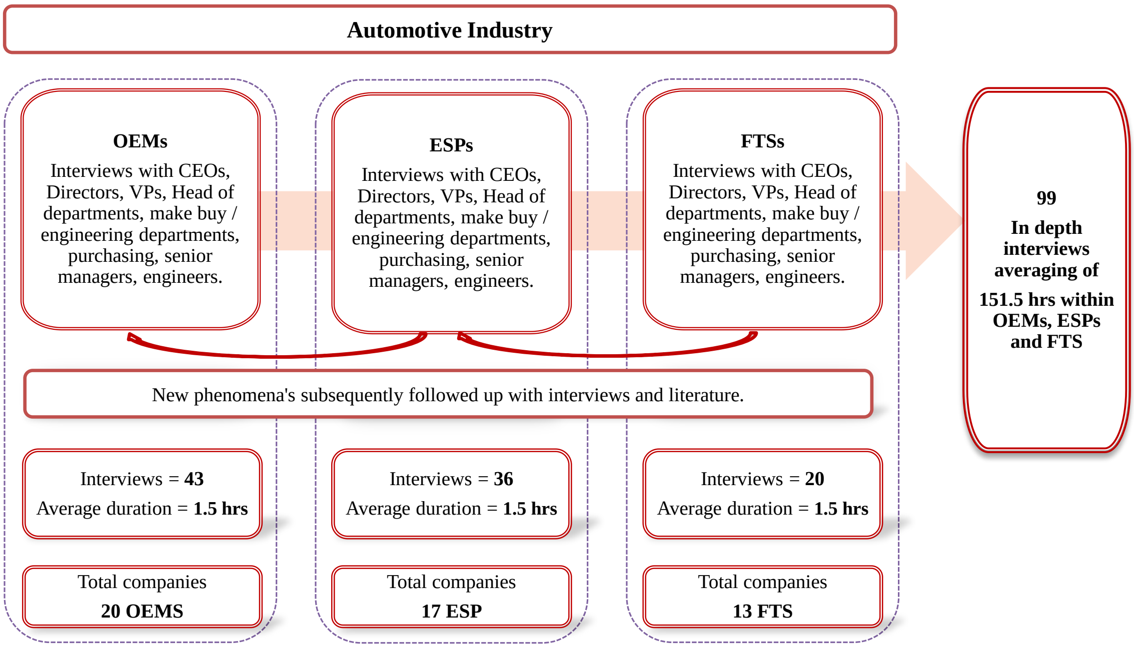


Figure 3.6. Interview map.

As shown in Figure 3.6, in general most interviews lasted between 1.5 - 2 hours, consisting of interviewees contacted by telephone, email and further follow-up interviews to expand on areas that were unclear and required additional information.

A total of 99 semi-structured interviews were conducted for this research with 70 interviews that were face-to-face and 29 interviews that took place via telephone due to travel expenditure and critical timing involved in the research. A telephone interview provides a reliable source of information but becomes a rather costly method of interviewing (Creswell 1998). Thus, company resources have been utilised to overcome this weakness.

All participants that were interviewed via telephone were using virtual communication in daily conversations with their employees who were globally positioned within their organisation. It must be noted that all participants were involved in virtual communication on a daily basis which does not impact the data retrieved.

A total of 90 interviews were audio recorded and then transcribed to avoid error and increase the credibility of the results (Patton 2002, Saunders *et al.* 2003, Yin 1994b). Each interviewee was given the option to have the interview not recorded and was also given the opportunity to not have certain parts of the interview recorded. When the recorder was switched off detailed notes and schematics were made on supplement documentation that supported the interview guide, capturing relevant information. At each field visit, field notes were also taken to ensure that all information was captured in addition to audio recordings. The transcription process has taken over 500 hours based on Bryman (2001) who suggests that one hour of audio recording takes up to five to six hours to transcribe.

In the case of the nine interviews that were not recorded, detailed notes were taken by the researcher and assistant which then became the source for transcribing the data.

The organisations used for this research study were examined in the industry to understand what percentage of engineering work was outsourced and offshored. The purpose of doing such examinations identified which organisations were more advanced in outsourcing and offshoring of PDD and the relevant strategies each organisation had adopted. This approach also revealed how decisions were made on outsourcing and offshoring and further identified the implications of the organisation taking such approaches.

Many automotive organisations are dispersed across Europe and travelling to all destinations was not feasible due to time limitations and financial commitments involved with this research study.

When analysing research interviews they can become rather complicated and difficult to understand. This is overcome by utilising Kvale and Brinkmann (2009) model that outlines five important steps when analysing a research interview as discussed below:-

1. *Condensation* – This is where long interview paragraphs are shortened which contain the original meanings.
2. *Categorisation* – All the interview data is coded then categorised. Many of the long statements in an interview are reduced to +/- categories indicating occurrence and non-occurrence of a phenomenon; or to a single number on a scale of 1 to 5, that indicates strength of such a phenomenon.
3. *Narrative* – A story is created from the interview, but the interview text is heavily reduced.
4. *Interpretation* – The interviews are more or less speculative and interpretations of the text are expanded. This is normally found in the humanities area.
5. *Ad Hoc* – A number of common-sense approaches to the interview text are used in particular textual or quantitative methods which being applied to all the text or certain aspects. Miles and Huberman (1994) have identified tactical methods for generating meanings in qualitative texts when using an ad hoc approach.
   These are listed as patterns and themes, seeing plausibility, and clustering, making metaphors, counting, making contracts/comparisons, partitioning variables, factoring, noting relations between variables and finding intervening variables. All the listed tactics are building a logical chain of evidence and making conceptual/theoretical coherence. The outcome of meaning generation can be in words, numbers, figures, flow charts or a mixture.

To ensure a fruitfulness of the interview analysis the methods defined by Kvale and Brinkmann (2009) have been mapped against the research objectives and questions. Therefore, only three were suitable for this research in order to fulfil the research questions:-

1. Condensation – Used when developing the interview guide.
2. Categorisation – Used for interview transcripts.
3. Ad hoc methods – Used when analysing interviews.

Importantly, condensation and categorisation was used when developing the interview guide and categorising four key area areas. Categorisation was used for the interview transcripts ensuring coding was carried out based on the methods developed by Blessing and Chakrabarti (2009) and Miles and Huberman (1994) which is dedicated for a design research methodology and utilising coding techniques from Saldaña (2012).

Ad hoc was used when analysing the research interviews allowing the researcher to apply a common sense approach to explicitly streamline the interview data and clear any areas of concern.

3.5.5. Distribution of interviews

Table 3.6 shows a total of 99 semi-structured interviews were conducted across the three segments with 43 interviews in OEMs; 36 interviews in ESPs is and 20 interviews in FTSs.

The distribution of interviews across the three segments is further identified in Table 3.9, Table 3.10 and Table 3.11. The shaded grey columns represent the case study interviews across all three.

The role of each interviewee is also provided along with additional information on the case study analysis. However, when only one interview was conducted within any segment an extended interview approach was used and these interviews took lasted two hours in duration.

A total of 12 interviews took place for the six case studies used for this research study and each interview lasted three hours to ensure a comprehensive coverage of all questions and themes.

All interview transcripts were returned to the interviewees to ensure consistency and their acceptance of the interview outcome. The transcripts were amended accordingly when additional data or slight adjustments was necessary to further enhance the credibility of the interviews

3.5.5.1. Distribution of interviews in OEMs

OEMs	Interviews	Role of interviewee	Additional Information
OEM A	4	Engineering group director = 1. Group chief engineer = 1.	Two additional interviews with two line managers and one engineer. (Each interview lasted 3 hours for case study).
OEM B	1	Engineering director = 1.	Extended interview.
OEM C	4	Purchasing director = 1. Engineering group director = 1.	Two additional interviews with one line manager and two engineers. (Each interview lasted 3 hours for case study).
OEM D	3	Engineering director = 1. Purchasing director = 1. CEO = 1.	
OEM E	2	Engineering director = 1. CEO = 1.	
OEM F	1	Engineering director = 1.	Extended interview.
OEM G	1	Engineering director and line manager = 1.	Extended interview.
OEM H	2	Engineering director =1. Director of vehicle strategy = 1.	
OEM I	3	VP product design and development = 1. Head of strategy = 1. Head of outsourcing = 1.	
OEM J	2	Head of strategy = 1. Director of engineering = 1.	
OEM K	2	Engineering director = 1. Head of engineering strategy = 1.	
OEM L	3	Head of outsourcing = 2. Engineering director with senior manager = 1.	
OEM M	3	Senior executive VP of strategy = 1. Head of offshore engagement = 1. Head of business efficiency = 1.	
OEM N	2	CEO = 1. VP body engineering and program development = 1.	
OEM O	2	Senior VP & Head of Global Product. Development = 1. Head of body engineering = 1.	
OEM P	2	CEO = 1. Executive Director Product. Development = 1.	
OEM Q	2	MD = 1, Director of Advanced. Product Engineering = 1.	
OEM R	1	Engineering director = 1.	Extended interview.

OEM S	2	Engineering director = 1. Director of engineering strategy = 1.	
OEM T	1	Director Product Development = 1.	Extended interview.

Table 3.9. Distribution of interviews across OEMs.

Table 3.9 shows the number of interviews conducted in each OEM organisation and two additional interviews for the case study organisations. In OEM A, two additional interviews were conducted with two line managers and one engineer all new to outsourcing and offshoring of their PDD activities. The additional interviews lasted three hours with line managers who were responsible to execute outsourcing and offshoring and engineers who engaged daily with outsourcing and offshoring service providers. The additional interview guide for the case study interviews is located in Appendix 3.

3.5.5.2. Distribution of interviews in ESPs

ESPs	*Interviews*	*Role of interviewee*	*Additional Information*
ESP A	2	Associate VP vehicle development = 1 Senior consultant = 1	
ESP B	1	VP and global head of engineering = 1	Extended interview
ESP C	3	CEO = 1 GM = 1 Director of body engineering = 1	
ESP D	4	CEO = 1 Head of offshoring = 1	Two additional interviews with one line manager and two engineers. (Each interview lasted 3 hours for case study).
ESP E	2	Head of research and Innovation = 1 VP product development = 1	
ESP F	2	Engineering director = 1 CEO of India = 1	
ESP G	2	Engineering director = 1 MD = 1	
ESP H	1	CEO = 1	Extended interview
ESP I	1	CEO = 1	Extended interview
ESP J	3	Head of design = 1 Director of product development = 1 President of automotive R&D = 1	
ESP K	3	COO = 1 VP engineering services = 1 Head of vehicle testing = 1	
ESP L	4	CEO = 1 Engineering director = 1	Two additional interviews with two line managers and two engineers. (Each interview lasted 3 hours for case study).
ESP M	1	Engineering director = 1	Extended interview

ESP N	2	Group VP International Operations =1 Engineering Director = 1
ESP O	2	Head of engineering services = 1 Head of programs = 1
ESP P	1	MD = 1
ESP Q	2	Engineering director = 1 Ex engineering director = 1

Table 3.10. Distribution of interviews across ESPs.

Table 3.10 shows the number of interviews conducted in each ESP organisation. Two additional interviews were conducted for the case study analysis. Two additional interviews in ESP D were conducted with one line manager and two engineers who were actively involved in outsourcing and offshoring their PDD activities.

The two additional interviews in ESP L were with two line managers that were not made aware of outsourcing and offshoring and two engineers who did not understand the business requirements when outsourcing and offshoring their PDD activities. All additional interviews lasted three hours in length and when required follow up interviews were used. The additional interview guide for the case study interviews is located in Appendix 3.

3.5.5.3. Distribution of interviews in FTSs

FTSs	*Interviews*	*Role of interviewee*	*Additional Information*
FTS A	2	Engineering VP = 1 Head of offshore centre = 1	
FTS B	1	VP and Chief Technology Officer (CTO) = 1	Extended interview
FTS C	4	Engineering director = 1 MD = 1	Two additional interviews with one line manager and one engineer. (Each interview lasted 3 hours for case study).
FTS D	1	Head of engineering = 1	Extended interview
FTS E	1	VP engineering = 1	Extended interview
FTS F	1	VP engineering and Head of offshore = 1	Extended interview
FTS G	1	VP engineering and platform director = 1	Extended interview
FTS H	1	CEO = 1	Extended interview
FTS I	1	VP engineering and Senior program manager = 1	Extended interview
FTS J	4	Group VP engineering = 1 Business development director = 1	Two additional interviews with two line managers and two engineers. (Each interview lasted 3 hours for case study).
FTS K	1	Head of R&D = 1	Extended interview
FTS L	1	VP global Engineering = 1	Extended interview

FTS M	1	Engineering director = 1	Extended interview

Table 3.11. Distribution of interviews across FTSs.

Table 3.11 highlights the number of interviews conducted in each FTS organisation. As shown two additional interviews were conducted in FTS C with one line manager and one engineer both responsible for managing the PDD activities from their OWOS.

Two additional interviews were also conducted in FTS J with two line managers who had experience when the organisation failed with their offshore third party provider. FTS J also developed an OWOS. The two engineers interviewed had daily exposure with the third party provider based offshore and their OWOS. All additional interviews for the case study analysis lasted three hours in length and when required follow up interviews were used. The additional interview guide for the case study interviews is located in Appendix 3.

3.6. Coding

The extensive amount of data collected during this research involved multiple sources as outlined earlier; NVivo 10 was used extensively for coding and analytic purposes. NVivo facilitated the handling and archiving of data which stemmed from each individual interview.
All transcriptions were carried out immediately after the interview as the data was still raw with the researcher (Blessing and Chakrabarti 2009). These transcriptions in draft format were sent to the participants for verification and all confidential details were retained such as vehicle codes, project names, employee's names and other information necessary ensuring the transcriptions were verified correctly.

The interview transcripts followed a detail coding scheme for qualitative research using Blessing and Chakrabarti (2009) guidelines. The guidelines suggest how qualitative data for design research is categorised and labelling with further guidelines followed by (Miles and Huberman 1994) recommendations of coding by using an interview theme as a starting point, grouping codes and using memos where possible.

A coding funnel guideline was used to generate the codes by using different sources of information as illustrated in Figure 3.7. Data was coded from the final interview transcripts that were enriched with additional sources of data providing a holistic and complete transcription.

Data was coded from the final interview transcripts that used several different sources as illustrated in Figure 3.7.

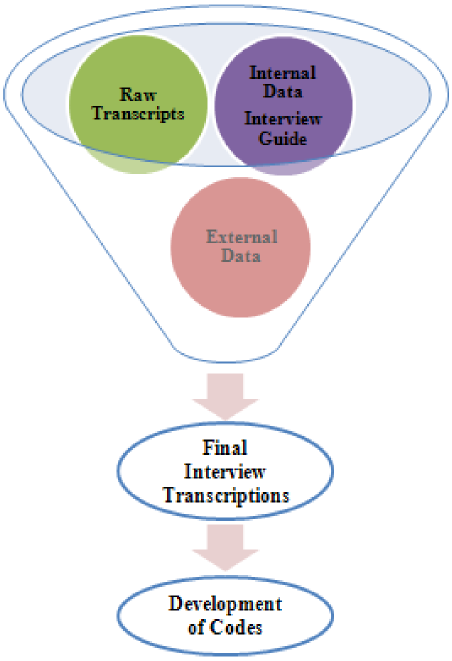


Figure 3.7. Coding funnel.

Before developing any codes in NVivo, a project was setup followed by adding three folders to the sources tab structure in NVivo as shown in Figure 3.8. A backup node was created to ensure data was accessible if there was a total loss of information.

The source's folders consisted of all primary interview transcripts and other documentation collected during the interview phase excluding the recordings as NVivo's database operated rather slowly when less than one gigabit of data was running. The interviews were separately named and classified where NVivo became the master source for editing all interviews and further amendments took place in this software.

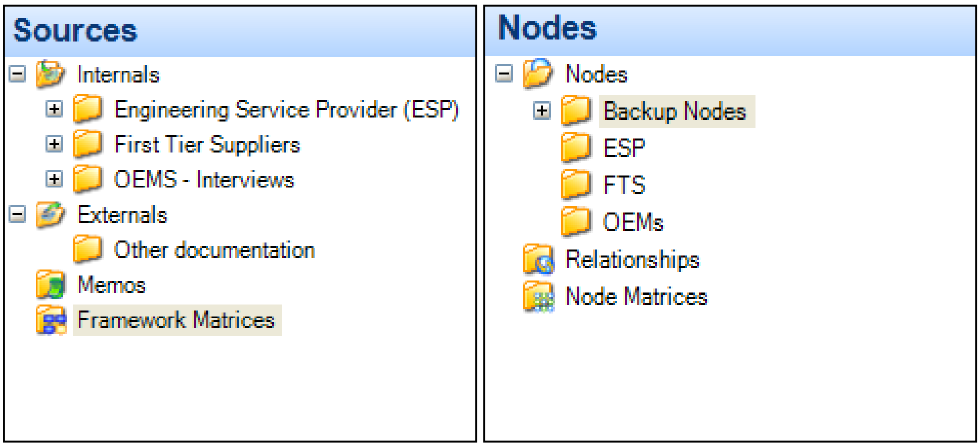
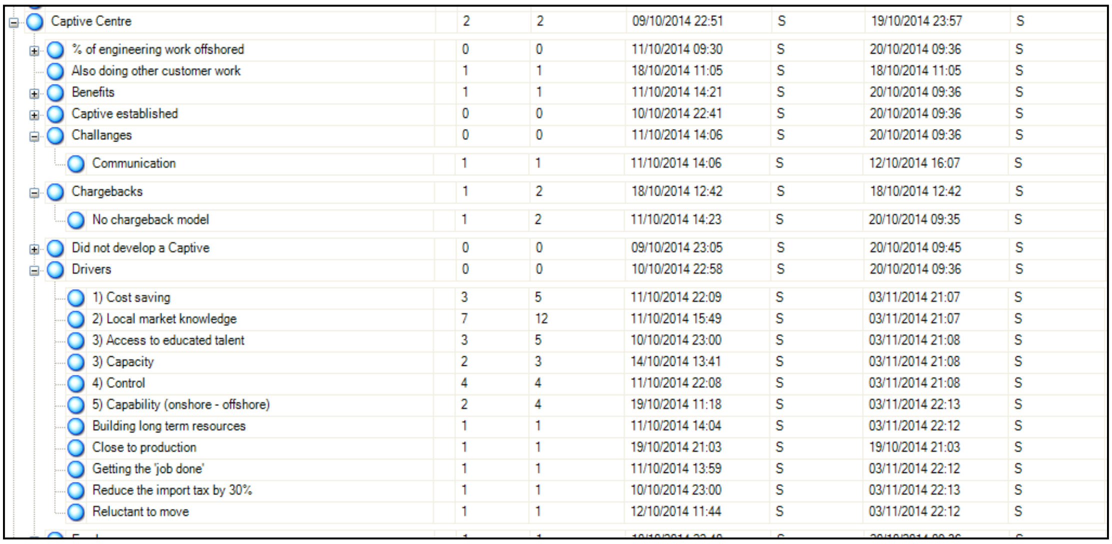


Figure 3.8. Internal sources and nodes used for coding process.

Once all primary data was uploaded into the internal source folders, three nodes were created, ESPs, FTSs and OEMs as shown in Figure 3.8.
All nodes created contained the codes and this was the core element of NVivo coding structure. Themes for coding was underpinning from the interview guide and coded themes were assigned for descriptive purposes capturing details of the individual cases such as outsourcing and offshoring PDD, OWOS, challenges for OWOS, drivers when developing outsourcing and offshoring propositions, and globalising the PDD and the complexities when dispersing product development. The next stage involved reading the transcripts and coding to each node where interview text was assigned to the codes. Data was broken down in simple meanings to address themes and research objectives. Themes generated involved a hierarchy format using sub nodes added to reflect the aims and objectives of the research. A sample coding structure used for this research is shown in Figure 3.9.



Captive Centre	2	2	09/10/2014 22:51	S	19/10/2014 23:57	S
% of engineering work offshored	0	0	11/10/2014 09:30	S	20/10/2014 09:36	S
Also doing other customer work	1	1	18/10/2014 11:05	S	18/10/2014 11:05	S
Benefits	1	1	11/10/2014 14:21	S	20/10/2014 09:36	S
Captive established	0	0	10/10/2014 22:41	S	20/10/2014 09:36	S
Challanges	0	0	11/10/2014 14:06	S	20/10/2014 09:36	S
Communication	1	1	11/10/2014 14:06	S	12/10/2014 16:07	S
Chargebacks	1	2	18/10/2014 12:42	S	18/10/2014 12:42	S
No chargeback model	1	2	11/10/2014 14:23	S	20/10/2014 09:35	S
Did not develop a Captive	0	0	09/10/2014 23:05	S	20/10/2014 09:45	S
Drivers	0	0	10/10/2014 22:58	S	20/10/2014 09:36	S
1) Cost saving	3	5	11/10/2014 22:09	S	03/11/2014 21:07	S
2) Local market knowledge	7	12	11/10/2014 15:49	S	03/11/2014 21:07	S
3) Access to educated talent	3	5	10/10/2014 23:00	S	03/11/2014 21:08	S
3) Capacity	2	3	14/10/2014 13:41	S	03/11/2014 21:08	S
4) Control	4	4	11/10/2014 22:08	S	03/11/2014 21:08	S
5) Capability (onshore - offshore)	2	4	19/10/2014 11:18	S	03/11/2014 22:13	S
Building long term resources	1	1	11/10/2014 14:04	S	03/11/2014 22:12	S
Close to production	1	1	19/10/2014 21:03	S	19/10/2014 21:03	S
Getting the 'job done'	1	1	11/10/2014 13:59	S	03/11/2014 22:12	S
Reduce the import tax by 30%	1	1	10/10/2014 23:00	S	03/11/2014 22:13	S
Reluctant to move	1	1	12/10/2014 11:44	S	03/11/2014 22:12	S

Figure 3.9. NVivo code structure.

In total 700 codes were initially developed for each segment (OEMs, ESPs, FTSs) totalling 2100 codes which was further condensed by grouping and merging codes having the same phenomenon using the hierarchy structure. This further reduced the codes to 150 – 200 in each segment developing easy to identify themes, visible patterns and visualisation of new phenomenon. The regrouping of codes was a fundamental task as this activity generated a large number of datasets but it was impossible to make any meaning or identify differences and patterns.

Figure 3.10 shows a sample coded section using NVivo data and highlighting the interviewing responses to the theme offshore capabilities which these organisations lacked.

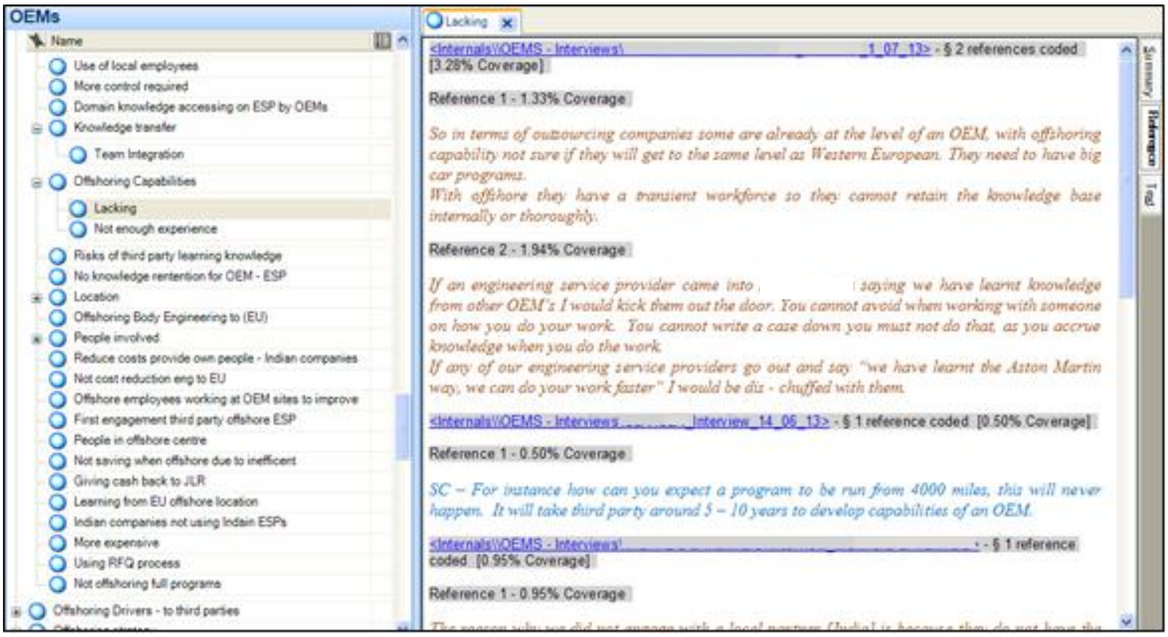


Figure 3.10. Example of NVivo coded data.

Overall the iterative process of comparing the codes, analysing all data has enhanced the rigour of the data coding and analysis stage by continuously reviewing the coded data and using external documentation collected during the interviewing phases.

3.6.1. Qualitative data analysis

The data collection stage has collected an extensive amount of empirical data requiring efficient management techniques to categorise, develop codes and further enhance the data set (Lewins and Silver 2007). Standard office packages were not suitable as the study involved more than 30 transcriptions (Gillham 2005) and there is no answer to "what is the best program?" as this solely depends on each research study (Miles and Huberman 1994).

There is a wide range of qualitative tools available which have been discussed widely amongst different authors to aid the analysis of qualitative data (Bryman and Burgess 1999, Easterby-Smith *et al.* 2012, Flick 2004, Miles and Huberman 1994, Silverman 1993).
The two most dominating software packages for qualitative studies are NVivo and ATLAS.ti (Easterby-Smith *et al.* 2012, Lewins and Silver 2007, Lewis 2004). Other software packages were reviewed but did not offer such capabilities of in-depth coding, ability to handle extensive amounts of data, and closeness to the data analysis which is extremely important in qualitative research (Easterby-Smith *et al.* 2012).

A demo version of ATLAS.ti 7, NVivo 10 software programs were downloaded then installed where a pilot process was commenced to understand which program would suit the research study. The guidelines from Easterby-Smith et al. (2012) Miles and Huberman (1994), Weitzman and Miles (1995) were reviewed and followed during piloting both software programs. After hours of navigation through each program, the researcher found some differences between the programs such as when developing large databases in particular for coding and case study building ATLAS.ti become sluggish during word searching and code searching in contrast to NVivo. The navigation menus in ATLAS.ti were not clear cut when reviewed against NVivo and there were a few instances when cutting and pasting from interview transcriptions caused ATLAS.ti to crash. In ATLAS.ti there is no undo feature available which made it difficult to revert back a few steps when coding the transcription. The limitations of ATLAS.ti forced the researcher to use NVivo for this research study.

Using NVivo 10 software package has enabled the researcher to get closer into the study, increased the overall accuracy, transparency, systematic and consistent coding, speeded the process of coding and overall rigour during data analysis and outcome stage (Easterby-Smith *et al.* 2012, Lewins and Silver 2007, Patton 2002).

It must be noted that the researcher has been entirely responsible for the qualitative analysis which includes the intellectual thinking, formulating of ideas, creative strategies, grouping of codes and the software has provided additional benefits of storing all the data in one central location (Denzin and Lincoln 2005, Patton 2002).

3.7. Validity and Reflections

This section reviews the research validity and reflections associated with the research study.

3.7.1. Research validity and approach

Research quality depends on the validity and reliability of the case studies used for this research study. Empirical data requires a more rigorous approach that ensures both quality and validity. To ensure fruitful results for this research, case studies are used as developed by Yin a famous author of qualitative research studies.

Yin (2003) has defined four tactics that are commonly used to establish quality in a case study.

1. Construct Validity.
2. Internal Validity (also called validity).
3. External Validity (also called Generalisability)
4. Reliability.

3.7.1.1. Construct Validity

Construct Validity requires the researcher to adopt correct measures for the concepts being studied (Yin 2003). In other words, this means that selected measures are measured correctly. To overcome the difficulties of achieving construct validity in this research, multiple sources of data was collected for each case and interview adding consistency to construct validity. Gathering evidence from a number of sources (triangulation) essentially provided multiple measures of the same phenomenon (Miles and Huberman 1984, Yin 1994b).

Another tactic was utilising participants to review draft case studies and analyse interview transcripts as suggested by (Miles and Huberman 1994, Silverman 2003, Yin 1994a). Furthermore, it enhanced and also verified the researcher's interpretation on the accuracy of case studies. The completed case from the participants was incorporated into the final case reports and where necessary this iteration was repeated until the participants had been satisfied with the outcome and this stage repeated with interview transcripts.

3.7.2. Internal Validity

Internal validity is a concern for casual relationships whether a certain activity has been led from other activities, mainly dealing with spurious effects (Yin 1994a). It also ensures that interpretations conducted by the researcher are correctly defined when the event cannot be directly observed (Yin 2003).

To address these, internal validity tactics are used in this research. Firstly, the use of triangulation was implemented by extracting data from multiple sources to build up the internal validity (Stake 1995). This is further discussed in section 3.7.6. Tellis (1997) states that triangulation increases the reliability of the data required in case studies to ensure internal validity has been achieved. Secondly, using construct validity tactics of utilising the key participants to review and comment on the case reports further enhances internal validity.

It must be noted that internal validity is critically important for explanatory case studies which have not been used for this research. However, internal validity has still been addressed as Creswell (2007) takes qualitative research one step further by developing eight strategies that are used to increase the validity of a study with at least two of them used in any research study. The strategies are triangulation, peer review of documents, the use of rich and thick descriptions, clarify bias from the study, revise initial hypotheses, researcher solicits participants views of the credibility of the findings and interpretations, and use external audits which are detailed in Table 3.12.

Validation Strategy	Implemented in Research
Triangulation	Multiple and different sources have been used in this research to provide corroborating evidence.
Peer review of documents	Peers within the research community who were met. There were frequent meetings with the director of studies who commented on the research progress and asked in-depth questions.
Use rich and thick descriptions	All interviews were qualitative and rich in context. The interviews were detail to enable readers to transfer information to other settings.
Clarify bias from the study	The researcher did not add any bias to impact the inquiry and had a clear open mind approach to the research.
Revise initial hypotheses	This research study did not involve any hypothesis, but a two phase pilot study was developed to split the interview into three categories for different organisations.
Researcher solicits participants views of the credibility of the findings and interpretations	Interview transcripts were taken back to the participants for validation, accuracy and credibility. The research findings were presented at conferences for feedback and critical observations which was used to enhance the credibility.
External audits	External consultants were asked to comment on the research that had no connection to the study.

Table 3.12. Research strategies used for Validity. (Adopted from Creswell (2007)).

3.7.3. External Validity (Generalizability)

External validity in case study research implies '*establishing the domain to which a study's conclusions can be generalised'* (Yin 1994b).

To overcome the external validity limitations, this research adopts a multiple case study approach using six case organisations to strengthen the generalizability as highlighted in Chapter 5.

3.7.3.1. Replication Logic

The use of multiple case studies and replication logic in case selection has enhanced the generalisation of this research study. Multiple case studies consist of two key outcomes (Voss *et al.* 2002, Yin 1994b).

1. The results collected are similar throughput the multiple case study analysis, this being called literal replication.
2. The results are different for an unexpected reason, this being called theoretical replication.

To achieve replication there must be at least two cases that support the same theory where findings are generalised to a broader theory (Yin 1994a). In scientific terms, a multiple case study is identical to multiple experiments in order to follow a replication of logic and generalise from experiment to another (Yin 1994a).

The multiple case studies used for this research have produced similar results in nature and consist of literal replication. The development of literal replication allowed generalisability to generate a strategic decision making model for outsourcing, offshore outsourcing and offshoring PDD within the automotive industry for OEMs, ESPs and FTSs.

Further, it must be noted that Leonard-Barton (1990) has also reinforced the point that a multi-case study analysis strengthens external validity and also overcomes bias against the researcher.

3.7.4. Reliability

Reliability is used to reduce errors and biases in the case study. It must be noted that evaluating the reliability of research actually refers to the results (Thietart 2001). This is a rigorous test as reliability validates whether other researchers would come to the same conclusions using similar data and methods (Cassell and Symon 2004, Miles and Huberman 1994, Thietart 2001, Yin 2003). There are two tactics suggested by Yin (2003) for increasing the reliability of case research.

Firstly, case study protocol is used in multiple case studies. Protocols have been used to describe the steps taken for the case studies. It has provided repeatability from an independent research to replicate the dataset.

Secondly, a case study database has been developed to store recorded interviews, transcriptions, reducing the error of misinterpretations or misunderstanding data.
Miles and Huberman (1984), Silverman (1993) highly recommend the use of a database and note taking which has reduced error in the research.

3.7.5. Other Forms of Validation

Other forms of validation to further strengthen validity and creditability of this research are used and illustrated below.

1. Validation with academics – A blend of attending and presenting at conferences subsequently undertaking professional talks with industry experts ensured validation with the academic community. In total, six conference papers were accepted after undergoing a double blind peer review. The six conference papers are presented in the Publications section of this thesis.

2. Validation with industry practitioners – The research findings have been validated with industry practitioners involved with outsourcing, offshore offshoring and offshoring of PDD. One method consisted of ensuring the interviewees approved interview transcriptions which eliminated the input of researcher bias or incorrectly interpreting the data. The model validity was tested through various workshops, see Chapter 6.

3. Validating the interview process – The seven stage interview process has been followed using the method below:-

    a. *Thematising* – The use of case studies and semi structured interviews to explore the nature of the research questions.
    b. *Designing* – Interview method was adopted due to the complexity of offshore outsourcing off product development and the nature of this research.
    c. *Interviewing* –Any unclear statements or dialogue not fully implicit is clarified through further questions in the interview stage or later if required.
    d. *Transcribing* – The interview was transcribed from recordings that were written accurately. To further enhance the credibility all interviewees are given the opportunity to read the transcripts once completed and ensure the data is accurate before a case is produced.
    e. *Analysing* – Methods used to analyse interview material.
    f. *Verifying* – This step is conducted simultaneously during the interview process through the clarification of questions and other information as illustrated in section 3.5.2.4.
    g. *Reporting* – Completed synchronously through the thesis process.

3.7.6. Triangulation

For the purpose of this study triangulation is used to seek corroborate on source and methods with another to enhance the quality, credibility and accuracy of data collected whereby reliability of data is ensured by using multiple sources in this phenomenon (Creswell and Tashakkori 2007, Denzin 1970, Mason 2002).

There are four types of independent triangulation methods applicable to qualitative research studies (Denzin 1970, Easterby-Smith *et al.* 2002, Flick 2004, Yin 2003).

1. Data triangulation used with interviews from different participants during different stages of the research study within the same organisations. For instance interviews were crosschecked with information that was collected from different sources consisting of other published material, internal documentation, annual reports and organisation websites/intranet.

2. Investigator Triangulation is where multiple researchers are used in any of the research stages. This was not used due to time constraints and practicality of the research study involving sensitive data. Easterby-Smith *et al*. (2002) defines this occurs in multi-disciplinary research teams and not included in this research.

3. Theory triangulation was implemented by using models from different disciplines to explain situations, and different people approached to review the research outcome ensuring consistency and accuracy of results.

4. Methodological triangulation has been implemented by using multiple methods to collect data for this research such as semi-structured interviews, document analysis, observations and daily conversations with people involved in this sector.

Using triangulation in this research further enhanced the fruitfulness and depth of the interviews, case studies using multiple sources which increased the credibility (Patton 2002). Brewer and Hunter (1989) define that using multiple methods ensures *'an arsenal of methods that have non overlapping weakness in addition to their contemporary strengths'*. Therefore, this research used several case studies along with different methods to ensure all triangulation methods were covered.

3.8. Ethics

Ethics in this research study is extremely important as participants are involved. Ethics has been discussed in different disciplined areas such as social sciences, and in particular engineering design research when reviewing content from industry (Frankfort-Nachmias and Nachmias 2007, Kimmel 1988).

The ethical issues are a primary factor of success for a research project, and to ensure this was not derailed the following three areas were implemented:

1. Inform consent – Bryman and Bell (2007) identified a lack of informed consent in the academic literature. To address this, informed consent is applicable to both individual participant and the company policy. Before recording commenced permission is requested from the participant or the company. Participants were contacted via email or phone requesting them to participate in this research study and the benefits of having an executive summary of the final results. If agreed then the informed consent and participant information leaflet were sent out. An informed consent provides the

participant with all the information required about this study (Tuthill 1997). This is located in Appendix 4.

2. Participant information leaflet – details on what the research is about, contents involved, risks, benefits and other information. This is located in Appendix 5.

3. Anonymity – all commercial sensitive data is treated with confidentially and no documents or other information is used against them. This applies to both the participant and the company involved. No names are mentioned unless written permission has been granted. All participants have been given the opportunity to read the transcripts from the interviews before they are finalised. When developing case studies artificial names are used to protect anonymity of those companies.

Data collected for this study is extremely sensitive, so special arrangements were implemented to ensure all data was kept confidential. The data collected for this study has been stored on a DELL Latitude Laptop with an encrypted hard disk. This offers additional security in terms of loss or theft where the data is unreadable by unauthorised disclosure.

In the event of total data loss, all data was also backed up on a portable IBM ThinkPad which offers a high level 128 bit advanced encryption security algorithm. Both file storages are password locked for additional security.

3.9. Limitations of the Methodology

Throughout this chapter a number of weakness and limitations have been identified along with mitigations put in place to ensure weakness are eliminated or reduced. However, every research project has limitations and no study is purified or perfect (Patton 1990, Polonsky and Waller 2010).

Qualitative research carries criticisms due to its descriptive methods and is not deemed as being rigorous enough (Patton 1990). This has been addressed thoroughly in section 3.7 demonstrating how the quality of the empirical research through several of different methods.

Obtaining access to organisations has been difficult and interviews that were arranged with post senior positions such as CEOs Directors, Vice Presidents, and heads of departments got cancelled and rearranged. In some instances there were delays in responses. The automotive industry is very dynamic and post senior executives are fully committed to the business with extremely busy diaries; comparing daily challenges to the research interview being classed as low priority and it has taken a number of iterations to get such people motivated to participate. This limitation exists in empirical research studies, and requires certain tactics on how post senior position attention is attracted and motivated in order to participate in the interviews.

Using convincible values and beliefs on gains from this research project has attracted many to participate, but interviews that were scheduled on certain dates were moved causing delays and follow-up interviews took further time to arrange.

In some instances when key people were not available for initial contact, a replacement was suggested where another interview was conducted to understand cross examination during interviews. Thus, this was an added feature to the research which contributed to additional hours spent on interviewing**.**

Chapter 4 . Data Analysis

4.1. Introduction

The purpose of Chapter 4 is to provide an in-depth insight to the research findings collected from the field work. This chapter is structured such that the data analysis stage has been constructed and fragmented into two chapters to allow a holistic and transparent data analysis:

Chapter 4: This chapter reviews the results within each segment OEMs, ESPs and FTSs by identifying the key themes and topics that emerged during the data collection stage and provides a helicopter insight into the findings. Each segment (OEMs, ESPs, and FTSs) is analysed independently to understand the different business models used during outsourcing, offshore outsourcing and offshoring the PDD activities. The findings in this area are related to the research question, aims and objectives which have guided the research study (section 1.3 and 1.4).

Chapter 5: This chapter analyses six in-depth case studies; two taken from each industry segment OEMs, ESPs and FTSs ranging from large organisations with several thousand employees to smaller organisations employing a few hundred employees. The case studies analyse how outsourcing, offshore outsourcing and offshoring of PDD activities were conducted in the automotive industry, identify the key findings presented to understand the challenges, actions implemented, implications to the PDD activities and more importantly the decision-making processes and models used. These in-depth case studies then undergo a cross case examination to discover new phenomena's. The findings in this area are related to the research question, aims and objectives which have guided the research study (section 1.3 and 1.4).

A total of 99 interviews were conducted within the automotive industry consisting of 43 interviews with OEMs, 36 interviews with ESPs and 20 interviews with FTSs.

All 99 interviews were in-depth and fully transcribed and coded using NVivo 10, a qualitative software package utilised throughout the data collection stage.

The interviews were carried out in 50 independent organisations each having dispersed HQ's located globally around the world. In fact, the organisations interviewed as part of this research represented 13 different countries and over 150 hours of interviewing data was collected.

4.2. Data Analysis

The data analysis stage followed the qualitative research process starting with breaking down of data and ending with generating concluding outcomes based on the research findings. Miles and Huberman (1994), highlight that before the data analysis stage is conducted a pilot analysis is fundamental to ensure that all the data has been collected and whether additional information is required. This ultimately saved time and avoided the researcher being interrupted when transcribing, coding and analysing the data.

The process of collecting data, developing transcriptions and the data analysis was an iterative process that took several stages referring back to the final interview transcriptions. This process confirmed completeness of the data. Coding as defined by Saldana (2012) in qualitative inquiry is a word or short/long phrases that symbolically represents visual data, usually interview transcripts, documentation, literature and so on (Johnny Saldana 2012).
Data used in the analysis section has been developed from the coding process as outlined in section 3.6.

The extensive review of the data analysis adds depth, validity and is a critical part of the research analysis stage. The in-depth analysis ensures the research objectives are satisfactory completed and a comprehensive review of the results. Within the data analysis stage there is some repetition of the results reported in this chapter. The results are considered to be sufficiently important as the challenges and drivers amongst the three segments when outsourcing, offshore outsourcing and offshoring varied as shown in Figure 4.24 and Figure 4.25. Therefore, if synthesising or editing of the data occurs, the in-depth examination becomes detracted and the insights discovered from the automotive industry are diluted.

4.3. Data Analysis – Across three segments OEMs, ESPs, FTSs

Section one of the data analysis stage provides a helicopter view into the research findings from all three segments OEMs, ESPs and FTSs. Research findings for this section are categorised into outsourcing, offshore outsourcing and offshoring strategies, models to discover different working practices these organisations implemented or were in the process of implementing.

The interviewees used for this research were typically responsible for making key outsourcing or offshoring strategic decisions within the automotive industry and consisted of CEOs, VP, senior management, directors, engineers who were either fully engaged on outsourcing and offshoring projects or undertook strategic analysis by executing these strategic in practice. Interviewing also consisted of post senior management, and managers from different areas were also interviewed to understand the connectivity of the engineering activities with other functional areas.

Outsourcing of PDD in the automotive industry is classified into two engagement models across all three segments OEMs, ESPs and FTSs:

4.3.1. Fixed price deliverable

Fixed price deliverable, also termed deliverable-based within the automotive industry. The first type of engagement within the PDD arena involved automotive organisations outsourcing PDD activities on a fixed-price deliverable model where a price has been agreed by both parties to conduct a certain project and a RASIC document produced to identify the responsibilities and deliverables involved. When a fixed price deliverable model is used the PDD activities involve small to large turnkey projects where an entire body engineering project is outsourceable.

This engagement model involved onshore organisations to outsource their near core PDD activities within the three segments. With a fixed-price deliverable model the supplier has full management responsibility for delivering the PDD activities which are reviewed and brought off by the customer as shown in Figure 4.1. The risks and complexities in PDD fixed price deliverable model when outsourcing are high compared to a fixed term contract because the project success is a function of the external organisations capability. Figure 4.1 also shows the level of outsourcing responsibly

4.3.2. Fixed term contract

Fixed term contract, also termed transactional based within the automotive industry. The second type of engagement within the PDD arena involved automotive organisations to outsource, offshore outsource and offshore their PDD activities through the use of a fixed term contract model. This type of model involves an organisation to buy engineering resources and position them within the organisation to increase the internal engineering capacity and support the high peak work content. This type of engagement model is widely known within the automotive industry as *'bums on seats'*.
The management responsibility when using a fixed term contract model resides with the buying organisation who are also accountable for the PDD activities as shown in in Figure 4.1.

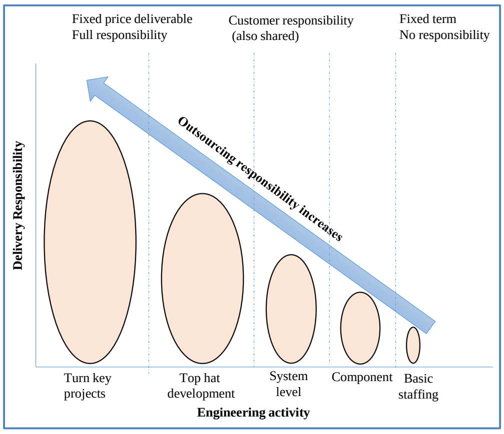


Figure 4.1. Fixed price and fixed term responsibility

4.4. OEM Analysis

The OEM analysis compares empirical findings from 20 independent organisations approached and participated in the research study. Table 4.1 highlights the OEMs interviewed for this research, their HQ location, annual revenue and the total number of employees. The data displayed in Table 4.1 has been taken from Appendix 6 having a full comprehensive and detail review off each organisation. A total of 20 OEMs were interviewed ranging from 181,000 people to 1200 people with annual revenue from $146,917 billion to $127 million.

In total the field interviewing consisted of 43 semi structured interviews taking place in OEMs across 10 different countries as shown in Figure 4.8 and each interview lasting approximately 1.5 hours. The probing strategy used during interviewing OEMs inevitably increased the duration by another one hour and provided transitioned information to explore the phenomenal in further detail by closing gaps that were highlighted during the interview.

# no	***Company OEM[11]***	***HQ Location***	***Annual revenue ($ million)[12]***	***Total employees in organisations (2013)***
1	OEM A	UK	18,587.2	24,913
2	OEM B	UK	1,900	1,200
3	OEM C	GER	93,748	110,351
4	OEM D	USA	146,917	181,000
5	OEM E	GER	156,661	96,895
6	OEM F	GER	65,472	71,781
7	OEM G	GER	185,898	107,559
8	OEM H	CHN	127.0	1,200
9	OEM I	ITL	86,61.6	89,025
10	OEM J	CR	13,709.0	24,561
11	OEM K	FRN	48,414.52	75,421
12	OEM L	UK	1,093	3,600
13	OEM M	JPN	85,843.20	23,605
14	OEM N	SWD	18,765.3	23,242
15	OEM O	IND	6,996.07	34,612
16	OEM P	UK	446.48	1,480
17	OEM Q	IND	38,600	30,000
18	OEM R	GER	19,022	19,456
19	OEM S	JPN	6,800	139,100
20	OEM T	UK	811.9	1,422

Table 4.1. OEMs Interviewed. (Source: author).

The OEMs headquarter locations are shown in Figure 4.2 illustrating that UK, GER, JPN, IND, USA, FRN, SWD, CHN, ITL, CRZ were countries where OEMs developed their automotive

[11] Data for OEMs was frozen in Dec 2013.
[12] Bank of England currency rates for 2013 used see Appendix 7.

headquarters, with UK and GER being the most popular locations with 5 HQ for each organisation. Figure 4.2 shows the OEM HQ locations mapped graphically.
There are 66.3 per cent of OEMs interviewed being part of a parent group organisation (for example parent group is defined as AUDI or Skoda both have VW as parent organisations) whereas 33.3 per cent of OEMs were independently owned (for example, Ford Motor Company).

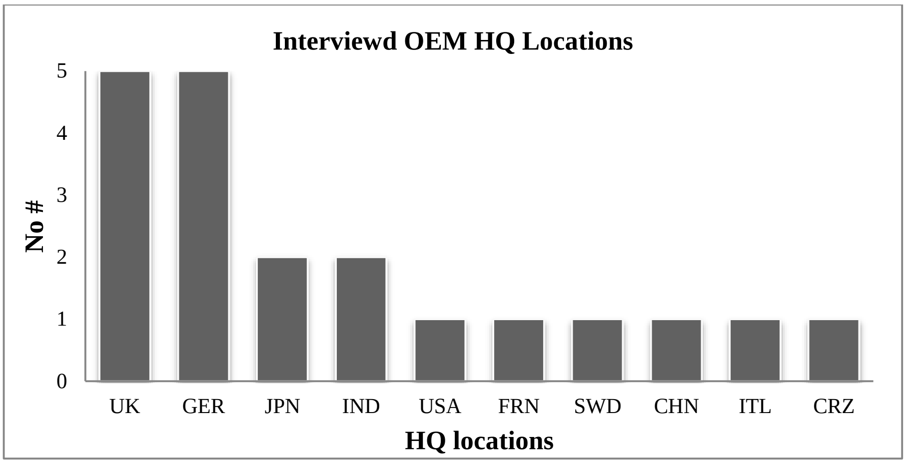


Figure 4.2. Interviewed OEMs global locations (Source: author).

Outsourcing and offshoring of PDD within the automotive industry consisted of various OEMs using different strategies, for example engaging with an onshore/offshore service provider or development of an OWOS. The OEM empirical findings have been segregated into three categories to allow continuity and flow throughout this chapter ensuring each analysed segment is architected to provide a complete in-depth study.

Figure 4.3 shows an overview of the OEM analysis which includes outsourcing, offshore outsourcing, offshoring and joint ventures.

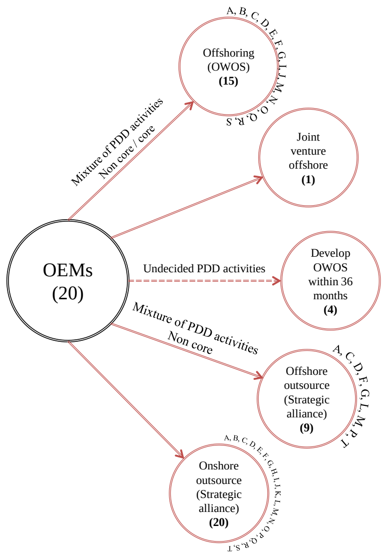


Figure 4.3. Overview of OEM analysis.

The 20 OEMs interviewed onshore outsourced, offshore outsourced and offshored their PDD activities to their OWOS. 15 OEMs developing OWOS, one developed a joint venture, four OEMs had plans to develop their OWOS within 36 months, nine engaged with offshore outsourcing organisations (ESPs) and all 20 OEMs were onshore outsourcing to local service providers as shown in Figure 4.3.

Thus, the three categories below are discussed in more detail.

Onshore outsource/outsourcing – Organisations that engaged with third party onshore outsourcing ESPs.
Offshore outsource/outsourcing – Organisations that were offshore outsourcing to third parties ESPs located in developing countries.
Offshoring – Organisations that developed OWOS in low cost developing countries.

4.4.1. Onshore Outsourcing

This part of the research findings analysed 20 independent OEMs outsourcing their PDD to third party ESPs based locally and within a short proximity to the OEMs research and development headquarters.

All 20 OEMs outsourced a mixture of PDD activities mainly near core to third party ESPs as shown in Figure 4.4 and each outsourcing organisation is identified. These external organisations were responsible for delivering the PDD activities and were based within a short distance from the OEMs.

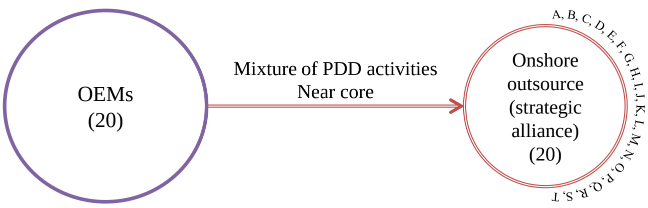


Figure 4.4. OEMs and onshore outsourcing.

The onshore outsourcing scale of engineering projects ranged from small engineering work packets to large engineering turnkey activities, financially from $39.11 thousand to $156.44 million and over. These outsourcing contracts involved over ten to a several hundred people.

An OEM seeking to outsource the PDD activities utilised two critical valves. The first valve consisted of fully utilising the internal capacity (FTEs) and recruiting additional employees to fulfil the engineering demand. The second valve was released as the cycle plan demand over took the requirements of engineering resources. This consisted of recruiting additional resources from external agencies that were positioned internally within their engineering centres.

After both valves were exhausted the OEMs had no option but to consider outsourcing the PDD activities to third party ESPs in order to meet the market demand and deliver the expected product portfolio and simultaneously retain their competitiveness within the industry. The blending of both resources (external agencies and ESPs) enabled the OEMs to meet their cycle plan demands.

4.4.1.1. Onshore Outsourcing Drivers

The research has identified the following top five key drivers presented in chronological order that OEMs implemented when deciding to outsource their PDD activities to ESPs based onshore with the drivers consisted of:

Engineering capacity – The main driver for all 20 OEMs (100% of respondents) that were interviewed as part of this research highlighted they were going through a growth period where difficulties arose to maintain the product portfolio by using FTEs and additional Contract Employees (CEs) specially recruited for taking out peak demands. The OEMs contracted ESPs to deliver the product portfolio.

An example of engineering capacity emerged during an interview with the director responsible for engineering at OEM G stated:

> The main driver for outsourcing our product development work was the organisation growth and we needed to maintain our product portfolio. As the business got bigger we needed more people than we didn't have so quickly so we hired people virtually as body leasing or elongated workbench and ESPs who could develop our derivatives. Ultimately we are outsourcing because of capacity issues we have with our engineering resources in particular body engineering side of product development.

This interview concludes that OEM G expanded their product portfolio without taking into account the engineering resources and infrastructure required to roll out the new vehicles. OEM G did not have the time to develop the engineering resources internally, so they were acquired from market.

Another example of capacity driver was mentioned during another interview with the engineering director at OEM C stated:

> We are currently using our engineers internally to concentrate on the vehicles that generate cash cow revenue for the organisation, these vehicles would not be outsourced but we brought the engineering resources from ESPs who would contribute to the development of these vehicles in our own facilities. To give you a flavour the press release on the full electric car by OEM C launched was completely retained in-house but was supported with our extended workbench company such as ESP D for instance. The organisation is outsourcing derivatives to ESPs capable of producing, designing these vehicles from concept stage to serial production. Currently we are facing difficulties with the engineering resources within the business so we need to buy engineers from the market rather than develop them internally that will take a very long time.

OEM C has used both models of engagement sporadically; when resources were low they acquired additional capacity (time and material; transactional based) mainly for offshore outsourcing and offshoring (discussed further in section 4.4.2 and 4.4.3) and to maintain the product cycle plans they used a fixed price deliverable contract with a number of ESPs based onshore.

Costs reduction – This was secondary to obtaining the engineering capacity for onshore outsourcing and consisted of 40% of the respondents citing cost reduction. OEMs anticipated having engineering resources at costs which were within their vehicle budgets that did not exceed the internal costs of developing a vehicle. These organisations also identified that moving costs from fixed into variable was significantly important to survive if unexpected and circumstances arose out of their control. In addition, each organisation interviewed set an annual budget for the headcount required where body engineering as a group was the largest in terms of employee resources deployed and outsourcing activity within the organisation.

An example of this emerged during an interview when the group engineering director and senior manager at OEM A stated:

> If time will change again once you have started with outsourcing and subsequently something happens it is less of a burden to have an external company rather than your own people. For instance in a recession you need to retract all the money, so it's easier to do with an outsourcing company than doing it internally. It costs more to lay off the internal people than the outsourcing organisation. Outsourcing is expensive than contractors. In actual fact, in some areas it can be a factor of two and ESP L is our cheapest on outsourcing but not offshoring.

This comment clearly clarifies that OEMs are using external ESPs in case market conditions change and redundancies are easier to develop with external organisations than going through an internal redundancy program which is costly and time consuming.

In another interview, the director at OEM B responsible for PDD stated:

> It's very often about fixed cost vs. variable costs; it's a great benefit because if you outsource a project to ESPs and say that project fails you can easily kill off the project more easily as it's not done with your own people, which is very flexible. If we had to recruit it's a very slow process, buying services is much quicker and cheaper than rather doing it internally. Take for instance a new model development, which means that you need to recruit people, by the time you have done this the vehicle program is over.

This comment also highlights that OEMs are using ESPs increasingly more than adding additional FTEs internally which could lead to financial impacts to the business if the outsourcing projects are not successful or if the project does not meet the organisations gateways.

Flexibility – Outsourcing of product development added additional flexibility to the OEMs as more resources contributed to the engineering development process and areas which had been under resourced were filled with additional capacity. The OEMs could demand resources as and when required from the ESPs allowing them to strategically plan their outsourcing projects where 80% of respondents cited flexibility.

An example of flexibility emerged during an interview with the engineering vice president at OEM D based in Germany who stated:

> The automotive industry is very cyclic, you have peaks and troughs, at some point you develop more vehicles than others. However, if we increase our assets internally and we have a down period we could automatically face a loss to the business so we have to be a bit less flexible with the workforce which requires a level of outsourcing to external organisation. The demand is faster than we can build up any facility or recruit people. I would say strategically OEM D will always plan to have outsourcing as part of the business strategy in terms to gain flexibility. I can say for sure it will never become 100% in-house.

During another interview, the engineering director at OEM B mentioned:

> Outsourcing of our PDD has increased the flexibility it allows us to approach the ESPs and request by saying we need X amount people to work on this project. So being flexible as an organisation we can say we want this model our available resources are busy we wouldn't be able to do it if I didn't go to these companies.

These were only two snippets taken from interviews with 20 OEMs taking part in this research study. The interviews highlighted the OEMs are outsourcing and benefiting from becoming flexible allowing a constant use of external people during the outsourcing process and leveraging their demands.

Time to market – All 20 OEMs (100% of respondents) interviewed all reported outsourcing the PDD including mid cycle actions, derivatives, engineering work, testing, and other activities has accounted for launching their vehicles into the market within the vehicle timing plans. Outsourcing has contributed by maintaining the competiveness between OEMs as without the additional support competitors lack the introduction of new models causing market starvation and an opportunity for other OEMs to generate additional profits.

An example of time to market emerged during an interview, with the director responsible for engineering at OEM G mentioning:

> We would not keep up with our competitors or with the resources available internally to get these vehicles within a timely manner to the market. We have seen a great advantage of using outsourcing in order to meet time to market demands, but the pure engineering time to launch a vehicle into the market has not decreased and we have not identified any occurrences of this.

Capability to acquisition – 30% of the respondents within OEMs used ESPs in niche areas where internal capability was not fully developed or the skills sets within the organisations were not matured. In these instances the organisations decided with caution what activities were outsourced. OEM A has been outsourcing niche Computer Aided Engineering (CAE) activities to a local ESP consisting of only several hours per month at $160 per hour. The business case did not warrant these skills to be developed internally. Thus, they have continued outsourcing packets of work to this ESP.

The OEMs also stated that when they did not have the capability internally to carry out the PDD activities they would engage with ESPs or FTSs and if their engagement was successful these smaller organisations were acquired through smaller acquisitions.

4.4.1.2. Onshore Outsourcing Challenges

The challenges highlighted are taken from all 20 OEMs interviewed on outsourcing of their PDD activities based on both transactional and deliverable models. These are the top five key challenges and are categorised in areas of most complexity for OEMs when outsourcing their PDD activities.

Communication issues – A total of 14 OEMs from the 20 interviewed (70% of respondents) reported poor communication resulting in delays with the outsourced engineering activities. All other OEMs reported they had critical communication issues when offshore outsourcing or offshoring their PDD activities.

An example of this emerged during an interview when the director at OEM B responsible for outsourcing of product development mentioned:

> Yes we are facing challenges with communications from English to German design companies based in Austria. This is language barriers base within Europe and not offshore. The same word sometime has a different meaning in organizations. Communication issues between EU countries are still present and have caused problems with our designs where we had to do a number of rework iterations resulting in additional costs.

During another interview, the senior manager responsible for engineering at OEM G stated:

> Our main concerns are with offshoring than outsourcing locally. Our service providers have developed a good relationship with our people. On some instances there are still communication issues with our local people but these have not really caused any significant problems.

Communication issues have varied in each OEM but onshore to onshore challenges have arisen during the outsourcing journey resulting in additional costs and delays.

Quality of work – All 20 OEMs (100% of respondents) reported they had experienced quality issues with the craftsmanship of engineering activities that were outsourced to ESPs. The quality inefficiencies occurred in multiple areas of the engineering development phases. ESPs engaged with OEMs on engineering activities faced difficulties as the engineers lacked training and understanding of producing quality data by following the OEMs engineering processes or design methods.
An example of quality issues was mentioned in all 20 OEMs but most importantly during an interview, with the engineering director at OEM B mentioned:

> The data received from the ESPs was relatively unclear and they had not followed any of our processes. Upon investigation we discovered that our internal processes were incorrect and out of date […] so there is no chance that an external organisation will be able to deliver to the expectation level required. We also discovered that our engineers and module leaders had not cascaded the correct level of information to the ESPs.

This quote demonstrates an external organisation requires fundamental processes that are coordinated through the OEM. Further, the OEMs are lacking in cascading or developing their internal process for readiness when engaging with an external organisation.

Reluctant to engage with outsourcing partner – All 20 OEMs (100% of respondents) highlighted employees were reluctant to engage with external ESPs as they feared their jobs could have been at risk with the ESP learning knowledge and becoming the fact holding organisation.

As a researcher I was working on a large engineering project that was outsourced by OEM A to ESP A. Upon various discussions with OEM A the employees working on a project level clearly stated:

> We need to be very careful what we tell you as you lot will take our jobs in the future. End of the day we need to protect our jobs here first. Other similar instances occurred when other OEMs did not share critical data with third party organisations.

During another an interview with the engineering director at OEM B:

> If anything you have more friction when sending work to the external engineering parties, as the employees have never worked with external engineering providers.

In addition to the above quotes, senior management had not been made aware of the employee’s reluctance to engage with their selected ESPs. These responses from the interview highlight employees are key stakeholders when OEMs outsource their PDD activities and critical to success.

Customers not cascading internal processes – Each OEM is equipped with their own processes most which are rather complicated to understand and having their unique philosophies. All 20 OEMs (100% of respondents) reported difficult in working with ESPs as their processes had not been followed and lack of working procedures used due to poor cascading to external organisations. In many instances the OEMs did not fully understanding their own processes.

An example of this emerged during an interview with a senior manager at OEM A mentioned:

> There have been varying degrees of challenges, as with any partnership it requires a learning process. Generally you will find that the outsourcing providers are good at doing the drawing side of the project, but less good at OEM A specifics such as the releasing activity known internally as automated issue management system (AIMS), engineering report out systems and many others. It is difficult for suppliers to recognise outsourcing providers as our people, they are classified sometimes competitors. We have to continuously teach our partners what are the deliverables required at each stage.

In most cases the OEMs processes lacked detail that created these additional challenges when engaging with external service providers. The researcher discovered many of the OEMs processes were outdated with old level documentation which required updating which caused additional confusion amongst ESPs.

Additional coaching and control required – All 20 OEMs (100% of respondents) reported their outsourcing agreement resulted in additional coaching and control of the ESPs than originally anticipated. Coaching ranged from supporting the ESPs to understand milestones in the project phase and deliverables required during the program.

An example of this emerged during an interview when the engineering director at OEM A stated:

> Yes much more control is required. Predominately management support, technical specialities and especially process, so AIMS, Product Creation System (PCS) and many others. At each project milestone there are learning curves, so under body (UN build), upper body (UP build), etc., what do you need to fulfil in each milestone has been lacking; the ESPs were unclear in what needs delivering.

During another interview with the engineering director at OEM R:

> The core engineering facility is close to our headquarters and we do not want to move the work to any other country, because we want to be control of what's happening in the areas of development. Even with the service providers we are using today our business needs to ensure that we are fully control of the designs and processes they are using.

In another interview with the engineering director at OEM B:

> Internally we do not need to control our structure than outsourcing to ESPs. You cannot leave ESPs to just get on with the job; you know that from your studies so far. The module leaders need to stay on top and really understand where you are. Miracles don't happen!!!!!! When outsourcing work you need to have unique project coordinators for such projects, but when doing this work internally you do not need these people.

The three interview quotes extracted from the transcriptions demonstrate that additional coaching and control is important from a OEMs perspective to ensure the ESPs deliver on time and with the necessary quality levels. The quote also highlights that an outsourcing organisation (in all cases ESPs with PDD) requires additional coaching throughout the contractual journey and takes many months to build confidence and trust for the completion of PDD activities.

4.4.1.3. Onshore Strategy

All 20 OEMs interviewed implemented different onshore strategies when outsourcing their PDD to ESPs. 12 OEMs had implemented a strategic vision for a long-term strategy and partnership with the ESPs to strengthen and tailor their core competences for outsourcing programs. The OEMs taking this approach increased their engineering content with the ESPs over several years and additionally added further ESP as the product portfolio was rather demanding. Despite the OEMs contracting with additional ESPs they favoured their strategic long term service providers over their short term gap fillers.

An example of this emerged during an interview with the engineering director at OEM C who stated:

> We are talking here long-term investments. Long-term relationships for our organisation are usually a partnership and are strategic decisions we take when working with third party providers. Our business cannot afford to change outsourcing suppliers regularly as this involves costs, time and additional resources.

Another example emerged during an interview with the engineering director at OEM F:

> We had a vision to develop a strategic partnership with a ESPs utilisable through the group to outsource various engineering activities rather than dispersing the outsourcing activities to a number of third party ESPs. A long term vision made our organisation in 2010 acquire ESP G, who then became our external engineering development capacity resource to fulfil the expansion of the product portfolio. A further acquisition was and development and to specialise in niche areas.

Another example emerged during an interview with the engineering director at OEM E:

> The plans are for long-term development, most of the ESPs companies have been around for 20 – 30 years and they all have special fields of expertise. These companies are not alike; you pick what suits your requirements.

During another interview with the COO of OEM D stated:

> Our plans with an ESP are for long term. They need the experience from previous programmes and we need to make sure that new partners are not chosen for each and every product. These are very strategic decisions, long-term plans. The strategic decision is on a high level on how much workforce we keep internally and maintain in-house and how much of the engineering you will outsource.

Further, the director at OEM B mentioned:

> This is definitely a long-term strategic decision. When you have such skilled companies you tie them to you as they become important assets. When we are designing a new car we talk about who would develop what based on previous projects.

All the above statements testify 12 out of 20 OEMs interviewed used long-term strategies when developing and engaging with external ESPs. A number of comments were made to develop the capability of the ESPs and integrating them into the organisation to become one big team. The OEMs also witnessed these organisations can work differently as they are normally working across multiple OEM sites.

The remaining eight OEMs of the 20 interviewed developed short-term strategies involving no vision or leadership on their organisations future. This, the researcher identified no outsourcing strategies present and all eight OMEs lacked the ability to craft out a long-term plan. These organisations faced difficulties when outsourcing to ESPs as their strategies were misleading and contained a disorganised decision making processes followed by deprived management principles not understanding outsourcing.

As an example the engineering director at OEM H stated:

> We are outsourcing short-term based on contract works but I would say that we are still confused on how to develop a long-term strategy. Our people don't understand outsourcing a great deal hence why we still have not decided which strategy is the best.

Another example of this emerged during an interview with the vice president at OEM N:

> Our plans for outsourcing vehicle development work is based on short-term requirements, we are looking at increasing our headcount internally but outsourcing is rather new to our business and we don't really have any strategy it's just a let's see what happens attitude, hopefully it all works, if not we just hope it does well.

A further example of short-term strategies occurred during another interview with the engineering director from OEM T stating:

> It's purely on a needs basis. The judge on competiveness is the overall on how we develop a car. If outsourcing is a part of that we are very competitive as long we stay within the targets. Basically there is no strategy behind our outsourcing model and these are not short term or long term.

4.4.2. Offshore Outsourcing

This section analyses 20 independent OEMs interviewed as part of this research that executed offshore outsourcing of their PDD activities to third party ESPs based in low-cost developing countries. All nine ESPs that OEMs used were all located in India the dominant country for these OEMs to offshore their PDD activities. A total of nine OEMs developed offshore outsourcing engagements that consisted of offshoring a mixture of PDD activities, in particular non-core activities and four contracts were terminated as shown in Figure 4.5.

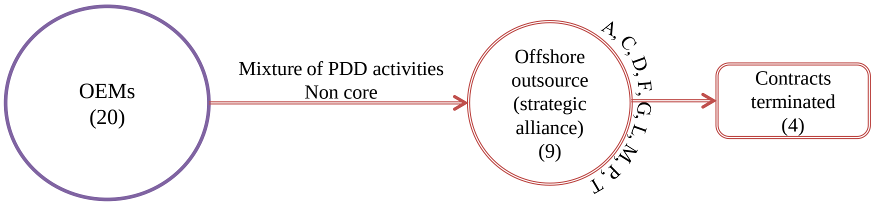


Figure 4.5. OEMS and Strategic Alliances Offshore

These OEMs used two models of engagement: onshore outsourcing for near core activities and offshore outsourcing for non-core activities both being used interchangeable to reduce the engineering development costs of designing a vehicle and enabling internal resource to be allocated onto other core activities. The OEMs using a dual model of onshore and offshore outsourcing are illustrated in Table 4.2.

OEM	Category of engagement
OEM A	Onshore and offshore ESPs.
OEM C	Onshore and offshore ESPs.
OEM D	Onshore and offshore ESPs.
OEM F	Onshore and offshore ESPs.
OEM G	Onshore and offshore ESPs.
*OEM H**	*Onshore and offshore ESPs in western countries.*
OEM L	Onshore and offshore ESPs.
OEM M	Onshore and offshore ESPs.
*OEM O**	*Onshore and offshore ESPs in western countries.*
OEM P	Onshore and offshore ESPs.
*OEM Q**	*Onshore and offshore ESPs in western countries.*
OEM T	Onshore and offshore ESPs.

Table 4.2. OEMs using dual outsourcing and offshoring models (Source: author).

The three OEMs highlighted in Table 4.2 with asterisks are organisations located in low-cost developing countries (OEM H in China, and OEM O, Q in India) offshore outsourcing the PDD activities to Western ESPs. These OEMs used a completely different strategy on how a typical western OEM conducts offshore outsourcing to low cost countries taking advantage of lower labour rates and other associated benefits and therefore were outliers to the data sets.

The OEMs analysed in Table 4.2 offshored their PDD activities to the ESPs and consisted of all transactional activities solely for time and material purposes.

4.4.2.1. Offshore Outsourcing Drivers

The offshore outsourcing top five key drivers are presented in chronological order beginning with the most cited driver during the interviewing phase. The offshore outsourcing drivers steered OEMs to disperse their PDD activities to offshore ESPs. Offshore outsourcing costs are segregated in two clusters; the first cluster views cost reduction through the lens of direct costs which are associated with employee rates, and the second cluster views cost reduction through the lens of indirect costs such as upfront investments and infrastructure.

Cost reduction (Direct) – This was the most cited driver where 75% of the respondents within OEMs developed contractual agreements with third-party offshore organisations. All nine OEMs reported cost was a significant factor when deciding to offshore coupled with internal engineering capacity that become soaked up on other engineering projects resulting in some instances cost no longer the driving force behind offshore outsourcing. The OEMs are under more immense pressure than before to reduce the overall engineering development costs when designing an automotive vehicle. The design and development costs were targeted by OEMs to take advantage of lower labour costs in offshore areas as the majority of the activities within the designing/engineering phase are rather labour intensive, in particular the body engineering element.

An example of direct cost reduction occurred during an interview with the engineering director at OEM T:

> There has been a cost-cutting activity in OEM T and the team has reviewed engineering offshoring that should be executed first. We have decided to transfer our low responsibility tasks to an offshore ESP for cost purposes.

During another interview with the head of outsourcing and offshoring at OEM L:

> We are offshoring where the labour rate gives us the best benefits. The main driver for using a third party offshore organisation was that computer aided design (CAD) is cheaper I.e. offshore CAD is cheaper than onshore CAD by 20 per cent. The engineering functions were first offshored to reduce costs within the business. We are able to move our fixed costs into variable cost within the organisation.

During another interview, the head of engineering at OEM G stated:

> Offshore is good to reduce the price. It is very good these guys are cheap, but it’s very hard to have two guys thinking the same way, normally this does not work, it is cheap but on the other hand we are facing difficulties with engaging onshore and offshore thinking process. The cheaper people come with a reduced level of capability.

The primary driver for nine OEMs to offshore was based on reducing cost from the organisation, in particular the cost of labour deployed across engineering projects such as CAD, CAE, activities that did not add core value to the product. These organisations benefited from moving fixed costs on engineering projects to variable costs and reducing the internal headcount. However, as mentioned by OEM G reducing the labour cost did not necessary mean having access to skills and capability from the offshore outsourcing organisation.

Lack of Engineering Capacity – This was the third cited driver to engage with an offshore outsourcing ESPs where 80% of respondents mentioned a lack of engineering capacity. All nine OEMs reported lack of internal capacity as the second driver run in parallel with the cost element when offshoring.

An example of this emerged during an interview when the engineering director at OEM T stated:

> Our internal capacity was full so we decided to offshore some engineering work really; there is no real plan or direction for OEM T to develop such capabilities of one supplier. The UK is becoming a very competitive market for resource and all the good guys are in a job, we are struggling to employee good engineers. Main drivers for offshore outsourcing engineering work has been capacity as sometimes we have peaks and troughs in our workload, where some work goes out.

During an interview, the head of outsourcing and offshoring at OEM L stated:

> We are using offshore to increase our capacity internally due to the amount of programs and engineering work we have today. We use offshore outsourcing for quick and dirty jobs that will free the internal capacity.

During another interview the engineering director at OEM A stated:

> We had an aggressive cycle plan so the overflow work had to be done externally as there was limited capacity internally that was on more important jobs.

Further, during an interview the head of strategy at OEM M stated:

> Offshoring helped OEM M expand our workloads to cover peaks and troughs, it was an effective way to manage workloads and at the same time trying to understand the India business, this is learning stage for both partners to start off with. India was chosen mainly for the availability of engineers and was better than the entire world.

The interview snippets demonstrate OEMs internal projects demanded additional engineering capacity which had been acquired from offshore outsourcing organisations based in low-cost regions to accommodate for peaks and troughs in the work content. Offshore outsourcing tasks from OEMs mainly consisted of low-responsibility development activities and availability of educated workforce.

Flexibility – All OEMs (100% of respondents) stated they had a greater flexibility when offshore outsourcing their PDD activities to third party offshore ESPs. As PDD within the automotive industry there are a number of internal milestones projects/programs are required to fulfil. If the objectives are not met then internally these project/programs are stopped or if financial difficulties arise during the journey. The flexibility was advantageous as a number of OEMs reported they had engineering projects/programs that were cancelled enabling them to easily switch off a third party organisation (variable costs) than switching off their FTEs (fixed costs) as there were other financial ties with this option and was difficult and expensive to execute.

Capability – From the 20 OMEs (30% of respondents) interviewed three OMEs reversed offshore their PDD programmes to Western countries where the skill sets were more developed than developing countries and the remaining OEMs acquired capability in where a high level of expertise was required.

The three OEMS were based in low-cost developing countries, the skills and knowledge required to design and launch a vehicle effectively compared to Western organisations based in developed countries initiated a large gap of competence and capability allowing them to tap into this expertise.

An example of capability emerged during an interview, with the president of engineering at OEM O stating:

> In actual fact what we are doing is both we are offshoring work outside of India especially for capability and some for capacity. Also contributing to this we have a giant cycle plan and we have no resource with the capability internally that could develop such solutions as compared to Western ESPs. Because we have an aggressive cycle plan we need to address the issue of capability within our people hence the reason why we engaged with the western offshore third-party engineering company on this large program. At the end of the day this is an experiment for us as an OEM to understand program management, services, how to work efficiently, etc. This whole project will then be transferred from Italy to India to be completed and launched.
>
> We selected areas in particular where the company was weak and gave those areas of responsibility to ESP E and this has developed a shared program where the interior design/styling, project management, prototype and engineering it is being handled by OEM O people, the interior is being developed by our fully owned subsidiary in Italy working with ESP E.

During an interview, the vice president of engineering at OEM M stated:

> I must point out here another area is where the third-party has certain speciality skills which we as an OEM do not have and use on a periodically basis. This consisted of developing a new electrical architecture which you only develop every four or five years and there is no real benefit of having these skills internally at very high costs. We offshore this part of the electrical design process.

The OEMs based in Western countries used offshore outsourcing when capability was required in certain niche areas of the PDD phase.

No upfront investments – All nine OEMs (100% of respondents) reported they were reluctant to develop a OWOS due to the upfront financial investment required, a timely process for training the employees and the risk of not knowing about a country. These OEMs engaged with offshore outsourcing ESPs to avoid such risks and develop a platform to learn the fundamentals regarding offshore outsourcing.

An example of indirect costs was mentioned during an interview with the engineering director at OEM T:

> One of the things I wanted to do was experiment with offshoring because you don't actually know how it's all going to work. The fact that we have tired it out with a couple of ESPs and it's worked well, this success has given us the confidence to carry on. However, if success was not met then our confidence levels to continue would be rather low.

During another interview the engineering director at OEM A stated:

> We did not want to develop our own OWOS due to the high up-front initial investments required. The reason for using ESP A offshore was we did not want to invest a whole load of money in software, license, etc., equipment [….] was amortised within the price. We used ESP A as an experiment as we were not sure they could grow the competency. It was a toe in the water job, here is a project; do it feedback to us. We have been monitoring the quality of work returned back and it slowly is getting better.

During an interview, the director of purchasing at OEM C mentioned:

> We have currently engaged with a large ESPs located in India who is providing our additional engineering capacity. This organisation was selected as we wanted to understand the offshoring business and how we could capitalise on this in the future. Ultimately for us the offshoring is a test allowing us to use this as a learning curve.

The interview snippets demonstrate that nine OEMs experimented with offshoring to understand how this type of business is implemented in addition with understanding the country, competencies and general quality and craftsmanship of work.

OEMs based in low-cost regions outsourced locally and offshored to Western ESPs taking advantage of the developed capability and skills. Capability was a driver for offshore OEMs as there was a knowledge gap between the two countries and tapping into Western competence was a great advantage for these organisations to learn new ways of working. However, the OEMs based in Western countries also offshored in niche areas where onshore costs were greater than offshore.

4.4.2.2. Offshore Outsourcing Challenges

The top five key challenges are outlined when OEMs offshore outsourced their engineering PDD to third-party organisations. These challenges consist of the most cited and complex during the offshore outsourcing journey experienced by OEMs.

Communication – All nine OEMs (85% of respondents) during the interviewing data collection phase reported they faced communication issues when offshoring their product designs and development activities. The communication issues ranged in scope and depth from basic engineering tasks to deeper first principles engineering analysis. The offshore outsourcing organisations struggled with both types of activities.

An example of communication was mentioned during an interview with the engineering director at OEM P who stated:

> Communication is always a challenge we are looking at having people on site to become CAD co-ordinators, this was one way we have managed to reduce the interfacing and interaction problem. I would say around nine or 10 people on the site that are from India, OEM P. Further, we have had problems with design services not correct, issues with people not understanding what we need; our own processes are not fully concrete for an external service provider, etc.

A further example of communication was mentioned during an interview with the engineering director at OEM T who stated:

> Communication will always be a problem; we have to use the local engineering company to liaise more with the offshore engineering centre.

Additional checking of data – The second cited challenge (70% of respondents) the OEMs faced when offshore outsourcing as continuous checking of the work packages which had been sent incorrect. Some engineering activities such as BIW development had been backshored due to insufficient capability. Continuous learning events took place on critical work elements but the offshore employees were unable to grasp the core fundamentals which resulted in incomplete work package errors discovered by the onshore OEMs. The additional checking of data from onshore OEMs added further hours to the project which had been absorbed by the OEMs. These costs are hidden during the project phase and did not appear on the bottom line of the project.

An example of this emerged during an interview the head of outsourcing at OEM L stated:

> At the end all the work is double checked in house from an analytical perspective. We, as a business, will never stop checking the work; we need to be 100 per cent confident that the work returned is of high standard and after consistently receiving incorrect data we had lost faith with the offshore ESP.

Another example emerged during an interview with the director at OEM T stating:

> The drawing checking needs more work than if we done this ourselves internally. As long as you accept this will happen and put processes in place to do that, it’s fine. I have put more ownership on our third-party provider on drawing checking rather than OEM T and put emphasis on further project management. The learning curve we have been up is the checking of the data coming back from offshore, that’s when I mentioned processes in place I meant having onshore coordinators.

Unclear PDD specifications –60% of respondents reported when offshore outsourcing is conducted with external service providers, in particular from a OEMs perspective is an extremely difficult and complicated task. The OEMs acknowledged a number of times being rather reluctant to send the full data offshore because of IP infringements risks and if offshore outsourcing organisations are cheaper our jobs could be at risk.

An example of unclear specifications emerged during an interview with some front-line managers and engineers at different OEMs who stated:

> We completely understand how to design a component but we did not give this information to the offshore organisation as we wanted them to not succeed.

In a separate interview with a senior manager at OEM A response to my interview question regarding *"how they support the offshore organisation"* answered by saying:

> The little information regarding the PDD activities we give is better; this means that when the offshore outsourcing organisation fails, we will be the ones who rescue this organisation and we will become savers.

Lack of employee experience – During the field data collection all OEMs (100% of respondents) reported offshore organisations had shortfalls in their employee experience being fresh from university with no experience and only a few engineers actually had several years of experience. The experienced engineers were responsible for larger groups of engineers where the skill level was rather low.

An example of employee experience emerged during an interview with the head of outsourcing at OEM L stating:

> The knowledge is not good, the distance is not great, and we spend more time rechecking the job. End of the day we are benefiting from lower costs, so these inefficiencies are not a great deal, we just have to recheck the work.

Employee Attrition – Nine OEMs (50% of respondents) reported that employee attrition had improved over the years but were less informed by the ESPs as this would have a negative impact on the business (in other words the offshore ESPs did not disclose much information on employee attrition in case the OEMs lost confidence and decided to move service provider which would result in loss of business for their organisations).

An example of employee attrition emerged during an interview, with the head of strategy at OEM M stating:

> There are high levels of labour turnover and especially in ESPs. We are investing in employees to retain them in our OWOS by giving them additional training, sending them to onshore locations and providing additional benefits.

The challenges have highlighted that communication issues are present in offshoring organisations despite a number of strategies implemented to improve the language barriers between both onshore and offshore organisations. OEMs are still facing additional costs by checking data sent from offshore organisations as their confidence in developing first time right is rather low. For instance a premium automotive organisation OEM L mentioned they will always continue to check the work from offshore locations. Specifications sent from OEMs to ESPs consisted of incomplete information and detail as employees in these organisations witnessed offshoring as a threat to their jobs and lacked basic understanding when working with external service providers. The OEMs also experienced offshore employees having poor engineering experience and attrition rates believed to rise.

4.4.2.3. Offshore Outsourcing Strategy

The OEMs approach to offshore outsourcing with ESPs was distributed around short term and long term strategies both disorganised with operational cost reduction activities.

From the 20 OEMs analysed nine OEMs developed offshore outsourcing engagements to disperse their PDD activities to offshore service providers all based in India. All of the OEMs had engaged with the offshore ESPs to reduce labour costs and free the onshore employees through offshore outsourcing the PDD activities where labour rates were cheaper.
Six OEMs did not have a clear strategy when offshore outsourcing to ESPs as trial and error methodologies were used at high organisational cost. Only three OEMs were keen to understand offshore outsourcing and what different actions could be implemented to overcome the challenges. The remaining three OEMs had a strategic vision to work with their offshore outsourcing organisations but there was no documented business plan.

Thus, the nine OEMs had developed offshore outsourcing contracts as an experiment before they developed their own OWOS.

An example of this was during an interview with OEM M head of strategy who stated:

> Before we developed our internal OWOS we first engaged with ESP B who became one of our partners on a project working at their offices, and we wanted them to work in our domain to utilise our CAD systems, etc. We engaged with ESP B before setting up the OWOS centre as they had the skill and capability that was not present in our organisation. This engagement was basically a learning activity for us.

OEM T mentioned during an interview:

> We have not set the direction of choosing one supplier and building their competence; we will just pick different suppliers. In the future we would not rule out working with a fourth or fifth party to do offshore outsourcing/contract work. There is no real strategy used when we conduct offshore outsourcing and is an ad hoc decision.

The interview examples exemplify two different approaches OEMs took, firstly developing a contractual agreement with an offshore ESPs and secondly an altered approach by choosing multiple ESPs and developing their competence. OEMs in general lacked the ability to develop offshoring strategies as they had little exposure to this new phenomenon and were not prepared to learn how offshore outsourcing could be managed more efficiently.

4.4.3. Offshoring

This section of the research analyses the 20 independent OEMs interviewed who were offshoring to their wholly owned subsidiaries. The two main countries OEMs used for offshoring were China and India. These countries are experiencing exponential growth (India growing at a slower rate than China). OEMs that developed OWOS capitalise on lower labour rates, access to educated workforce, access to local markets and having the ability to leverage the internal and external resources on a project. The OWOS locations are shown in Figure 4.6 where 11 OEMs had developed OWOS in China, five developed in India, two developed in USA, one developed in Brazil, Mexico and UK.

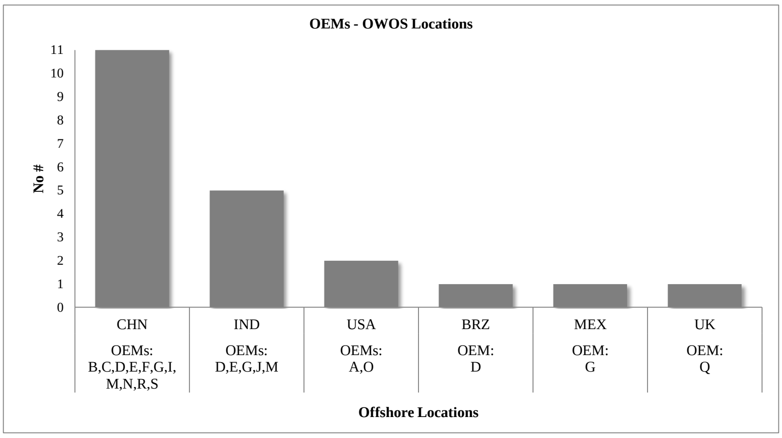


Figure 4.6. OEM Interviewed OWOS Offshore Locations (source: author).

15 of the 20 OEMs developed offshore OWOS in more than one location; all wholly owned subsidiaries; 11 developed in China, five developed in India and one developed in Brazil, Mexico and UK.

Figure 4.7 shows 20 OEMs that were interviewed for this research, 15 had developed OWOS; locations are shown in Figure 4.6.

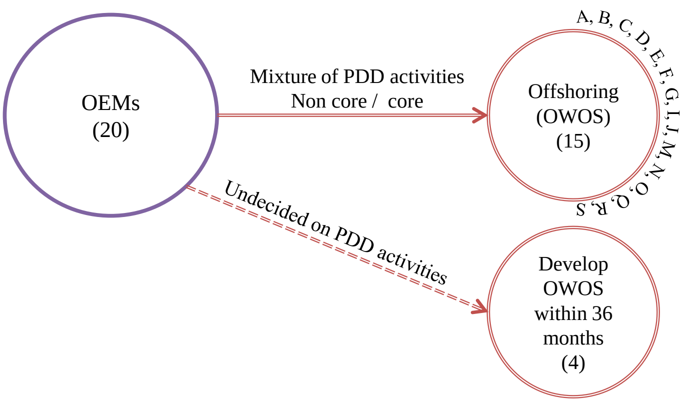


Figure 4.7. OEMs with OWOS.

Offshoring to the 15 OWOS consisted of a mixture of PDD activities in particular non core and core. The core PDD activities were an evolution over a period of time and OEM E was the only organisation close to offshoring core activities but they were still another few years away. A further four OEMs had plans to develop OWOS within 36 months. These organisations were relatively small compared to their competitors and had undecided which PDD activities would be offshored.

OEMs D, G, and M had engagements with onshore ESPs and also developed their OWOS based in India. The three OEMs had further engagements with offshore ESPs based in India. The PDD activities offshored had been incorrectly classified which resulted in challenges after developing their OWOS which are discussed in the following sections.

4.4.3.1. Offshoring Drivers

The top five key offshoring drivers varied dependent on OEMs location in developing their OWOS either in China or India. OEM E had established their OWOS in India for over 17 years which was built for cost reduction purposes within the organisation and is the longest serving OWOS by an OEM within the automotive industry.

The following drivers were used when these 15 organisations developed their wholly owned subsidiaries.

Cost reduction – 90% of respondents reported when designing a vehicle either based on an existing platform or a derivative it involves several months of pure PDD activities. OWOS were developed by OEMs in offshore locations to reduce the overall engineering PDD costs when developing a vehicle.

An example of this emerged during an interview with the engineering director at OEM M who stated:

> The OWOS engineering centre developed in India was a cost driven strategy as we were looking to reduce costs within the organisation. If you look at the project overall cost there is only a certain element that can be offshored to low-cost countries, and that job itself must yield savings of at least 30 or 40 per cent.

During another interview with the COO at OEM D:

> Cost was a driver for our business, but I would say not the prime driver anymore. When all this outsourcing and offshoring started, cost was the primary driver and it was called low-cost country engineering, has already changed to growth market engineering so the focus has switched from yes we want to take the cost saving opportunity to having a presence in the market (a bigger footprint) engineer the cars where the people buy the car and India/China are the growth markets.

Engineering capacity – All OEMs (100% of respondents) discovered they were offshoring for an extended work bench model that allowed freeing up of internal engineering resources. These engineering OWOS developed by the OEMs all conducted non-core basic engineering activities which takes considerable amount of time. All OEMs reported their OWOS did not support any core engineering.

An example of this emerged during an interview with the engineering director at OEM M who stated:

> Our offshore OWOS was developed for capacity constraints within our business; we wanted to offshore our non-core work to reduce costs. We as a business have a problem where there is not enough capacity and human talent to help support our product development growth.

Local market presence – 85% of respondents reported when OEMs were looking to grow in particular markets were unable to remotely conduct this operation as capturing the customer's requirements were rather difficult to comprehend; vehicle engineering development and styling for localisation only operated efficiently once the organisations develop local market presence.

An example emerged during an interview with the engineering director at OEM C who stated:

> The offshore engineering centre was developed in China because of innovation and our customers we wanted to be close to our customers as this country is growing rather quick. It is in our interest to set up research & development (R&D) centres where we have a huge pool of customers and where there are suppliers in the country who supplied OEM C. Ultimately the objective was to offshore to China that enabled us to understand our customers and develop solutions round them.

A further example of local market presence was during an interview with the COO of who stated:

> We are developing offshore OWOS in markets which are growing, inevitably you need to have presence there otherwise you are easily ruled out. These products are not meant for the European markets which are pretty more advanced and require the high skill and capabilities.

Access to educated people – 75% of respondents reported India was a destination where they were able to access talent as part of their offshore engineering centres. India was also used for developing their R&D centres as the labour rate was cheaper than western countries and these centres housed both research and development and engineering. However, the educated workforce was used for developing innovative frugal solutions that did not including body engineering or aspects of engineering development.

An example emerged during an interview with the engineering director at OEM M who stated:

> Our research and development OWOS we needed to increase our capability in research and this would allow us to engage with some universities and academics and organisations in India. We are not really developing any real hard engineering activity in terms of body engineering design.

Another example emerged during an interview with the engineering director at OEM E who stated:

> You cannot be too focused on one type of experience in the local market. So if we kept our R&D inside Germany this would not really work as access to skills, etc. would not be that possible, we have seen different approaches to solve problems, software related issues, etc. The tasks are distributed globally across our engineering centres according to experience and knowledge. We have tapped into the engineering and talent pool available in India compared to other German auto makers which has given our organisation cutting edge compared to the competitors.

Capability – The capability arises from OEMs that were based in low-cost countries and reversed offshored allowing them to tap into the local skill base and capability. Only 20% of respondents reported capability as a driver. From the 20 OEMs interviewed, three developed OWOS in western countries (Germany, Italy and UK) for the reasons identified. Additionally the OEMs also mentioned that core activities over a gradual evolution conducted in their wholly owned subsidiary but they started with non-core tasks.

OEM N was acquired by a large Chinese OEM in 2010 where the capabilities to develop innovative engineering solutions was lacking in comparison to the Western location of OEM N. Thus, the Chinese OEM decided to develop an engineering centre of competence based in Europe where they took advantage of the skill base and capability of the engineers. During an interview with the VP at OEM N stated:

> The Chinese OEM has opened this office in Europe because of capability in this market which is not present in China. As OEM N was part of a larger group there are still some IP infringements in terms of platform sharing and development. The Chinese organisation tried to develop platforms locally but they just did not have the capability.

This was also apparent in OEM Q who stated during an interview:

> Our wholly owned subsidiary based in UK is providing capability for our engineers based in India; we are using this engineering centre for early phases of a project requiring capability and then using them for other areas of the vehicle development process where we lack the capability.

Offshoring was predominately based on cost reduction the primary driver subsequently followed by additional engineering capacity at reduced costs, but these offshore locations did not work on core elements or value adding engineering work. Due to globalisation OEMs have positioned their engineering subsidiaries in local markets giving them the advantage to learn locally. In western developed countries high educated labour was identified as a shortfall so the OEMs developed engineering subsidiaries in offshore locations as highlighted above.

Finally, OEMs based in low-cost countries offshored to western subsidiaries to gain knowledge and experience by applying skilled and matured knowledge to programs based at HQ location.

4.4.3.2. Offshoring Challenges

This section analyses the top five key challenges experienced in the most frequent cited during the interview phase when OEMs offshored their PDD activities to their OWOS. These challenges were analysed independently during the interview phase along with the coding of interview transcripts.

Communication – 85% of respondents within the OEMs reported communication challenges with their OWOS which spanned from understanding simple instructions to sophisticated engineering tasks. The OEMs reported communication issues were still present and marginally improved even when expatriates were present within the offshore subsidiary.

An example of this emerged during an interview, with the engineering director at OEM E and D both stating:

> Their OWOS have suffered financially and impacted in some instances project timescales as the understanding has been rather poor.

Reworking of data – 70% of respondents reported poor data generation from their offshore subsidiaries which could not be used without some alterations as it lacked simple engineering standards. A number of training session were implemented by the parent organisations to improve the engineering standards but this process took several months and in the case of OEM E it took over 10 years to achieve this goal.

Lack of experience – 60% of respondents reported engineering PDD requires significant thought and well fleshed out solutions to ensure challenges were robustly closed. The OWOS were struggling and far behind their Western engineering centres which created difficulty when discussing engineering topics. The lack of experience was due to recent graduates from university having the qualifications required but minimum experience when engineering activities were discussed. Data retrieved from the offshore centres was incomplete and consisted of gaps and inconsistency when reviewed by the onshore organisations; causing additional delays, inefficiencies and more importantly further costs that were not accounted during the development of the OWOS.

> OEMs were positioning expatriates within the offshore centres to ensure there was a local presence of skilled engineers that would drive the wider team through learning and coaching.

An example of this was during an interview with a director from OEM D stating clearly:

> Our offshore people are working according to the “cookbook” if I should say it is all written down and they work exactly to this. Something obvious is not applicable and do not see common sense, nevertheless they do have some really good people, but are just lacking that additional component which we are trying to support them by implementing training sessions on development along with coaching and education using expatriates within the local offshore centres.

During another interview with the offshoring director at OEM M:

> You have to ask questions so the offshore centre is not primed to give a yes/no answer. So if you ask a question and the answer you are looking for is yes then it will always be yes, this is a challenge for our business and would say for all OWOS, the amount of inefficiency and loss time that occurs is phenomenal

A final example to further demonstrate the lack of experience which is rather important was mentioned during the interview with the engineering director at OEM Q who mentioned:

> So, I can access a number of people in India quite imminently but really they do not know anything, they can operate some good CAD or CAE people. If I want to drive 1000 people in India I need to have at least 4 expats that can actually drive the whole project and in a way when we go to ESP C they will bring a team of half a dozen or eight people who will be based locally and will drive the local teams and resources. This would work for smaller projects but not larger projects. OEM Q has this issue today, we are not very competent at saying here is all the information go and get on with it and I want it back in this timeframe.
>
> The biggest problem with the Indian companies are they all claim they've done more work than they have, they will all claim the same pieces of work, they all oversell their services. European companies would be rather sceptical about Indian service providers.

Employee attrition – 40% of respondents within OEMs reported employee attrition was rather high (excess of 20 - 30 per cent) in OWOS as employees would move from one organisation to the other in respect of being offered additional salary.

This was quite evident from an example which emerged during an interview with the Europe COO of OEM D who stated:

> With offshoring it is really difficult I have personally used offshoring, they have a tendency to change jobs quite frequently and you have a big turnover of people.
>
> If you have someone working with you he will move on and you will start from scratch which is a rather bad for any organisation as the learning journey then restarts. Sometimes you think to yourself why bother if all we do is restart.

Unclear specifications – 50% of respondents within OEMs reported their specifications sent out had been unclear, in fact some of these OEMs were unable to document or describe how an activity should be conducted and the same people had been submitting work packages and specifications to their offshore counterparts. Specifications were incomplete where the onshore employees did not take into account the skill gap between the offshore employees.

The most common challenge the OEMs experienced was communication with their onshore and offshore employees which was still a problem after implementing different strategies as discussed in Chapter 5. OEMs had challenges with inexperienced engineers based offshore as compared to their Western matched pairs which resulted in additional hours and money being spent in coaching and educating the offshore employees. Data that was received from the offshore organisations required their onshore employees to validate. In most cases the data was incorrect and this would usually end up with additional time and money spent with the offshore organisation required to rectify their error or the job was done onshore at additional cost.

Attrition rates were deemed to be rather high in excess of 20 - 30 per cent as once employees received the necessary training they gained sufficient assets and usually moved to other organisations that were offering a higher salary. Finally, the OEMs were still weak in developing clear and understandable specifications for their offshore employees and lacked detailing the work streams required. These challenges experienced added additional complexity, time, resources and costs to the OEMs which was not factored or thought about.

4.4.3.3. Offshoring Strategy

Offshoring strategies were rather diffused with OEMs applying different strategies consisting of either short term or long term which were not fully integrated into the business, strategies starting off as cost reduction, operational strategies that were confused with the overall organisation strategy at expense.

Of the 15 OEMs, 11 developed OWOS in China and India reported their strategies were long-term but there was no strategic vision in developing the OWOS. These subsidiaries were developed with expats. All four OWOS developed in India by the OEMs were solely for cost reduction purposes as these OEMs were on a journey to reduce their PDD costs. Their OWOS bundled additional work activities not involving direct PDD activities. In actual fact these organisations took advantage of the educated talent available in the low-cost/developing countries and started to offshore IT and other non PDD functions. The cost associations with an OWOS were also linked with the engineering capacity constraints these organisations faced as their internal engineering resources were soaked up on other projects.

The four OEMs (D, E, G, and M) that developed their OWOS on short-term strategies had faced challenges with benefiting from cost reductions while using the OWOS as they struggled to provide innovative solutions and take on higher value PDD activities. All four OEMs D, E, G, and M that developed their OWOS in India struggled with delivering the PDD activities as their short-term objective was to make immediate profit from the OWOS and this was not the case.

As an example of this during an interview the engineering director at OEM E stated:

> Several years into the offshoring engagement cannot start with immediate profits initially but you need to be patient. Sending work offshore does not overnight increase the profit. After several years of engagement we now understand that offshoring business is definitely a long-term plan and not a short-term decision, you cannot simply reduce costs by developing an OWOS.

A further example of this was during an interview with the head of strategy at OEM M:

> There is no way you can develop an offshore centre as a short-term business proposition you will not make any money out of it, in actual fact you will spend a lot of money and not get any benefit out of it to be honest from experience. We have learnt this lesson; offshoring is a long term plan now and in fact we are heavily investing in offshoring not only to capture frugal engineering but also to enjoy revenue of supporting one or two key providers when they help other suppliers and OEMs.

OEM Q was located in India but developed an offshore engineering centre in UK and used a strategy of tapping into the Western skills-base to develop innovative solutions. Costs reduction was not the offshoring strategy for this organisation but they required the capable people to be deployed on certain engineering tasks which were not available locally or internally.

During an interview their PDD president stated:

> Their offshore centre in UK is definitely a long-term plan and the local engineering centre they developed in India was also a long-term offshoring strategy in developing the capability and competence in the engineering calibre.

OEM M and Q developed wholly owned subsidiaries in high-wage countries which used offshoring in reverse as they were tapping into Western countries where the skill level was more advanced and mature compared to their locations in China and India. These organisations identified their internal capability in developing a vehicle compared to Western ESPs was not comparable and would still take them several years.
The product development strategies spanned across two main countries of interest China and India, the emerging and growth markets. From the 20 OEMs interviewed 11 OEMs developed OWOS in China, four OEMs developed 50/50 joint ventures in China for various legislative restrictions applied by the Chinese government and four OEMs developed OWOS in India as stated previously.

These OWOS located in China only conducted work for the local market and were localising automotive vehicles for the Chinese markets. There was a significant amount of R&D activities also taking place such as developing new infotainment, styling and other areas of automotive commodities. The joint ventures consisted mainly of manufacturing automotive vehicles coupled with elements of engineering for vehicle localisation.

All 11 OEMs who had presence in China developed their business proposition based on localised long-term offshoring strategy for presence in the market and inventively benefiting from low-cost engineering.

During an interview with the vice president from OEM O stated clearly:

> We have an engineering services division who are basically a bunch of guys doing contract design engineering work at very low level. If I am short of people I will use this company, catia, engineers, etc. This company is not treated as part of the group but as an autonomous organisation. The organisation has never developed a new product from a blank sheet compared to the European ESPs. Technically speaking if you put your corporate head you will always go to our internal organisation for engineering. They charge me the same as they charge everyone else; they charge the price of the guy plus a 30 per cent mark-up if I am in India. There are no deals from the engineering organisation, but what you get is a decent service as their part of the group. It needs to be clear that if OEM O services do not have the capability; simply I will not hire them [….].

Another important statement was made from the vice president at OEM O:

> When a North American company goes to India everything looks like a bargain until you look into the quality of work returned. Software development is very good in India but in terms of anything else it is usually takes more time and effort and requires people watching them through each stage.

The interviews undertaken for the offshoring testify that strategies lacked the direction of short-term or long-term planning. OEMs that develop short-term strategies faced more challenges than those developing long-term strategic plans. The OEMs that developed OWOS based on short-term cost reduction strategies faced additional costs as their engineering centres lacked the development required to deliver the engineering content and value to the parent organisation.

4.5. ESP Analysis

This section will compare the empirical findings from the ESP organisations that participated in the research study. A total of 17 ESPs were interviewed consisting of 35 individual interviews with an average duration of 1.5 hours and were located in 10 separate locations. All interviews were semi-structured, allowing the researcher to probe areas within the ESP analysis inevitably adding an additional hour to these interviews. The organisations that were interviewed as part of the ESP analysis ranged from a minimum of 40 employees to 300,464 with annual revenues from $13.3 million to $13.44 billion.

Table 4.3 demonstrates some key ESP attributes which have been selected from Appendix 8 that maps and details a full comprehensive detail review of each organisation.

# no	*Company ESP*[13]	*HQ Location*	*Annual revenue ($million)*[14]	*Annual Engineering Revenue (auto $ million)*	*Number of Employees (2013)*
1	ESP A	SGA	385.0	34.5	7,000
2	ESP B	IND	13,44	851, 59	300,464
3	ESP C	GER	5,885	2,150	10,300
4	ESP D	GER	839.2	528.48	7,268
5	ESP E	ITL	106.0	98.26	831
6	ESP F (Min body Eng.)	UK	359.3	281.75	2,100
7	ESP G	ITL	146.1	119.51	743
8	ESP H	GER	491.3	258.93	3,300
9	ESP I	UK	46.9	40.67	600
10	ESP J	SWD	289.0	166.30	3,000
11	ESP K	FIN	464.7	15.93	2,000
12	ESP L	UK	32.9	26.63	190
13	ESP M (Min body Eng.)	UK	13.3	0,782	40
14	ESP N	GER	119.5	19.92	1,350
15	ESP O	GER	1,038.9	529.00	10,829
16	ESP P	ITL	251.5	172.62	2,700
17	ESP Q	UK	46.9	14.13	650

Table 4.3. ESP analysis. (Source: author).

The ESP headquarter locations are shown in Figure 4.8 illustrating that UK, GER, ITL, FIN, IND, SGA, SWD were countries where ESP organisations had developed their automotive headquarters and mostly involved with OEMs working on outsourcing and offshoring of PDD.

[13] Data for ESPs was frozen in Dec 2013.
[14] Bank of England currency rates for 2013 used see Appendix 7.

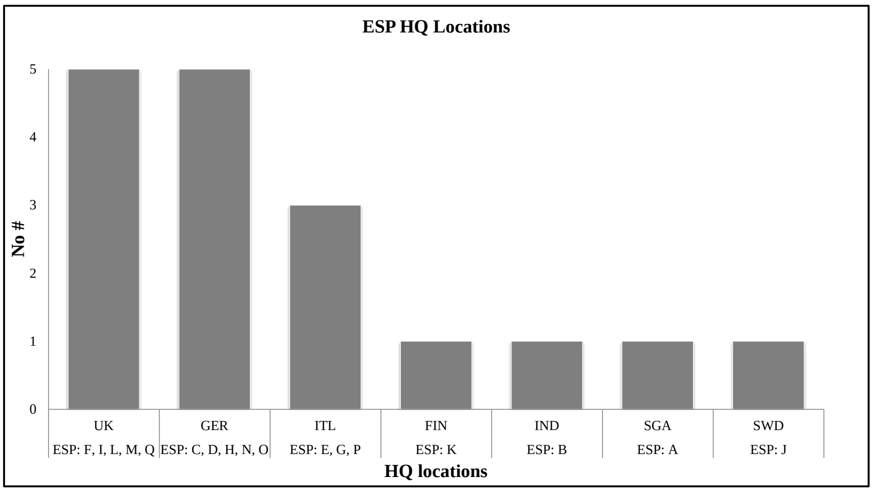


Figure 4.8. ESP HQ Locations (source: author).

In percentage terms, 86.6 per cent of ESPs were based in EU (UK, GER, ITL, FIN, and SWD) countries where the skill levels was more advanced, while 13.3 per cent had HQ locations outside of EU predominately IND, SGA in developing countries with Western organisations setting up low-cost offshore centres.

Figure 4.9 shows an overview of the ESP analysis from the 17 organisations interviewed. 14 ESPs developed OWOS which contained offshoring a mixture of PDD activities in particular noncore/core, one developed a joint venture, two had plans to open a wholly owned subsidiary located in India within 12 months and undecided which PDD activities to offshore.

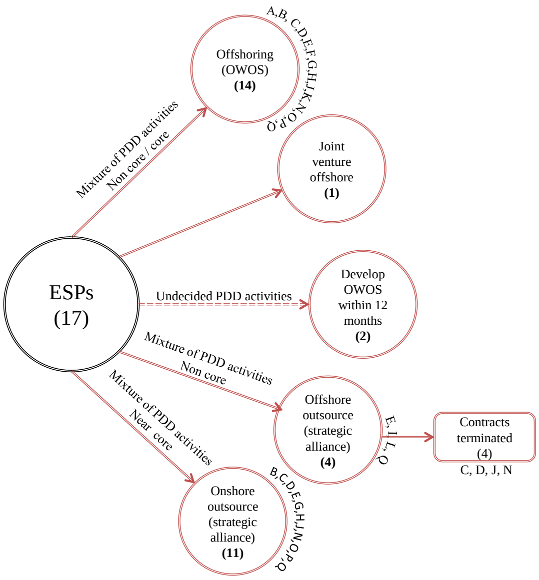


Figure 4.9. Overview of ESPs Analysis.

A total of four offshore outsourcing strategic alliance engagements were conducted with ESPs based in India where a mixture of PDD activities were offshored containing non core activities. There were four contracts terminated as these ESPs did not meet their objectives which are discussed in section 4.5.1.2.

In total 11 of the 17 ESPs engaged with other ESPs based onshore which consisted of outsourcing a mixture of PDD activities in particular near core. These ESPs had been working with other ESPs and classified as competitors.

The ESP empirical findings are analysed separately as outsourcing and offshoring in automotive product development involves a high level of complexity and is difficult when all components are collectively analysed. Thus, the three components within the ESP analysis were identified as the following:

Onshore outsource/outsourcing – ESPs that engaged with third party onshore outsourcing ESPs.
Offshore outsource/outsourcing – ESPs that were offshore outsourcing to other third parties ESPs located in developing countries.
Offshoring – ESPs that developed OWOS in low cost developing countries.

4.5.1. Onshore Outsourcing

The empirical data collected for onshore outsourcing discovered that ESPs based in the same country as the OEM with local engineering offices were more in favour of being awarded small and large PDD contracts (including responsibility for a complete body engineering vehicle program) in contrast to organisations that were typically based in an offshore location. The data collection discovered a new phenomenon for ESPs to implement a decentralise strategy by developing engineering centres close to the customer. For instance, organisations that did not follow such an approach were identified as a risk as the type of PDD activities required a local presence through regular interfacing amongst the key project teams.

From the 17 ESPs that took part in the research, 11 organisations had developed strategic alliances with onshore organisations as indicated in Figure 4.10.

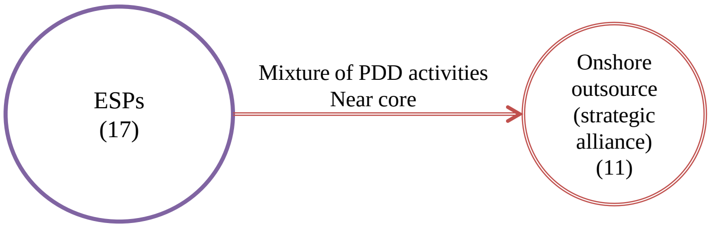


Figure 4.10. ESP Strategic onshore outsourcing.

The PDD activities that were outsourced to onshore organisations consisted of a mixture but specifically near core activities such as complete engineering programs and activities close to the organisations' core competence over the past decade had been retained internally.

These 11 ESPs that developed strategic alliances with onshore organisations, six had short term visions for increasing the resources and reducing costs, whereas the other five had a strategic vision to develop their external organisations.

An outsourcing agreement with an OEM and ESP involves high risks to ensure the engineering and delivery is achieved on time and to a high standard. The OEMs also required on demand onsite engagement from the ESP to ensure stability throughout the development process simultaneously building trust and confidence in the ESPs.

The majority of the ESPs were located within close proximity to the headquarters of the OEM allowing them to be fully coherent and engaged within the outsourcing organisation.

The ESP analysis identified larger organisations with an annual turnover over $469 million were fully embedded on three large engineering programs running concurrently at any time, each with a financial value over $31 million.

OEMs are outsourcing smaller engineering work packets that consisted of model year updates, financially in the region of $1.5-$4.7 million and other testing/development work streams financially from $6.2 million to $12.5 million. The smaller work packets were bundled together which allowed the ESPs to have a better understanding of the product development process.

The larger engineering programs consisted of complete turnkey solutions in engineering design and development coupled with manufacturing of the vehicle. Turnkey contracts for any organisation are the most expensive carrying the greatest risk when outsourcing the product design and development. Complete turnkey projects were financially worth around $156.44 million. For instance, Magna Steyr, a world class leading ESPs and part of the Magna group was responsible for the delivery of the BMW X3 after the concept definition stage was crafted by BMW. The contractual value was in excess of $156.44 million that included the entire PDD along with manufacturing the vehicle at their own facility.

Figure 4.11 illustrates a simplified vehicle launch cycle plan mapping the project development time and the resources required through a number of phases.

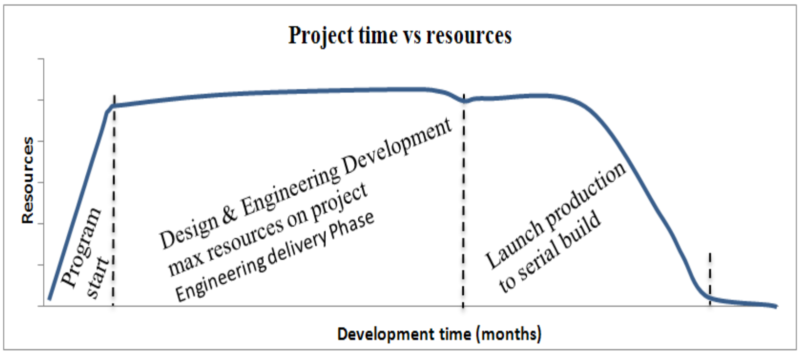


Figure 4.11. Project development time vs. resources required (Source: author).

In a typical project an outsourcing agreement involves a short phase where the OEM develops the programme strategy and a business case study which is presented to the board of directors. The initial phase includes physical clay built model that showcases the vehicle to board members and the extended organisation. This phase usually exists of a small team who develop the vehicle architecture, key characteristics, benchmark data, ride handling, and other important attributes. Once program start is confirmed an aggressive ramp up of engineering resources is initiated to engineer the vehicle from design and development to start of production.

These two stages inevitably require the maximum engineering resources within a project as shown in Figure 4.11 (development time vs. resources). The launch production stage may include physical prototype builds which progressively over several weeks matures into serial production after several quality iterations that could affect the tooling development retaining resources on the projects for longer. Overall the launch phase does not require all the engineering resources as the upfront designing and engineering has already been completed.

When an OEM decides to outsource the PDD phase, one element of the procurement analysis consists of identifying an ESP with the right competencies, capabilities and financial stability to ensure the organisation can survive through peaks, troughs and more importantly survival throughout the project duration. The ESPs interviewed demonstrated that new contracts were awarded to existing ESPs on the basis of building robust reliable reputations with the customer and achieving the project deliverables. For instance an executive at ESP N stated:

> Because we have a good reputation within OEM D globally and also have maintained high quality levels, we are recognised as a preferred ESP. Generally we do not go into massive competition wars whereas on the other side organisations are selecting ESP M a well-recognised Italian company due to their long historical heritage on styling and design. ESP N has the capability of styling and engineering automotive vehicles which leads OEMs to select our organisation.

This statement exemplifies that maintaining high levels of quality for an ESP is significantly critical and the larger ESPs are becoming more capable in developing complete engineering programs.

As OEMs are increasing the product derivatives within their portfolio, ESPs are becoming a key ingredient for the OEM when outsourcing their vehicle PDD activities/development process, gaining larger responsibility for vehicle projects and transferring a large segment of risk to the ESPs. The majority of interviewees stated that complex tasks required their organisations to invest in time and money, where these tasks are retained within the business and kept onshore to allow full control and stability. During an interview with a director from ESP L stated:

> A lot of low-cost stuff is rent a pencil end of market, and what our organisation offers to customers are new insights into different architectures, materials, technologies, which these rent a pencil companies don't. We are currently not offshoring extensively the design process but are in the process of selecting an ESP and plan to offshore only relatively simple tasks.

This quote demonstrates the scalability of ESPs within engineering PDD, firstly low responsibility is rather a quick fix for organisations requiring access to engineering resource and the opposite scale is more complex and thought out solutions requiring a cognitive approach. It further strengthens that ESP L amongst others is also reviewing the offshore process.

4.5.1.1. Outsourcing Drivers

This section analyses the top five key drivers for ESPs when engaging with other external ESPs.

The drivers are presented below and are in order of most cited during the interviews and outsourcing journey.

Engineering capacity – 100% of respondents reported ESPs were outsourcing to external ESPs as their internal capacity was fully utilised. Increasing the product portfolio creates additional complexities for OEMs as they are forced to develop new strategies to deliver the additional product content while remaining competitive and fulfilling their aspirations.

Outsourcing to ESPs can occur when an OEM is over capacity where the internal resource is fully utilised on other engineering programs. As more programs are outsourced to ESPs this creates additional challenges for them to manage the shortage of engineering capacity. A new phenomenon is emerging within the automotive industry where ESPs are working directly with their competitors to overcome the shortage of engineering capacity. An ESP outsources the work from the OEM again, adding further complexities to the outsourcing chain.
During an interview with an executive at ESP C stated:

> We are using smaller ESPs for other activities where we need to free our internal resource. So, for example in Italy we are using smaller companies who can provide engineering services, CAD services, capable of doing small work packages.

This quote highlights that ESPs are becoming more diversified when planning for the future as work that was currently done internally is being outsourced to external organisations who are deemed to be competitors.

Engagement with other ESPs also includes the field of competency where organisations do not have the relevant experience to conduct engineering activities and are more lenient to outsource to other ESPs. During an interview with an executive at ESP G stated:

> We use companies like ESP P specialising in styling for instance and have collaboration with this company. We are working on a large project that has been outsourced to ESP P because we don't have the spare capacity or some key competency required to deliver the project. Currently in 2013 there were two large projects secured from OEMs and both have been outsourced to ESP P.

Further to the comments made previously this quote also strengthens the fact that ESPs are taking a slow approach, but rather consistent to engage with other ESPs.

In another interview with an executive from ESP M stated:

> We have started to work with other companies which are German because these companies know very well our customers, the approach, projects, topics, testing for our business is to have collaboration with these companies as they know our customers better than us due to their long relationship. Outsourcing the development work gives our business the flexibility to leverage internal resource on more strategic and core parts activities. For instance, we used OEM O for the CAE/CAD analysis company for development of closures. This is a rather new development in our field by approaching our competitors and getting them to work with us on a customer project they have probably worked on before.

The comments stated here by ESP M executive again further exemplifies that ESPs will collaborate and approach other organisations which have good relationships with customers on their working products as the knowhow and internal knowledge regarding these organisations is strategically matured.

Cost reduction – 40% of respondents reported cost reduction. The engineering projects were outsourced due to the lack of engineering resources within ESPs. Thus cost reduction when outsourcing the PDD activities was a joint mechanism. Within a project that was outsourced there were a number of tasks bundled together to ensure a competitive cost.

Local presence – 80% of respondents reported outsourcing of PDD activities involved a high level of cooperation and interfacing between a number of departments and therefore a local presence from the ESPs was required.

Engineering capability – 67% of respondents reported ESPs lacked domain capability outsourcing to other ESPs took place. This type of capability outsourcing only consisted in niche areas of the PDD phase and was not identified as an area of emphasis placed by ESPs.

Failed with strategic alliance – 60% of respondents reported the ESPs stated their outsourcing and offshoring engagements had previously failed where their business propositions were not met. Therefore the ESPs revisited outsourcing of their PDD activities but this time conducted a screening process to ensure the external EPSs had sufficient capabilities.

The outsourcing drivers demonstrate that ESPs outsourced as there was a lack of internally engineering capacity/resources to complete the PDD activities. Outsourcing to other ESPs was a new approach that is slowly progressing. The second driver was reducing the labour cost involved with the PDD activities.

4.5.1.2. Outsourcing Challenges

This section analyses the top five outsourcing challenges the 11 ESPs experienced when outsourcing their PDD activities to external organisations.

Communication – 85% of respondents reported the ESPs mentioned that communication was a challenge within their organisations and stemmed from their customers not providing complete information on the PDD activities. Data was missing and interpretations between one person and another was different.

Resistance from customer – 70% of respondents reported the ESPs reported their customers were reluctant in working with their organisations and they faced resistance in obtaining the detail required to complete the PDD activities. The customers did not provide the level of commitment than they did internally. The employees feared their jobs were at risk so a barrier was in place. The ESPs reported their customers were biased towards the fail side, so they could be seen as the savers to outsourcing. There were also minor instances of sabotaging the data before it was sent to the ESPs.

Lack of knowledge transfer from customer – 60% of respondents reported the poor knowledge transfer was due to tacit knowledge not cascaded correctly. Tasks done repeatedly over a long period of time without any formal process caused the external organisations to experience further challenges with obtaining the data. The information within the customer was embedded between people and processes which also took several weeks to obtain fully.

Outsourcing any PDD activities – 75% of respondents reported the ESPs also reported any PDD activity was outsourced which developed challenges. These activities required a new set of skills and knowledge which was not internally available. There was instances where activities had been outsourced because they were too sensitive (core) for external organisations to develop.

Not understanding customers systems and processes – 65% of respondents reported the systems and processes within the customer's location were complicated and took several weeks for the employees to fully understand. A number of training sessions were held but it required practice and experience which took additional time and resources. This was not identified during the start-up due to lack of strategy these organisations implemented.

4.5.2. Offshore Outsourcing

Offshore outsourcing is widely misunderstood as offshoring and both terms are discussed separately throughout this research. In 70 per cent of interviews the researcher had to explain to the differences.
Offshore outsourcing refers to a third party organisation based in a low cost developing country providing engineering services to automotive organisations.
An offshore third party ESP is located in a low cost country and usually has the facilities required to undertake PDD activities. A typical offshore outsourcing engagement is where an ESP is located in Europe who offshores PDD activities to a third party service provider usually consisting of a lower labour rate and supports PDD activities.

From the 17 ESPs interviewed four developed strategic alliances with offshore outsourcing and a mixture of PDD activities were offshored in particular non core as shown in Figure 4.12.

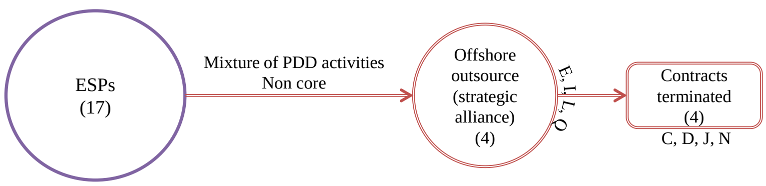


Figure 4.12. ESPs offshore outsourcing.

Automotive organisations that were in the process of reducing costs after exhausting potential cost reduction activities used offshore outsourcing for PDD as one method to become more competitive in the market upon bidding for new contracts and cutting costs of work in progress projects. Organisations relatively new to offshoring had little experience and wanted to increase engineering capacity over a short period of time were more in favour of engaging with an offshore ESP than developing a wholly owned subsidiary as there was high costs involved.

However, there were four ESPs that terminated their offshore outsourcing contracts a few years into the engagement. These organisations took a poor approach to offshore outsourcing their PDD activities as shown in Table 4.4.

An in-depth case study of ESP D is further developed in section 5.5.

ESP	*Reason for contract termination*
ESP C	Insufficient knowledge applied to start of contract, random PDD activities offshored.
ESP D	Lack of management support during the initial phases of the contract, no decision making model used.
ESP J	Poor decisions made ad-hoc style causing catastrophic failure on the PDD activities.
ESP N	Management conflictions due to no strategy or process used upfront during engagement.

Table 4.4. ESPs – Contract termination when offshore outsourcing (source: author).

In total, eight ESPs that engaged with offshore outsourcing organisations had inadequate strategies and decision-making processes. These ESPs developed offshore outsourcing engagements as the cost of developing a wholly owned subsidiary was rather significant. The benefits of choosing an offshore outsourcing service provider were the increase to the internal engineering resources which reduced the PDD costs. It further strengthened their offshore experience.

In all eight ESPs there was no identification or classification of PDD activities which added further challenges when offshore outsourcing. The ESPs terminated their contracts as offshore outsourcing was developing towards a negative cost. The organisations did not meet their objectives created through weaknesses during the decision-making process.

However, the two of the four organisations were only two months into the engagement with their ESPs and are at the start of a long and challenging journey. From the four ESPs analysed one had a long term plan and was satisfied with the outcome.

4.5.2.1. Offshore Outsourcing Drivers

The top five key offshore outsourcing drivers are analysed when ESPs offshore outsource their PDD activities to third-party service providers. These drivers navigated the ESPs to engage with other ESPs and are presented in their most cited during the interviewing/coding phase.

Cost reduction – 80% of respondents reported cost reduction during the interviews as organisations were striving to reduce the engineering development costs by offshoring work packets to low-cost countries by engaging with a third-party organisation. In total eight ESPs stated cost reduction as a key driver for them to develop an offshoring engagement. Offshoring PDD activities also enabled the ESP to maintain competitiveness in the market. An example of cost reduction was expressed during an interview with the director at ESP N mentioning:

> Our biggest driver to engage with a third party was based on reducing our overall costs, but in particular the engineering PDD costs. The offshore rates are cheaper than our onshore employees so we have taken this opportunity and given the customer a discounted price.

Customer Driven – 50% of respondents reported customers are driving ESPs to reduce costs and one method is through offshoring elements of the product development phase. An executive at ESP N stated:

> OEM D requested our business to have a presence in India so we engaged with a third party where the objectives did not coincide with our original proposals.

No upfront investment – 40% of respondents reported the ESPs highlighted that minimal investment was required as compared when developing an OWOS. This was critical for organisations that were reluctant to invest in offshoring. During an interview with the executive at ESP I who clearly demonstrated:

> The business did not have the sufficient funds to develop an OWOS, it was ideal for us. If we invested and develop our OWOS, there would be cash flow constraints within the business.

Engineering capacity – 70% of respondent reported the ESPs are offshoring to take advantage of the highly educated people in low-cost countries (India) and the availability of labour. The availability of labour gives onshore organisations the advantage to extend their engineering workbench by engaging with third-party companies in offshore locations as their internal capacities cannot fulfil the demand required. An executive at ESP D stated:

> We were able to increase our engineering capacity by having access to available educated workforce.

Retain competiveness – 65% of respondents reported the ESPs stated offshoring the PDD activities to external organisations enabled them to retain their competitive position in the ESP sector by saving in development costs that would normally be at EU rates. The employees in EU facilities where the cost of labour was higher enabled these ESPs to concentrate on activities requiring a high level of skills and competence. During an interview the executive from ESP I stated:

> We use our offshore ESP in India to lower the price on engineering projects and become more competitive. However, we still don't have a real plan with this offshore ESP but gives us the flexibility when leveraging onshore/offshore costs

Offshore outsourcing drivers were primarily driven by reducing cost from the organisation in particular the PDD costs that was associated with pure engineering development. The cost savings had been cascaded to the customer, where the customer is also demanding ESPs to develop low-cost engineering development enabling them to reduce the overall engineering cost of a product.

As more projects were secured at ESPs the internal engineering capacity was engaged on other activities so additional capacity was required and acquired from the offshore outsourcing organisations providing a highly educated additional resource.
ESPs that engaged with offshore organisations had minimal upfront investments which created added value for these organisations to experiment with offshoring at low risks.

4.5.2.2. Offshore Outsourcing Challenges

The top five key offshore outsourcing challenges are analysed in chronological order, the most cited during interviewing/coding phase.

Communication – 90% of respondents reported communication was the most challenging factor when ESPs offshored their PDD activities. For instance during an interview with the engineering director at ESP I stated:

> We have been offshoring for over six years to a third-party organisation and still to this date (from 2006 to 2012) we are refining our communication issues.

During various interviews all six ESPs stated that:

> Employees in offshore centres in India and China would say "yes yes yes" to everything and we think that's what they mean, but after they deliver their work packages, we have found out that this does not mean "yes yes yes".

Controlling offshore – 75% of respondents reported the offshore provider can become difficult when trying to achieve the objectives. An executive from ESP N stated:

> I would not do a third party ever again as there are too many risks involved. Look at FTS G just brought out the joint venture with OEM Q in India (was 50:50), now fully owned by FTS G as the management dedication and commitment was on a different level to the customer.

Management commitment – 60% of respondents reported the onshore and offshore organisations had different visions and objectives which created turbulence during the offshoring journey. An example of this emerged during an exhaustive interview with a director at ESP L stating:

> We found out that most of the companies we spoke to were not honest about the gaps in their knowledge base; say for example if there was something in the RFQ that they were lacking in terms of knowledge, they would not say to exclude this work. They will just say the obvious yes we can do that, and it's not a problem. I think it comes down to cultural issue, they were saying yes yes yes we understand the work and half way through the project you can see

things are going wrong, but they still declare yes all if fine; everything is great. They are not brave enough to say I'm sorry it is out of my depth, they never ask for help and management are not fully committed in changing.

Lack of skills – 80% of respondents reported the ESPs experienced challenges with employees based in offshore ESPs had a knowledge gap that created difficulties when working on engineering projects for the onshore organisations as additional training and mentoring took place over a period of several months. The director at ESP N mentioned:

> We have spent hundreds of hours training the people offshore on how to work with our organisation. The offshoring process takes time and there is no easy fix for companies to gain benefits overnight.

Rework of data – 85% of respondents reported the rework of data was still rather high in the region of 20 per cent requiring more time from the onshore organisation to teach and coach the offshore organisation through various stages of the design process. An example of this was mentioned during an interview with an executive from ESP G stating:

> We used offshoring predominantly for costs reduction as the hourly rate was cheaper than our engineers based locally or in nearshore locations. On paper the hourly rates look rather interesting and can provide a significant cost reduction to the organisation, but in real life the onshore cost increased because of hours required for reworking data that was incorrect.

Frustrations – 45% of respondents reported the onshore organisations easily became frustrated with offshoring and "just give up". Offshoring when implemented is more difficult to practise and maintaining momentum once traction was lost became difficult for the teams due to additional time required for coaching and mentoring than their peers based in home countries. During an interview an executive from ESP I stated:

> Offshoring takes time and patience the easiest solution when offshoring becomes difficult is to pull out, and not continue further. However, the amount of effort and time we put into offshoring has become rather exponential, and sometimes the organisation does think it's taking too much time and effort from our managers let's cut our losses and stop. Thus, we have invested significantly with offshoring and have identified this as long-term.

The main challenge when ESPs offshore outsourced to external organisations was communication limitations and the lacking ability to understand engineering principles. ESPs experienced difficulties to control the offshore centres as the management dedication and commitment had not coincided with the onshore organisation. The offshore organisations, after engaging with ESPs, lacked the ability to support on engineering activities as employees had less work experience meaning additional time and resources had been deployed leading to data not being reworked a number of times before it was correct. All ESPs reported offshore outsourcing was difficult and internal employees became rather frustrated creating a negative culture.

4.5.3. Offshoring

Offshoring is where the parent organisation develops a wholly owned subsidiary in a low cost destination (also referred as a developing country) located a few thousand miles which is clearly distinguished from onshore, nearshore and offshore outsourcing. Offshoring can be developed by any organisation but in the context of this research is typically developed by automotive ESPs.

The ESPs analysed as part of this research had locations dispersed globally with local engineering centres within a short proximity from the customer. In total 17 ESPs took part in this research study and 14 developed their OWOS with two ESPs having business plans for developing their OWOS within 12 months as illustrated in Figure 4.13. This involved the parent organisation offshoring a mixture of PDD activities in particular non core activities. Some activities were backsourced as the skill involved was not present within the OWOS.

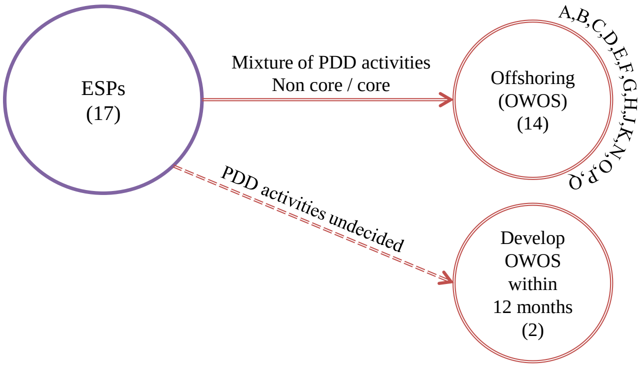


Figure 4.13. ESPs with wholly owned subsidiaries offshore.

A number of ESPs have selected different locations when developing their OWOS[15] and considered to offshore the PDD activities as identified in Figure 4.14.

Five individual locations had been selected where 22 OWOS were developed in multiple locations by the 14 EPSs as showing in Figure 4.14. However, it must be acknowledged that more than one offshore centre was developed by a ESPs.

[15] The ESP subsidiaries are a pure representation off engineering centres where only engineering work is carried out. There are many subsidiaries based in low-cost countries which are branded as engineering centres but factually contribute to 5 – 10 per cent of their total work activities to engineering.

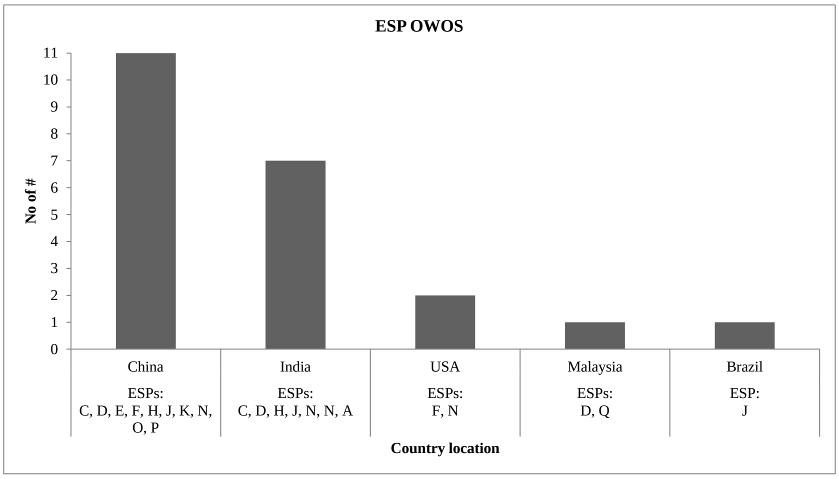


Figure 4.14. ESP OWOS. (Source: author).

The data collected demonstrates China and India as two independent countries were used more than USA, Malaysia and Brazil. Company's operating in Brazil are subject to 34 per cent taxation when profits are taken out of the country causing hesitation amongst automotive organisations to develop wholly owned subsidiaries. ESP B has not been shown on Figure 4.14 as there were various locations in different countries and there automotive engineering content was marginal compared to the other ESPs.

In total 14 ESPs had developed OWOS in developing countries to take advantage of the low labour rates. There were 10 ESPs that implemented a long term approach after learning that short term benefits when offshoring leads to excessive challenges which are expensive and resource draining. The 10 ESPs developing a long term strategy still faced the same challenges as discussed in section 4.5.3.2.

The other four ESPs had no strategy and were struggling to maintain employees, develop quality innovative solutions and the OWOS was draining additional resources than expected.

4.5.3.1. Offshoring Drivers

The top five key offshoring drivers are analysed within the ESPs. The analysis from this study discovered a number of driver's organisations took into account when deciding to develop their OWOS. These are discussed below and are in order of most cited and recorded during interview and coding phase.

Cost reduction – 90% of respondents reported OWOS were developed to reduce the overhead costs associated with the PDD and simultaneously bundling other back office tasks namely to mention IT activities and other non-core work. During an interview with ESP D the CEO mentioned:

> Customers are driving ESPs to reduce costs which in our case the only option was to develop a low cost engineering centre where hourly rates are much cheaper than Germany.

Engineering capacity – 80% of respondents reported the ESPs interviewed demonstrated the local engineering centres were fully manned up using a combination of full-time employees and contractors that enabled them to leverage staff if unexpected conditions occurred such as economy downturns, projects being cancelled and customers capping outsourcing limits. The driver to develop an OWOS was the number of projects secured versus the people required was exponential so an extended capacity bench model was used in parallel to the current organisational engineering resources. The use of this model allowed ESPs to leverage their workload with onshore/offshore teams, secure further projects from the market and ensured the parent organisation concentrated on more high-value innovative activities. Overall the extended capacity bench allowed the ESPs to leverage its internal resource to focus value adding activities.

Protect IP – 75% of respondents reported an OWOS gave the advantage over a third-party organisation when protecting the IP rights and ensured there was no leakage of engineering work to third parties as in the case of offshore outsourcing. During an interview with ESP F' a senior engineering executive stated that:

> If we teach other people not belonging to our business we are going the wrong way and this will have significant impacts on the business, therefore when we use external service providers extreme care is taken to ensure we don't teach them our business. We had to be very careful what we tell them and how our knowledge is transferred across.

In another interview an executive from ESP N stated:

> The offshore third-party engineering centres based in India just want to learn your work and then target your customers so they can win future business. We secured a contract with a large OEM, and we found out several months after our engagement the third party approached the OEM without our consent offering the same services cheaper than ESP N.

These statements provided by different organisations that engaged with an offshore third-party provider discovered that these organisations had different objectives from the outsourcing organisation and management teams were a key component to success of the contract.

Control – 80% of respondents reported they developed an OWOS centre which enabled the organisations to gain full control on the daily running of the business and understand how the offshore organisation is managed. During an interview with the vice president from ESP M stated:

> We are looking at opening a facility in India but we are in very early stages. The main reason for opening our own OWOS was to gain control after losing out on cost with an offshore third party. We subcontracted some engineering work to OEM Q based in India, what stops this company going out directly to the customer and winning this work. We need to control our own centres and not let them be run by third parties.

In another interview with an executive from ESP I mentioned:

> We have had a number of problems with third-party providers where they do not deliver, not fully understanding our commitments to the customer and a lack of people are employed on our projects. In reflect to this, I would definitely go down the OWOS route as the cost offshoring cost has been rather expensive taking into account the additional activities.

The interview quotes provided here do not count for all 17 ESPs that were interviewed; however 14 ESPs developed OWOS with four ESPs that terminated their contracts with third-party offshore providers with controlling the offshore centre a crucial element in the decision-making between offshore outsourcing and offshoring.

Failed with offshore alliances – 35% of respondents reported their organisations failed with offshore strategic alliances. In total there were four ESPs that failed with their offshore ESP alliances. The key failures are presented in Table 4.4 which forced these organisations to develop their OWOS whereas the other ESPs developed them from start.

The offshoring drivers identified cost reduction was the primary motivation for ESPs to develop their offshore centres and the lack of internal engineering resources these organisations encountered. ESPs faced difficulties in retaining their IP rights when engaging with offshore third party ESPs even after signing nondisclosure agreements as information sharing became rather hesitant. ESPs experienced challenges with controlling and managing an external organisation which was resolved after developing an OWOS.

4.5.3.2. Offshoring Challenges

The findings illustrate offshoring challenges experienced by ESPs and are discussed in order of most cited recorded during interviewing and coding phase.

Communication – 100% of respondents reported they experienced communication challenges with their offshore engineering centres. The communication barriers ranged from understanding simple engineering tasks to more complicated activities for example a complete vehicle design was not possible to run from a remote location.

Rework of data – 100% of respondents reported their quality of work from their offshore organisations required additional reworking in excess of two or three iterations before the engineering activities were deemed acceptable. The quality of work submitted from the OWOS was rather low compared to their Western counterparts in the parent organisations. An example of this was during an interview with the CEO of ESP D who mentioned:

> Our challenge is to take care of the right quality and not to rework much of the design that is coming from the offshoring centres. Currently we are spending about 20 per cent of our time reworking the design work.

Another example of reworking emerged during an interview with the engineering director at ESP J who stated:

> The work quality was poor. These people in offshore centres have very little experience and their mind-sets and cultures are so far behind our European parent. We are still educating the offshore centre in how to develop quality within the product design and using expats to improve quality.

Management trust – 70% of respondents reported the offshore OWOS were located thousands of miles away from the parent organisations and maintaining management trust within the OWOS was rather difficult.

The ESPs reported that their OWOS were not managed efficiently as the offshore management teams lacked the capability and drive required to operate an OWOS. The 14 ESPs who developed their OWOS reported management attitudes and timing was rather relaxed compared to the parent organisations. Work packets that required delivering on certain milestones were late and the ESPs expectations had not been achieved.

An example of management trust emerged during an interview, when the CEO of ESP D stated:

> We found that some of the Indian managers were transferring money into their own accounts and did not care about the offshore facility. You need an honest person in charge of these engineering centres who understands offshoring and how EU companies work in particular German companies.

Another example of management trust was mentioned during an interview with the engineering director at ESP C stated:

> We need to gain trust from the management and also key management who are capable of driving such changes and managing an offshore centre. The people are a key activity when developing an offshore centre. Also timing when jobs are to be complete has a different understanding in India, they took much of a laid back approach. How you define and annotate is completely different in India and Europe.

A further example was mentioned during an interview, the engineering director at ESP J stated:

> The Indians would say yes we can do the work purely because they are hungry for the work they are not being honest with you. End of the day they cannot do it and the result that comes back is totally wrong. People under estimated the cost of being late, when offshoring doesn't go right and it is late the people do not calculate the costs accurately as the cost of delay upsets the whole business.

Control – 75% of respondents reported the OWOS provided better control from the parent organisation as they were able to interrogate the management teams and also understand the types of activities conducted offshore. As for diagnostics was available on the rates per employee, hours spent on activities and were the key bottlenecks during the PDD phase. This information was camouflaged with an offshore outsourcing organisation declaring smooth running of their engineering centres.

Employee attrition – 45% of respondents reported the ESPs experienced difficulties with retaining their employees as the OWOS had high attrition rates in excess of 10 - 15 per cent. An example of employee attrition emerged during an interview with a senior manager at ESP J:

> The problem we have experienced is you can build a relationship with someone and then you find at the end of the week they are leaving the company.

Another example of employee attrition was mentioned during another interview, the CEO ESP D mentioned:

> We need to build a stable team as there is much fluctuations with offshoring as you know in areas of India is higher than EU. Training relevant people and promoting them has worked in some instances but there are companies down the road that are offering better salaries making it a motivation for our employees to leave and join them. As a business this creates challenges as the experience people leave and we are faced with reintroducing training and coaching.

The offshore challenges experienced by ESPs was communication issues with the offshoring organisation which stemmed into additional reworking of engineering activities as the communication between the onshore and offshore was unclear and capability was lacking offshore. ESPs also face difficulty with trusting management in their offshore centres as they had identified the local management running these OWOS were crucial to the success. In addition to these challenges ESPs faced difficulties with retaining the people who were also key enablers to make offshoring work.

4.6. FTSs Analysis

The FTSs analysis compares the empirical findings from 13 independent organisations interviewed as part of this research study. Each interview within the ESP industry had durations of 1.5 hours on average, the breakdown of each organisations HQ location, annual revenue and automotive revenue is presented in Table 4.5. The data construed within this table has been extracted from Appendix 9 detailing a further compressive review on each organisation. From the 13 independent FTSs interviewed employees ranged from 9,000 to over 281 thousand, with annual revenues between $2.3 billion to $61.1 billion.

# no	*Company FTS*[16]	*HQ Location*	*Annual revenue ($million)*[17]	*Auto revenue ($million)*	*Number of Employees (2013)*
1	FTS A	GER	44,230	26,578.10	103,217
2	FTS B	UK	16,463	11,543	160,000
3	FTS C	USA	16,200	12,000	122,300
4	FTS D	USA	6,769	2,549	23,000
5	FTS E	GER	61,171	40,401.20	281,381
6	FTS F	FRN	23,939	8,695.20	97,419
7	FTS G	USA	42,700	21,350	170,000
8	FTS H	GER	6,240	5,020	21,989
9	FTS I	CND	34,835	23,332	125,000
10	FTS J	SWD	8,803	8,101	52,000
11	FTS K	FRN	6,805.10	7,478.13	22,000
12	FTS L	USA	2,387	2,000	9,000
13	FTS M	USA	5,200	4,850	26,000

Table 4.5. FTSs Analysis (Source: author).

The FTSs analysis consisted of 20 interviews conducted across 13 independent FTSs organisations with headquarters in 6 different countries as indicated in Figure 4.15. The HQ locations included USA, GER, FRN, UK, CND, and SWD. These organisations also had subsidiaries in global locations where they had setup complete manufacturing and design capabilities to support the local OEMs.

[16] Data for FTSs was frozen in Dec 2013.
[17] Bank of England currency rates for 2013 used see Appendix 7.

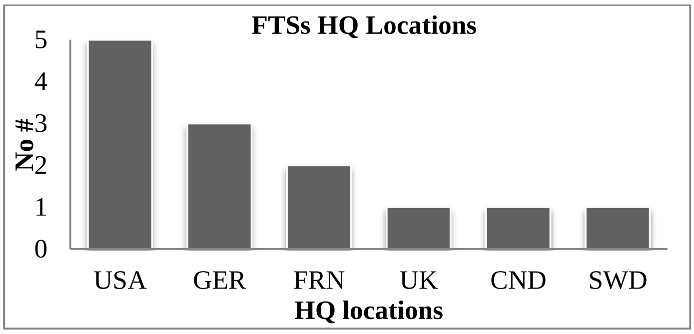


Figure 4.15. FTSs HQ locations (Source: author).

Figure 4.16 identifies the FTSs overview from the 13 organisations interviewed. 11 FTSs developed OWOS which contained offshoring a mixture of PDD activities in particular noncore/core, two developed a joint venture, three engaged with offshore outsourcing organisations also offshoring a mixture of PDD activities in particular non core. In total five FTSs terminated their contracts with offshore ESPs as their PDD activities and strategies were ever changing and costs had spiralled out of control where OWOS had been developed.
Eight were onshore outsourcing near core PDD activities followed by a mixture of tasks.

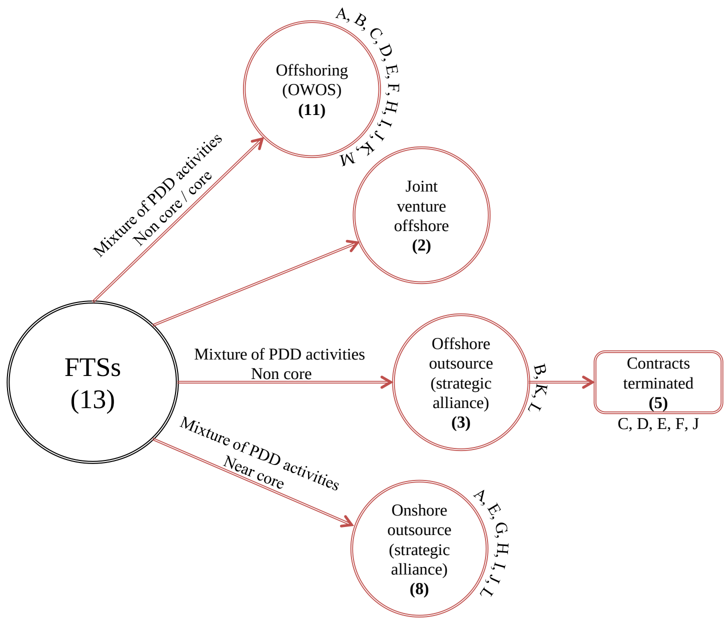


Figure 4.16. Overview of FTSs Analysis.

4.6.1. Onshore Outsourcing

A total of 13 independent FTSs organisations took part in the research study. The onshore outsourcing within FTSs consisted of organisations outsourcing their PDD activities to ESPs located in the same country. In total there were eight FTSs that engaged with strategic alliances based onshore as indicated in Figure 4.17.

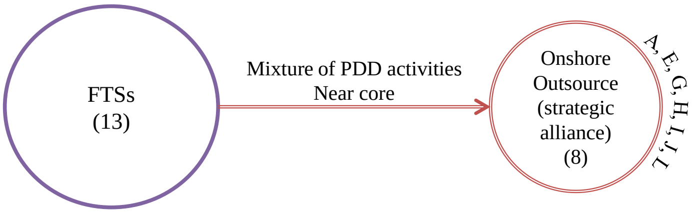


Figure 4.17. FTSs Strategic Alliance Outsourcing Onshore

All eight FTSs outsourced near core PDD activities followed by a mixture of other activities to their strategic alliances based onshore and had development offices close to the customer. These organisations also had other methods of delivery which are discussed in this chapter. The onshore outsourcing drivers from these organisations followed by the challenges are now discussed.

The FTSs were situated in the same country as their customers and of the eight strategic alliances based onshore six had long term plans whereas the other two developed a short term strategy based on increasing their engineering resources and reducing costs. The short term strategy lack the detail to attention and analysis on which activities these organisations could outsource.

4.6.1.1. Onshore Outsourcing Drivers

Engineering capacity – 100% of respondents reported the amount of people employed by the FTSs reached their maximum capacity and all other options were exhausted before outsourcing to onshore strategic alliances. The research discovered all FTSs who engaged with a strategic partner outsourced their near core PDD activities to these organisations and also a mixture of other activities as these activities had not been classified into what could and could not be outsourced.

During an interview, the vice president from FTSs A stated:

> I can rely on the capability of our counterparts here onshore then I can in an offshore location. As I am responsible for PDD within the organisation I would typically send our high-level interaction activities to onshore to dig alliances than sending the development to organisations which are thousands of miles away from us.

During an interview the vice president from FTSs A stated:

> I can rely on the capability of our counterparts here onshore then I can over in the offshore location. As I am responsible for PDD within the organisation I would typically send our high-level interaction activities to onshore to ESPs than sending these activities to organisations which are thousands of miles away from us.

During an interview the engineering director from FTSs C stated:

> We thought our business had the capability to conduct PDD activities to our wholly owned subsidiary based offshore. What we didn't do is take account of the level of interaction each activity has and what are the implications of moving this activity away from our development office. Therefore these activities were backshored from our offshore subsidiary which resulted in additional costs, resources and further complexities during this process. Throughout this learning stage we have decided to retain our near core activities onshore and use strategic alliances onshore than any offshoring.

Cost reduction – 50% of respondents reported cost reduction was becoming a major factor when outsourcing locally to external organisations and therefore the lack of engineering resources along with cost reduction had been important. The cost reduction had been developed from bundling a number of activities and outsourcing to external organisations who had the relevant experience and knowledge where were carried out cost effectively.

Local presence – 70% of respondents reported that outsourcing activities that involved a high level of engineering competency and skills required the FTSs identified a local presence for an external organisation was very important. This improved the communications and reduced the amount of error between the two organisations.

Engineering capability – 75% of respondents reported the FTSs as part of their on-going growth and the vast number of projects being secured many had a shortage of engineering resources. This created complexities for these organisations as the internal engineering capacity was full utilised so external onshore service providers were used to smooth the peak work demand.

Failed with strategic alliance – 65% of respondents reported the FTSs were outsourcing/offshoring to external ESPs where the engagements did not surface through leading to the organisations engaging with other external organisations to overcome the challenges and weaknesses they experienced.

4.6.1.2. Onshore Outsourcing - Challenges

The challenges highlighted are taken from all eight FTSs interviewed on outsourcing their PDD activities. The challenges the organisations faced are discussed below.

Communication – 70% of respondents (eight FTSs) reported they had communication challenges when outsourcing their PDD activities to ESPs which consisted of general understanding of what was required for a given activity and the overall attention to detail on activities.

Resistance to work with ESPs – 70% of respondents (eight FTSs) reported some instances of resistance when working with ESPs as they were identified as being more powerful and knowledgeable on products that our internal staff on one large programme that was outsourced from OEM to an ESP in particular a number of FTSs refused to work with the ESP for several months as they were viewed as competitors or an organisation that does not understand an OEMs automotive activities. During an interview a senior manager from FTSs G mentioned:

> *We were working on a large programme with an OEM that had been outsourced to an ESP developing the interior trim but we did not know who was ultimately responsible and therefore we did not work efficiently with this ESP. After several months into the project we slowly came to terms with outsourcing of a large programme.*

Additional resources required to manage people – 70% of respondents (eight FTSs) identified they had additional challenges with managing an ESP because they did not understand the FTSs processes or systems and therefore they had to deploy additional resources to manage these people.

Outsourcing any PDD activity – All 13 FTSs (70% of respondents) interviewed highlighted PDD activities had been sporadically outsourced to ESPs as there were no apparent methodologies or processes when deciding on which activities were outsourceable and most decisions made were ad hoc on the spot. This resulted in a number of activities across the value chain to be outsourced including core competencies where over a period of time some ESPs became fact holders or keen knowledge enablers with the business.

Poor knowledge transfer – All 13 FTSs (100% of respondents) interviewed identified the knowledge transfer between FTSs to the ESPs which was conducted at a working level lacked the level of detail required to carry out the PDD activities as the employees did not have sufficient training on how to work with an ESP and how to create work instructions.

4.6.2. Offshore Outsourcing

From the 13 FTSs organisations interviewed three FTSs (FTSs B, K, and L) engaged with offshore outsourcing organisations to support their PDD activities/engineering development as shown in Figure 4.18. The three FTSs offshore outsourced a mixture of PDD activities in particular non core activities were mostly offshored.

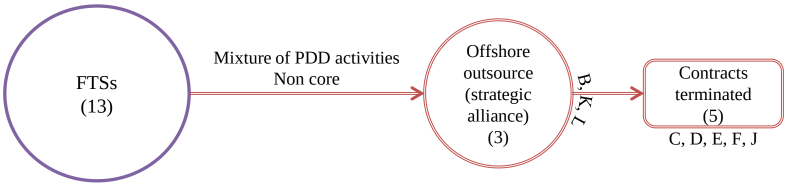


Figure 4.18. FTSs and offshore outsourcing.

Interestingly there were five offshore outsourcing contracts terminated where PDD activities were carried out. The five FTSs experienced challenges during offshore outsourcing the PDD activities which resulted in the FTSs to develop their OWOS. However, there were complex challenges before such a decision was made. These challenges are presented in section 4.6.2.2 which also included lack of management support from the offshore organisations, no decision making strategy from the FTSs, no strategy as to which activities were offshoreable and poor decision making in general.

The three FTSs B, K and L were only 10 months into their offshore outsourcing of PDD activities and had plans after the engagement period to invest into their own OWOS or if the complexities were not resolved the contracts to be terminated. Two were based on short term strategies and one based on a long term plan.

All offshore outsourcing ESPs were based in India where the PDD activities were carried out for the customers globally.

4.6.2.1. Offshore Outsourcing Drivers

FTSs used the following drivers when engaging with offshore outsourcing ESPs to provide PDD activities for the parent organisation. These drivers are presented in the most cited during interviewing and most experienced on their journey.

Cost reduction – This was the primary driver in all eight (including the five terminated contracts) organisations interviewed as the cost of labour was rather high which spurred customers to look elsewhere and approach competitors. 75% of respondent's reported cost reduction when interviewed. The cost reduction route steered these eight organisations to engage with an ESP offshore. An example of this emerged during an interview with the vice president of FTS G stating very clearly:

> India was really developed because of labour intense jobs such as CAD, CAE for example where the rates to conduct these jobs onshore is very expensive. Customers today are demanding the development costs to be low as possible forcing our business

> and all other organisations in the same field to look at reducing the engineering costs one route for us was to engage with and offshore ESP who could support in cost reductions.

Customer driven – 60% of respondents reported their customers required an element of LCC sourcing to reduce the engineering development costs as paying onshore rates was rather excessive. An example of this was mentioned during an interview when a VP of engineering at FTS G mentioned:

> One of the key reasons for going through a third party was the demand from the OEM (customer) that we need to reduce our engineering cost and one method into reducing the cost was to go into low-cost countries.

No upfront investments – 55% of respondents reported no upfront investment was required when offshore outsourcing to third party organisations. All eight companies held back investing in offshoring into a country of unknown expectations, limited knowledge and risks were deemed to be high. Thus, engagement with an offshore outsourcing ESP meant these organisations did not invest upfront. This was expressed in a number of interviews undertaken with eight FTS, in particular the engineering director of FTS F who mentioned:

> We engaged with an offshore ESP purely as there was no upfront investment and the business in an offshore centre with experts that had already established their business and have the learning through their offshoring process. When going offshore, developing a new wholly owned subsidiary can become rather expensive if a business fails or does not meet the expected objectives outlined. The safest route was to engage with an offshore ESP.

Engineering capacity – 65% of respondents demonstrated that their engineering capacity was engaged on programs and as more projects were secured with different customers, internal engineering resource became an issue. An example of this was highlighted during an interview, the vice president at FTS H responsible for engineering mentioned:

> We have used offshoring as our internal engineering capacity became an issue due to our employees who were spending considerable amount of time on non core work which could be done offshore and for them to concentrate on more value adding content. Therefore we decided to engage with an offshore ESP to smooth the work content throughout our business.

Retain competiveness – 40% of respondents stated their competiveness position was improved by offshoring the PDD activities to an external offshore ESP based in a low cost country giving them advantages over competitors to reduce the engineering costs ensuring the high wage employees concentrated on activities that created the most value for these organisation.

The offshore outsourcing drivers were primary based on cost reduction within the organisations. All FTSs based their business plans on reducing the hourly cost per person to become more competitive and grow the business. FTSs were reluctant to develop OWOS as they required a significant amount of upfront investment whereas engagement with a third-party service provider required no upfront investment and created an incentive driver for these organisations.

The amount of projects secured by the FTSs meant internally the engineering resource became fully utilised and engaging with a third-party offshore outsourcing organisation allowing them to smooth the peaks and troughs. Employees were brought at a lower cost base compared to the onshore employees. Costs were also an important factor for the customer to demand their FTSs to have elements of LCC and overall reduce the engineering development costs.

4.6.2.2. Offshore Outsourcing Challenges

The offshore outsourcing challenges outlined are from the in-depth interviews that occurred with all eight (including the terminated contracts) FTSs engaging with offshore ESPs then subsequently developed their engineering OWOS. All organisations experienced similar challenges when globalising their engineering activities which are outlined below and categorised in ranking of most cited during the interviewing and coding analysis.

Communication – All eight FTSs (90% of respondents) interviewed highlighted that they faced communication challenges with all of the ESPs. These challenges varied in their scope and depth in terms of how the interaction was conducted with these organisations. The communication difficulty from FTSs was regarded as an important area of improvement to succeed with the offshore outsourcing organisations. However, these organisations improved their communications over a number of years but there were still difficulties between the two organisations because their strategic visions were not aligned and the two organisations had different objectives.

An example of communication challenges occurred during an interview with the engineering director at FTS C:

> The level of English speaking in India is now good, but when we started there was an expat sitting on the conference calls who would communicate making it easier to understand. He would also locally describe our requirements to the team offshore.
> China English is very difficult to understand, once you spend sometime over conference calls, you automatically adopt a method which enables you understand.

Another example emerged during an interview with the vice president of engineering at FTS J who mentioned:

> With communications we had problems with language in the receiving end, for instance in our Japanese example that required the offshore people in India to speak this language was clearly an issue. Talk about Japanese OEMs the majority of information is in Japanese that required translation when offshoring work to India as an example they do not know any Japanese and this became a challenge in communication. We improve this by putting the problem on the table and the easiest way to resolve the problem was to hire Indian engineers with the capability of speaking Japanese, and in other areas it was making sense to use a translator. One of the good things about India is the English language skills.

Additional time in managing people/management – 70% of respondents reported they all had difficulties in managing the third-party organisations as more time was spent repeatedly

ensuring the management was committed in delivering the projects and ensuring availability of people. FTSs management team spent more time in managing the external organisations than conducting value added activities internally.
One example of this occurred during an interview with the engineering director at FTS C who mentioned:

> We had to get them to understand our methodologies, behaviour and work streams. The biggest issue was we spent more time managing the external vendors than doing the work ourselves. The whole process of billing, ensure you got value for money, the hours were difficulty, cascading the information, communication infrastructure was difficult. We worked with the offshoring organisation but they did not change their behaviour and attitudes so we pulled out the contract and develop our own OWOS.

Cascading of information – 100% of the respondents interviewed across the FTS organisations reported that their employees were not trained or not aware how to cascade information to external organisations and how supporting documents help the engineering activities progress during this phase. These companies invested time to get this right but challenges still occurred during the offshoring journey.

An example of this emerged during an interview with the vice president of engineering at FTS J who mentioned:

> Our offshoring failed because our work packages were not sufficient and not detailed enough. You need to have a very clear, streamlined process when ordering and delivering the work otherwise you would just fail. This meant that we did not give clear boundaries, work was not fully defined, and specifications were incomplete along with other forms of incorrect information. We lost a lot of time in sending work packages backwards and forwards due to the quality not being correct, this is because FTS J did not correctly specify the work packages and also the ESP was not requesting additional information.

In another interview, the engineering director at FTS C mentioned:

> We offshored engineering development work and sent incomplete specifications, information to the third-party organisation based in India. We have really failed here because our organisation and employees did not have the mentality or education to disperse their engineering activities to an offshore organisation.

Reworking of data – 70% of respondents reported they had between 15 - 20 per cent of offshore activities reworked as there were additional challenges during the journey. These challenges are highlighted in this section but mainly it involved the lack of understanding from offshore ESP and lack of knowledge from the FTSs.

Developing capability – 100% of respondents reported developing capability offshore with an ESP was very difficult and challenging. The PDD activities offshored from the FTSs included a range of non core to core which was critical to the organisations success. These activities were not retained internally and therefore it was difficult to develop capability with an external organisation because the offshore ESPs were becoming the fact holders. These sensitive core activities were backshored activities were developed in the FTSs wholly owned offshore facility.

The offshore outsourcing challenges identified that communication was the first concern for the FTSs they experience when offshore outsourcing their PDD. FTSs experienced challenges with the management team in various offshoring outsourcing organisations and this created additional complexities and additional activities that required resolving from the onshore organisation. All FTSs reported that their organisations were lacking the ability to cascade the relevant information to their third-party organisations which created additional challenges as the work streams were then reworked and sent for approval.

4.6.3. Offshoring

The offshoring section analyses 13 independent FTS interviewed where 11 FTSs developed their OWOS as indicated in Figure 4.19 after failing with their offshore outsourcing organisations.

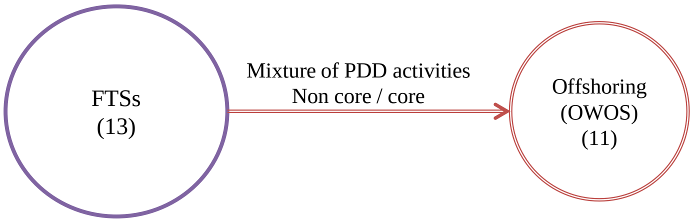


Figure 4.19. FTSs and OWOS

FTSs developed their wholly owned subsidiaries in more than one country, India being the most popular country where ten wholly owned subsidiaries were developed, in China seven wholly owned subsidiaries were developed and only one in the Philippines. The total number of wholly owned subsidiaries offshore is greater than the number of FTSs interviewed as these organisation built facilities in more than one location. The breakdown of FTSs that developed their offshore OWOS is shown in Figure 4.20.

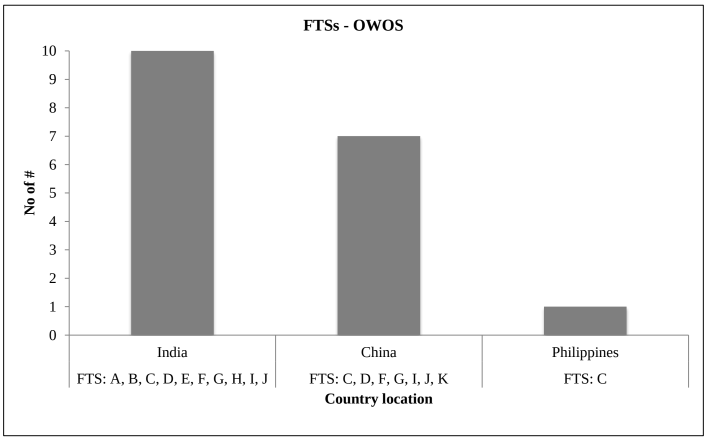


Figure 4.20. Interviewed FTS wholly owned subsidiaries (source: author).

Of the 11 FTSs that developed OWOS, five were using a short term strategy whereas the other six developed a long-term vision and invested offshore but many challenges were still present as discussed in section 4.6.3.2.

4.6.3.1. Offshoring Drivers

The FTSs findings have discovered a number of drivers that steered organisations to develop their OWOS. The drivers are discussed below in order of the most cited during the interviews and coding process.

Cost reduction – 100% of respondents reported a key driver when offshoring was reducing cost from and one of the main drivers for all FTSs to develop their OWOS in low-cost countries. These organisations looking at reducing costs targeted a lower hourly rate than they could achieve by using engineers in developing countries and where the total offshoring cost was lower than onshoring. Customers were also demanding that their engineering suppliers reduce development costs by having an element of LCC as a fundamental basis when quoting for work.

An example of cost reduction was mentioned during an interview with the engineering director at FTS F who stated:

> Reducing the cost of design and development within the group was one of the key drivers for our business and was followed by capacity constraints we had internally. The cost of becoming more competitive was a big benefit in terms of rates for the employees.

Engineering capacity – This was the secondary driver after cost reduction for all FTSs (100% of respondents) because their internal engineering resources had limitations to work on additional projects. This forced these organisations to develop their OWOS, enabling them to tap into where the low-cost engineering resources widely available. FTSs reported that their OWOS had been used for overflow of work that would normally occur internally but was offshored as the activities consisted of low complexity development.

Capacity as a driver was highlighted during an interview with the vice president at FTS J:

> The offshore centre can be used to take out high demands within programs that require excessive resources. The OWOS was developed after our initial engagement with the offshore ESP. Using the OWOS for capacity purposes enabled our organisation to concentrate on more core and value adding projects than worrying about simple tasks. India is a good source to pull academically qualified people and also have an engineering tradition and are long-term focused compared to China.

Proximity to customers – 70% of respondents developed their engineering centres close to the customers' manufacturing sites or engineering centres. The driver behind having OWOS close to these locations enabled smoother communication between the two organisations, knowledgeable people with experience locally who had already worked within the automotive industry and acquired local market experience ensured customer's specifications and requirements had been fulfilled.

An example of close proximity to customers emerged during an interview with the engineering director at FTS F:

> We not only do offshoring but also do local launches and also support for the Chinese and Indian markets. If there is anything launched in a country the support is provided by either China or India in this instance.

During another interview with the board member of FTS E:

> China was developed just for the fact it was a bigger growth market in automotive than you have in India, so we wanted to be close to our customers and the market. These locations will serve local markets but India will support the global part of the business as China does not have the level of competence.

Control and develop from existing manufacturing facility – 100% of respondents reported it was easier to control their own OWOS than using ESPs as both organisations had different objectives and deliverables. The FTS who initially engaged with an ESP then subsequently developed their OWOS had been more productive in managing and controlling their wholly owned people and required less management attention when going through monthly billing, less time spent in allocating people to different jobs, reduced turbulence when people overworked on projects requiring reworking.

This was highlighted during an interview with the vice president at FTS J:

> We learned a lot with the third-party provider something that we should have not really learned with a financial burden, but what we have learned has been used today. I can say the entire organisation of managing and control your own people and centre is definitely the way forward, you just cut out the middle person.

Development from existing manufacturing facilities – 45% of respondents (four FTSs) had existing manufacturing operations based in offshore locations which had been extended into OWOS. This approach saved the FTSs costs, time, recruitment had been easier and using the centres for localisation of engineering tasks.

An example of this emerged during a meeting with the vice president of engineering at FTS G:

> Our business developed a manufacturing centre in India for localisation of production. There was no plan to develop an engineering centre within the existing facility, it was highlighted during the offshoring discussions, let's use our existing facility and develop the OWOS from here. Other FTSs have also been using this approach and it is now becoming quite common to have a shared OWOS between operations and engineering.

The primary driver leading FTSs to develop an OWOS was underpinned by reducing costs from the business in particular the hourly rate of FTEs. Due to the expansion of OEMs product range and additional products being won the FTSs struggled utilising the current engineering resources over a number of projects which forced them to develop and recruit employees in low-cost countries.

Failed with offshore alliances – In total there were five FTSs (60% of respondents) that terminated their contracts with offshore outsourcing organisations and then developed their

OWOS. These organisations experienced challenges as outlined in section 4.6.3.2 and Figure 4.18 shows an overview of the FTS analysis.

All of the FTSs reported difficulties managing and controlling an offshore third-party organisation, so they develop their OWOS to better control and manage their wholly-owned subsidiaries.

Customers who had manufacturing or engineering centres wanted their engineering suppliers to be based locally which steered the FTSs to develop their OWOS close to their customers. FTSs that had offshore manufacturing facilities develop engineering OWOS from their existing plants making the investments more cost effective than new start-ups.

4.6.3.2. Offshoring Challenges

This section maps out the challenges FTSs experienced with their OWOS. The challenges are categorised in order of most cited during the interviewing/coding process and experienced throughout their journey.

Communication – 100% of respondents and all FTSs reported that communication between onshore and offshore organisations caused delays when developed their OWOS and resulted in additional time consumed which was not accounted for. The FTSs had lacked this part of integration in their business plans and contributed to the overall strategic developed of OWOS.

An example of this emerged during an interview session with the vice president of engineering at FTS G mentioning:

> Of course they are communication issues, this stuff is not easy, every offshore company has this problem, most are hidden or management are not willing to disclose the information. To resolve some of the communication issues and to have the team integrated in our product development cycle we are pulling Indian engineers over to Germany but I must point out that there is no cost saving. In addition to the above we are using videoconferences, Skype, additional emails PowerPoint documents displaying and indicating exactly what we need. An increasing amount of technology tools have been added to the business in addition by sharing drawings, desktops etc. Today (2013) I agree it is still a problem and having the wider organisation not trained in this area makes it even more difficult.

During another interview, the managing director of FTS H mentioned:

> We did not meet our cost targets. A lot of time, resource, money is lost in communication and transfer. In order to have proper communication, we have sent people from onshore to offshore to train, so a lot of investment and training is required upfront which we totally missed and never even thought would have been a problem. Communications between the onshore and offshore teams has had a negative effect. The 4 hour time zone does not work for us. So for example when urgent work is required and its afternoon onshore, the offshore team will have gone home which means we have lost several hours.

Reworking of data – 70% of respondents reported FTSs experienced consistent checking and reworking of data that was sent back to the parent organisation. The reworking of data derived as both organisations lacked the capabilities of outlining the work requirements. The researcher was rather fortunate to attend a number of meetings where the offshore data had been presented to the customer without being reviewed internally, causing the customer to lose faith with the onshore/offshore proposition. Reworking of data is rather expensive as the organisations had to spend additional hours in correcting and reissuing the engineering data.

An example of this emerged during an interview with the vice president of engineering at FTS G mentioning:

> To be honest we measure the rework rate monthly and I can tell you that our annual report will say 15 per cent but actually this number is not true. In reality the rework rate is closer to 25 to 30 per cent. The CAD model is developed and this is then transmitted to the supplier who then sees that this model is not feasible, I can't do this, they can't do that, this is impossible, and look at this etc. the offshore team operating the model in isolation do not see the bigger picture. The CAD model is then returned with a number of comments from us indicating what is wrong and where improvements need to be made.

During another interview, the engineering director at FTS C mentioned:

> So when we first started there was a drawing reject rate of 20 - 25 per cent, I am talking here simple 2D engineering drawings that consist of very little knowledge required. However, after several years of coaching and teaching the rework rate in 2013 was around 15 per cent, not a significant improvement but demonstrates that offshoring takes a long time to develop and an overnight strategy cannot be applied.

Lack of capability – 100% of respondents and all FTSs reported the offshore calibre was highly educated but lacked experience in developing innovative or creative solution/ideas in engineering PDD a gap was identified. This resulted in FTSs overspending as expatriates were used for coaching and running of the OWOS not originally planned for. FTSs reported their onshore culture of managing the OWOS evolved into a job shop environment where offshoring was not practiced correctly and had gone out of control.

An example of lacking capability occurred during an interview with the engineering director at FTS C:

> You can source people overnight; we have been using them for few years now so the experience over a period of time has grown. They are still not fully capable in terms of attention to detail and ability to design from clean sheet. They do not have the hands on experience to deliver a project; problem we have experienced in the plant, assembly problems, and how these are mitigated in the design are not closed out with our offshore facility. Yes we do have some guidelines on how experienced the guys are and what work packages can be given to these people. When we recruit graduates from University they usually start off with very easy work, you cannot give them very complex jobs. Having dedicated heads in the business and sometimes we use the offshore centres as jobbing shops which leads into other problems such as lack of consistency in one person who knows your requirements.

In another interview, lacking capability was mentioned with the CTO of FTS B mentioning:

> Many Western companies have gone into China and India expecting there will be talent for capability immediately available that certainly is not the case. Is a significant challenge for all western companies going into emerging regions they fail just like we have on capability. I can say categorically that India's competency is software systems; they have built the entire industry along with infotainment they have a good capability in that, anything else I would categorically state they are lacking.

Control – 60% of respondents reported their OWOS required more control than internal departments as inefficiencies in communication, understanding, knowledge, lack of developed process, employees had not been trained and commitment to deliver occurred during the engineering development stage. This was highlighted during an interview with the vice president at FTS J:

> Yes I would say so; it requires more management control and also depends on how solid your processes are. I would say that our processes are not that strong which means that we need more offshore control. The offshore centre in India is functionally related to our design centre in Sweden but we have a local Swedish manager who runs this in India. So the head of development centre in Sweden is responsible for the offshore subsidiary. This has enabled better control and communication.

During another interview with the vice president of engineering at FTS G:

> Control is very important for our business, we are continuously training the Indian guys and engineers by flying them over to our onshore site to understand our processes and systems but there's still a lot of work involved. It also requires management support from the local parent too so they fully understand what needs to be delivered. Let me put this into context, in each program there are certain people that spend time on offshore projects.

Management buy-in – 50% of respondents reported they had challenges with the onshore management teams to understand and appreciate that PDD activities were to be delivered from low-cost destinations. The FTSs employees did not understand the motivations for reducing costs within their organisations through offshoring and subsequently add further engineering resources to the business where the internal employees concentrated on more core activities. The importance of management buy-in was expressed in detail during an interview with the engineering director at FTS C who mentioned:

> To have a successful offshore subsidiary you need to have management commitment and dedication from both sides and ultimately need an ex-pat say from the onshore organisation for at least a complete year which would extend for another six or twelve months. We faced significant challenges when developing our OWOS as the management team did not understand that offshoring was required in the business and the journey/approach we took was long term than an overnight strategy.

In a separate meeting, the engineering director at FTS F stated:

> The success factors have been the management appreciating for offshoring this work to India and agreeing taking out time and dedication. Without their continued support and commitment the offshoring journey would have been rather difficult.

Labour attrition – 30% of respondents reported their employees based in OWOS had changed employment on a regular basis as competitor organisations offer additional salary. The attrition subsequently affects the continuity and flow of information when employees leave the organisation which over a period of time underpins and strengthens the offshoring model. FTSs have spent additional time, money and resources in retraining and educating new employees but the PDD cycle becomes slow with engineering activities not being completed in time. An example of labour attrition emerged during an interview with the engineering director at FTS C:

> We have also seen high migration in Philippines where employees are leaving to gain $0.50 per hour down the road. Attrition rates are pretty good, but it was very bad at the start when we were not allocating dedicated heads, now we are dedicated heads which has defiantly helped this retain the employees. They are seen as an extension of my headcount but people will still leave the business causing some disruptions.

The OWOS challenges have illustrated communication as a barrier and resulted in additional time and money being spent. The lack of capabilities within an offshore country inevitably impacts the level of engineering and innovation capable which creates additional challenges for the FTSs as expatriates were used at higher costs than originally anticipated.

FTSs identified more control was necessary with their OWOS than managing an internal department as their processes lacked the ability to become global. The management team when developing an OWOS offshoring engineering centre is rather critical to its success and dedication was required which was lacking in these organisations.

Reworking of data was across all OWOS developed by FTSs as consistent checking and modification of data became a normal process, but an average of 20 per cent rework was identified. Finally, attrition rates across the FTSs OWOS were rather high as employees were looking to enhance their salaries by moving organisations creating disruption to the offshoring model.

4.7. Summary of Data Analysis

This section provides a summary of the findings presented earlier on outsourcing, offshore outsourcing and offshoring the PDD activities within OEMs, ESPs and FTSs.

4.7.1. OEM analysis

A total of 20 OEM organisations were interviewed consisting of 43 individual interviews in the area of onshore outsourcing, offshore outsourcing and offshoring. The top five key challenges and drivers for onshore outsourcing, offshore outsourcing and offshoring are summarised in Figure 4.21.

	OEMs Challenges	Weighting Resp (%)	OEMs Drivers	Weighting Resp (%)
Strategic alliance (onshore)	1. Communication	*70*	1. Engineering capacity	*100*
	2. Quality of work	*100*	2. Cost reduction	*40*
	3. Reluctant to engage with outsourcing partner	*100*	3. Flexibility	*80*
			4. Time to market	*100*
	4. Not cascading internal processes	*100*	5. Capability	*30*
	5. Additional coaching and control required for external organisations	*100*		
Strategic alliance (offshore outsourcing)	1. Communication	*85*	1. Cost reduction (Direct)	*75*
	2. Additional checking of data	*70*	2. Cost (Indirect)	*45*
	3. Unclear PDD specifications	*60*	3. Engineering capacity	*80*
	4. Lack of employee experience	*100*	4. Flexibility	*100*
			5. Capability	*30*
	5. Employee attrition	*50*		
Wholly owned subsidiary (offshore)	1. Communication	*85*	1. Cost reduction	*90*
	2. Rework of data	*70*	2. Engineering capacity	*100*
	3. Lack of experience	*60*	3. Local market presence	*85*
	4. Employee attrition	*40*	4. Access to educated people	*75*
	5. Unclear specifications	*50*	5. Capability	*20*

Figure 4.21. OEMs key challenges and drivers.

4.7.1.1. OEM Onshore Outsourcing

This study identified all 20 OEMs based onshore were outsourcing to strategic alliance organisations based onshore consisting of a mixture of activities in particular near core activities. These organisations located themselves within a short distance from the OEM and operated a decentralised model by following their customers.

In all the outsourcing and offshoring organisations there were two engagement models: fixed price deliverable for outsourcing/offshoring and fixed term (transactional) based outsourcing or offshoring, both used interchangeably within these organisations. The onshore PDD activities consisted of fixed price deliverable where all 17 OEMs used this approach. Three OEMs used fixed term contracts mainly transactional as their PDD activities consisted of longer project cycles.

Onshore strategies varied between organisations from the 20 OEMs interviewed, where 12 had developed a long-term strategic vision and partnership with ESPs to strengthen their core competencies on outsourcing programs whereas the remaining eight OEMs had an unclear strategy/vision implementing a short term engagement not planned or thought out and consisted of more time and cost.

The OEMs top five key drivers and challenges for onshore outsourcing are summarised in Figure 4.21.

4.7.1.2. OEM Offshore Outsourcing

This study has identified the 20 OEMs interviewed; nine had offshore outsourcing contracts that were all located in India. The nine OEMs used onshore ESPs based locally and subsequently with offshore ESPs based in India. In summary there were two models of engagement used; onshore outsourcing for a mixture of PDD activities and near core activities, whereas offshore outsourcing also consisted of a mixture of PDD activities in particular non core activities. This was implemented to reduce the PDD costs of a vehicle and freeing internal engineering resources to concentrate on other core activities. The OEMs that used this model of engagement are shown in Table 4.2.

As shown in Table 4.2, the three OEMs H, O and Q were based in low cost countries and therefore these organisations reversed offshored their PDD activities to western countries where the skill base and PDD knowledge was further developed than the local people.

The OEMs strategy was to reduce costs and free the internal resources through an extended workbench located in a low cost country where six OEMs implemented a short term strategy and were rather inexperienced in developing an offshore outsourcing proposition. These organisations faced more challenges than the eight OEMs developing a short term solution for onshore outsourcing. Further, through the development of a short term implementation an oversight was developed on the offshoring process and decision making in these OEMs which caused additional complexities and challenges to be resolved.

Three OEMs based their offshore outsourcing on a long term strategy as they had already some experience due to termination of their contracts. This was the case with OEMs D, E, and G who had engaged with ESPs for several years and once the organisations were competent with offshoring they developed their OWOS.

All the offshore outsourcing contracts were identified as a long experiment before an OWOS was developed by the OEMs.

The OEMs top five key drivers and challenges for offshore outsourcing are summarised in Figure 4.21.

4.7.1.3. Offshoring

This study identified the 20 OEMs interviewed, 15 OWOS were developed to offshore their PDD activities. Additionally, there were four OEMs having plans to develop an OWOS within the next 36 months, taking the total number to 19 OWOS out of 20. The PDD activities consisted of non core to develop the capabilities of the employees through an evolution to core activities. The top five key challenges and drivers for offshoring are summarised in Figure 4.21.

OWOS were developed in low-cost/developing countries where these organisations took advantage of lower labour rates and the lack of engineering capacity available within the organisations. Four OEMs had a short term strategy to reduce cost and started to offshore high value tasks without any decision making strategy. The four short term strategies had no underpinning vision or business plans so challenges were experienced as identified in section 4.4.3.2.

However, the 11 OEMs developing there long term strategy based on cost reduction and development of offshore capability which was not immediate. The 11 OEMs also had unclear plans when offshoring their PDD activities as they were chosen randomly without analysing the consequences of offshoring activities that require a significant amount of interaction.

Offshoring drivers were predominantly based on cost reduction as the primary driver followed by the shortage of engineering capacity within the organisations and these OWOS had been developed in countries where an organisation can take advantage of learning the local market. OEMs based in low-cost/developing countries did the opposite where they offshored the PDD activities to their subsidiaries based in Europe with a higher level of skill, competencies and capability.

The challenges associated with an OWOS included difficulty in communication with offshore employees, inexperienced engineers employed for such activities and incomplete data which resulted in additional resources (time, money) to correct the data.

Offshoring strategies were diffused within the OEMs applying short-term and long-term plans which were unclear within the organisations. Four OEMs that developed their OWOS in India struggled with delivering the PDD activities as the short-term objective was to make profit and the overall objective of developing a strategy was missed.

4.7.2. ESP Analysis

A total of 17 ESP organisations had been interviewed consisting of 36 individual interviews in the area of onshore outsourcing, offshore outsourcing and offshoring. The top five key challenges and drivers for onshore outsourcing, offshore outsourcing and offshoring are summarised in Figure 4.22.

	ESPs Challenges	**Weighting Resp (%)**	**ESPs Drivers**	**Weighting Resp (%)**
Strategic alliance (onshore)	1. Communication 2. Resistance from customer 3. Lack of knowledge transfer from customer 4. Outsourcing any PDD activities 5. Not understanding customers systems and processes	*85* *70* *60* *75* *65*	1. Engineering capacity 2. Cost reduction 3. Local presence 4. Engineering capability 5. Failed with strategic alliance	*100* *40* *80* *67* *60*
Strategic alliance (offshore outsourcing)	1. Communication 2. Controlling offshore 3. Management commitment 4. Lack of skills 5. Rework of data	*90* *75* *60* *80* *85*	1. Cost reduction 2. Customer driven 3. No upfront investment 4. Engineering capacity 5. Retain competiveness	*80* *50* *40* *70* *65*
Wholly owned subsidiary (offshore)	1. Communication 2. Rework of data 3. Management trust 4. Control 5. Employee attrition	*100* *100* *70* *75* *45*	1. Cost reduction 2. Engineering capacity 3. Protect IP 4. Control 5. Failed with offshore alliances	*90* *80* *75* *80* *35*

Figure 4.22. ESPs key challenges and drivers.

4.7.2.1. Onshore Outsourcing

ESPs located in the same country and within a short proximity to a customer had been considered more favourably to be awarded a contract in comparison to organisations in a nearshore/offshore location. The organisations that developed local offices to their customers operated a decentralised strategy and position themselves strategically where required.

Of the 17 ESPs interviewed, 11 had developed strategic alliances with onshore organisations and six had short term strategy which was unclear during the interviewing and additional data collection. These six ESPs just outsourced any PDD activities which became difficult to manage and complete with no clear methodologies. The remaining five ESPs developed a long term strategy which enabled them to cohesively develop a strategic partnership with the external organisations.

The PDD activities outsourced to ESPs consisted of near core activities which had been retained internally over the past decade and classified into five segments. However, there was no clear methodology when outsourcing the PDD activities.

The drivers leading ESPs to outsource the PDD activities was due to insufficient engineering resources internally as the demand was greater than the supply of engineers so collaboration with other ESPs was conducted. The drivers and challenges are further identified in Figure 4.22.

4.7.2.2. Offshore Outsourcing

From the 17 ESP organisations four developed strategic alliances with third-party organisations and offshored non core PDD activities. Offshore outsourcing was used to reduce labour costs within an organisation, as a percentage of PDD activities were offshoreable, reducing the overall cost. All four organisations first engaged with an offshore outsourcing organisation as there was no strategy or decision-making process involved and the cost of developing a wholly owned subsidiary was rather significant. Thus, four ESPs (C, D, J, and N) which engaged with an offshore third-party organisation terminated the contracts because their objectives were not met due to a lack of strategy, management commitment and poor or nonexistence decisions making models within the organisations. There were no ESPs that developed a long term vision or methodology for the PDD activities.

However, it must be noted that all ESPs used offshore outsourcing as an experiment because they were reluctant to invest money in a country with no experience with a high risk of failure which was identified from other organisations that were offshore outsourcing.

The drivers for an ESP to offshore PDD activities were driven by reducing costs within the organisation followed by the customer demand for cost reduction. The top five key drivers are identified in Figure 4.22.

Communication was the most cited challenge from the ESPs followed by difficulty in controlling a third party organisation in particular the management. The top five challenges are identified in Figure 4.22.

4.7.2.3. Offshoring

From the 17 ESP organisations 14 had developed an OWOS and the ESPs initially started offshoring non core activities which over a period of several years core tasks were planned to be offshored. Interestingly there were no ESPs that reached this stage with PDD in the automotive industry. Of the 14 ESPs four had a short term strategy which was unclear and no clear decision making was identified. These organisations experienced more challenges than onshore outsourcing. The other 10 ESPs had a long term vision based on cost reduction and building offshore capability. In both cases the management had not paid attention on which PDD activities were offshoreable.

However, a further two ESPs also had plans to develop a wholly owned subsidiary. The 14 ESPs developed their wholly-owned subsidiaries in China, India, USA Malaysia and Brazil with China and India being the top two countries.

The drivers for developing a wholly owned subsidiary based offshore was driven by reducing overhead costs associated with the PDD activities followed by using a wholly-owned subsidiary as an extended capacity bench for outsourcing their non-core activities. The ESPs top five drivers are identified in Figure 4.22.

These ESPs also had challenges in communication between an onshore and offshore organisation and reworking of activities from the offshore subsidiary. The ESPs top five challenges are identified in Figure 4.22.

4.7.3. FTS Analysis

This section summarises the 13 FTSs that were interviewed consisting of 20 individual interviews. The FTSs PDD activities had been outsourced to ESPs based locally, offshore outsourcing organisation and to their OWOS. The top five key challenges and drivers for onshore outsourcing, offshore outsourcing and offshoring are summarised in Figure 4.23.

	FTSs Challenges	Weighting Resp (%)	FTSs Drivers	Weighting Resp (%)
Strategic alliance (onshore)	1. Communication	*70*	1. Engineering capacity	*100*
	2. Resistance to work with ESP	*70*	2. Cost reduction	*50*
	3. Additional resource required to manage external organisation	*70*	3. Local presence	*70*
	4. Outsourcing of any PDD activity	*60*	4. Engineering capability	*75*
	5. Knowledge transfer	*100*	5. Failed with strategic alliance	*65*
Strategic alliance (offshore outsourcing)	1. Communication	*90*	1. Cost reduction	*75*
	2. Additional time in managing people	*70*	2. Customer driven	*60*
	3. Cascading of information	*100*	3. No upfront investments	*55*
	4. Rework of data	*70*	4. Engineering capacity	*65*
	5. Developing capability	*100*	5. Retain competiveness	*40*
Wholly owned subsidiary (offshore)	1. Communication	*100*	1. Cost reduction	*100*
	2. Rework of data	*70*	2. Engineering capacity	*100*
	3. Lack of capability	*100*	3. Proximity to customers	*70*
	4. Control	*60*	4. Control – Develop existing facility	*100*
	5. Management buy-in	*50*	5. Failed with offshore alliance	*45*

Figure 4.23. FTS key challenges and drivers.

4.7.3.1. Onshore Outsourcing

A total of 13 FTS organisations were interviewed and eight FTSs outsourced to ESPs based onshore which consisted of a mixture of PDD activities in particular near core activities were outsourced.
The driver for FTSs organisations to outsource was the lack of internal engineering capacity to conduct PDD activities to develop engineering solutions followed by cost reduction. The top five drivers are identified in Figure 4.23.

The challenges FTSs experienced when outsourcing was management issues between the two organisations due to general misunderstanding, resistance to work with ESPs as the manager's feared risk and further challenges are identified in Figure 4.23.

4.7.3.2. Offshore Outsourcing

The FTSs developed eight offshore outsourcing contracts where a mixture of PDD activities had been offshored in particular non core activities. This was only identified after the organisations experienced failure with offshoring of high value activities.

Five FTSs contracts were terminated with an offshore third-party ESP where they experienced major difficulties and challenges leading them to develop their OWOS. The three FTSs had developed some structure and process and had minimum challenges and complexities compared to the five FTSs which were terminated.

The offshore outsourcing drivers that motivated the FTSs was cost reduction to reduce the overhead development costs and that there were no upfront investment costs when engaging with a third party. The drivers are further identified in Figure 4.23.

The challenges associated with offshoring PDD activities were communication between the two organisations; this was a major *'make or break'* success factor to continue offshoring, and the additional time in managing the people and the offshore management. The top five challenges are identified in Figure 4.23.

4.7.3.3. Offshoring

11 FTSs organisations developed OWOS which consisted of offshoring a mixture of PDD activities in particular non core PDD activities were offshored.
Over several years one FTS was close in developing core products for the local market but did not reach the goal and had another 24 months of maturity before this could be achieved. The 11 FTSs consisted of five developing a short term strategy which was based on cost reduction within the organisation. These organisations faced more challenges than the onshore FTSs as there was no clear strategy or decision making process that underpinned the decisions.

The remaining six organisations developed a long term strategy which was based on cost reduction and increasing the internal engineering resources. The OWOS for PDD activities were developed predominantly in India, China and the Philippines.

The FTSs drivers in developing their wholly owned subsidiaries were cost reduction from the organisation and the lack of internal engineering capacity to carry out the PDD activities. The FTSs top five drivers are identified in Figure 4.23.

The FTSs challenges were communication between the two organisations, causing delays in delivering PDD activities as these organisations did not take the challenges into account. The FTSs top five challenges are identified in Figure 4.23.

4.7.4. Decision Making Process

This research study has identified there was no clear outsourcing, offshore outsourcing or offshoring decision making models or processes used by the organisations based in the three segments: OEM, ESP and FTS. This created additional challenges and complexities for these organisations as discussed in this chapter.

The drivers for onshore outsourcing, offshore outsourcing or developing an OWOS had not been taken into account. The management within these organisations identified common derivers whereas the data has revealed the drivers for each category are different. Therefore, onshore outsourcing drivers are not fully interchangeable with offshore outsourcing or offshoring.

The challenges for onshore outsourcing, offshore outsourcing or developing a wholly owned subsidiary had been experienced through learning and failing due to lack of early identified. For instance, the challenges across outsourcing and offshoring (includes third party) were different whereas the management assumed practices onshore could be applied offshore until complex challenges were experienced and lacked the internal knowledge on how solutions could be provided.

These organisations suffered from additional costs, and more importantly misunderstood their drivers or challenges or how to identify the PDD activities into non core, near core or core. Core activities had been outsourced and offshored to external organisations, developing a risk to the organisations' competitive advantage. The lack of strategy and decision-making across the three sectors developed challenges where objectives were not met because the initial stages of the outsourcing or offshoring journey were overlooked.

4.8. Overview of challenges and drivers

The challenges and drivers for all three segments when onshore outsourcing, offshore outsourcing and offshoring are shown in Figure 4.24 and Figure 4.25. The respondents weighting for each challenge and driver is also identified.

	OEMs Challenges	Weighting Resp (%)	ESPs Challenges	Weighting Resp (%)	FTSs Challenges	Weighting Resp (%)
Strategic alliance (onshore outsourcing)	1. Communication 2. Quality of work 3. Reluctant to engage with outsourcing partner 4. Not cascading internal processes 5. Additional coaching and control required for external organisations	*70* *100* *100* *100* *100*	1. Communication 2. Resistance from customer 3. Lack of knowledge transfer from customer 4. Outsourcing any PDD activities 5. Not understanding customers systems and processes	*85* *70* *60* *75* *65*	1. Communication 2. Resistance to work with ESP 3. Additional resource required to manage external organisation 4. Outsourcing of any PDD activity 5. Knowledge transfer	*70* *70* *70* *60* *100*
Strategic alliance (offshore outsourcing)	1. Communication 2. Additional checking of data 3. Unclear PDD specifications 4. Lack of employee experience 5. Employee attrition	*85* *70* *60* *100* *50*	1. Communication 2. Controlling offshore 3. Management commitment 4. Lack of skills 5. Rework of data	*90* *75* *60* *80* *85*	1. Communication 2. Additional time in managing people 3. Cascading of information 4. Rework of data 5. Developing capability	*90* *70* *100* *70* *100*
Wholly owned subsidiary (offshore)	1. Communication 2. Rework of data 3. Lack of experience 4. Employee attrition 5. Unclear specifications	*85* *70* *60* *40* *50*	1. Communication 2. Rework of data 3. Management trust 4. Control 5. Employee attrition	*100* *100* *70* *75* *45*	1. Communication 2. Rework of data 3. Lack of capability 4. Control 5. Management buy-in	*100* *70* *100* *60* *50*

Figure 4.24. Summary of challenges across three segments.

	OEMs Drivers	Weighting Resp (%)	ESPs Drivers	Weighting Resp (%)	FTSs Drivers	Weighting Resp (%)
Strategic alliance (onshore outsourcing)	1. Engineering capacity 2. Cost reduction 3. Flexibility 4. Time to market 5. Capability	*100* *40* *80* *100* *30*	1. Engineering capacity 2. Cost reduction 3. Local presence 4. Engineering capability 5. Failed with strategic alliance	*100* *40* *80* *67* *60*	1. Engineering capacity 2. Cost reduction 3. Local presence 4. Engineering capability 5. Failed with strategic alliance	*100* *50* *70* *75* *65*
Strategic alliance (offshore outsourcing)	1. Cost reduction (Direct) 2. Cost (Indirect) 3. Engineering capacity 4. Flexibility 5. Capability	*75* *45* *80* *100* *30*	1. Cost reduction 2. Customer driven 3. No upfront investment 4. Engineering capacity 5. Retain competiveness	*80* *50* *40* *70* *65*	1. Cost reduction 2. Customer driven 3. No upfront investments 4. Engineering capacity 5. Retain competiveness	*75* *60* *55* *65* *40*
Wholly owned subsidiary (offshore)	1. Cost reduction 2. Engineering capacity 3. Local market presence 4. Access to educated people 5. Capability	*90* *100* *85* *75* *20*	1. Cost reduction 2. Engineering capacity 3. Protect IP 4. Control 5. Failed with offshore alliances	*90* *80* *75* *80* *35*	1. Cost reduction 2. Engineering capacity 3. Proximity to customers 4. Control – Develop existing facility 5. Failed with offshore alliance	*100* *100* *70* *100* *45*

Figure 4.25. Summary of drivers across three segments.

4.9. Synthesis amongst OEMs, ESPSs, FTSs

This section synthesises the data amongst three segments (OEMs, ESP and FTSs) to identify how outsourcing and offshoring of PDD activities was conducted within these organisations. Firstly, outsourcing of PDD activities is compared amongst the three segments, secondly, offshore outsourcing of PDD activities is compared amongst the three segments and thirdly offshoring to their wholly owned subsidiaries is compared.

4.9.1. Outsourcing of PDD activities amongst OEMs, ESPs, FTSs

Outsourcing of PDD activities amongst OEMs, ESP, and FTSs followed a similar approach with all three segments unclear which activities were outsourceable. There were a number of organisations that developed a process internally they used when outsourcing and offshoring their PDD, however there was no organisation that had a complete outsourcing or offshoring decision making process but these organisations were looking into developing a model to enhance and improve the efficiency. The OEMs that used a structured approach when outsourcing their PDD activities had a smooth journey.

The OEMs that outsourced their PDD activities contained a mixture of non core, near core and core to ESPs based onshore as illustrated in Figure 4.26 showing. The OEMs, ESPs and FTS in-depth analysis is explained in sections 4.4, 4.5and 4.6.

The OEMs developed 20 strategic alliances with ESPs based onshore, the ESPs developed 11 strategic alliances with other ESPs and the FTSs developed eight strategic alliances with ESPs all to conduct PDD activities. In total 39 organisations developed strategic alliances amongst all there segments and there was consistency on how these organisations outsource their PDD activities that required a high level of competency and attention to detail.

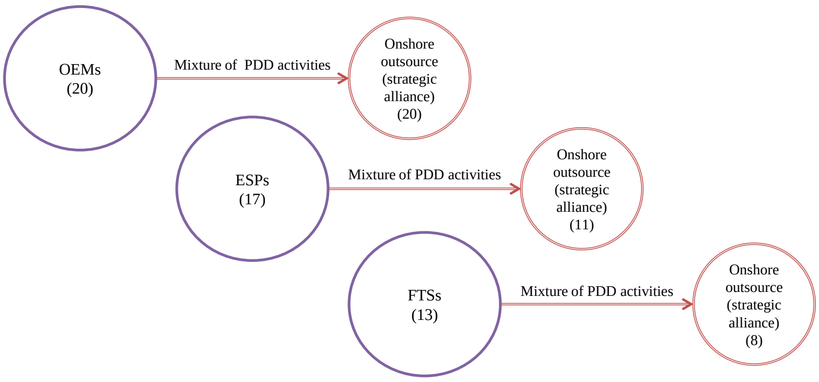


Figure 4.26. Outsourcing of OEMs, ESPs and FTS.

Firstly, within the 20 OEMs there were 12 that developed a long term strategic vision for outsourcing their PDD activities with a rough guide on what could be outsourced, eight of the OEMs had unclear decision making processes, strategies, visions and processes and faced financial difficulties.

Secondly, within the 17 ESPs there were 11that outsourced onshore with ESP organisations where only five developed an internal methodology to support their decisions, but these organisations still had further development work. Their intention was to build a strategic approach. The remaining six ESPs had no clear vision or decision making models and suffered from the consequences of poor planning and managing.

Thirdly, within the 13 FTSs there were eight organisations that outsourced; this included four organisations had no process or strategy when outsourcing PDD activities and difficulties and challenges arose during their journey. This was based on a short term perspective. However, the other four ESP that developed a long term strategy/vision on how they could outsource their PDD activities these organisations gained the benefits of having a structured and strategic approach to outsourcing.

These outsourcing PDD activities required a high level of engineering knowledge/competence and skill sets along with interfacing and interacting with people during the PDD phase. In fact the onshore outsourcing of PDD activities consisted predominately of project based PDD activities with some transactional work packets. The strategic alliances consisted of ESPs that developed local offices next to their customers engineering HQ. Development of these local engineering offices added additional benefits when liaising with the ESP.

4.9.2. Offshore Outsourcing of PDD activities amongst OEMs, ESPs, FTSs

Offshore outsourcing of PDD activities consisted of the three segments offshoring a mixture of PDD activities. All three segments developed offshore outsourcing strategic alliances with ESPs where the OEMs, ESPs and FTS in-depth analysis is explained in sections 4.4, 4.5 and 4.6 with a combined view of all three segments shown in Figure 4.27.

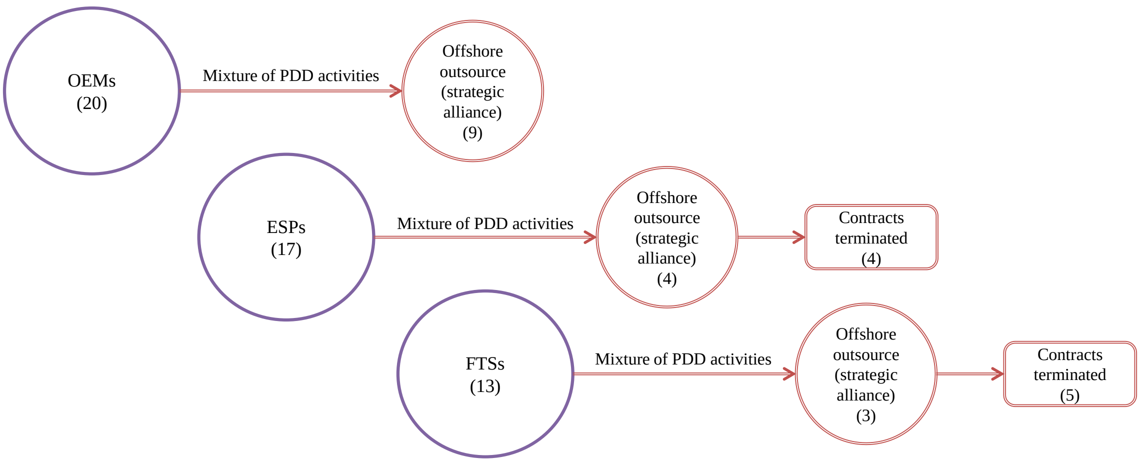


Figure 4.27. Offshore outsourcing of PDD activities to OEMs, ESPs FTSs.

Of the 20 OEMs, nine engaged with offshore outsourcing organisations, four out of the 17 ESPs engaged with offshore outsourcing organisations. All the OEMs used a transactional approach to offshore outsourcing and had plans within the next five years to develop project based offshore outsourcing. Nine of the 20 OEMs used onshore ESP is based locally along with offshore is piece based in India whereas the others. Six of the OEMs had no clear offshore outsourcing strategic decisions or decision-making models used within the OEMs segment when offshoring the PDD activities.

The four ESPs terminated their contracts with offshore outsourcing ESPs after not meeting their business objectivities and failed to develop a working relationship. These ESPs then developed their OWOS after failing to develop a successful engagement. These four ESPs carried out a NIKE approach *"just do it"* and offshored any PDD activity resulting in the ESPs terminating their contracts.

Of the four ESPs analysed, none had long term visions for offshore outsourcing. In all eight ESPs they used a transactional approach to offshore outsourcing and had plans to move away from simple activities to more complex activities once competency and the skill base was developed offshore.

FTSs developed three offshore outsourcing engagements and two had a short term vision without any clear strategy or decision making. The five FTSs that terminated contracts based their strategies on short term cost saving and objectives were not. The PDD activities were also of the transactional type.

Offshore outsourcing of PDD activities consisted of the three organisational segments offshoring their non-core PDD activities predominantly to organisations based in China, India, and USA. The three segments already had onshore strategic alliances with ESPs and also engaged with third-party offshore ESPs located in low cost developing countries to reduce the cost of PDD activities, customer pressure for cost reduction and extending their engineering resources.

The activities that were offshored to the third party ESPs contained a mixture of non core, near core and core that required a different range of skills and capabilities causing additional challenges and complications. The mechanisms required to integrate a mixture of the PDD activities into an offshore organisation required a high level of knowledge and skills which these offshore organisations lacked and therefore key activities had been back sourced.

4.9.3. Offshoring PDD activities to OWOS amongst OEMs, ESPs, FTSs

Offshoring of PDD activities consisted of the three segments offshoring to their wholly owned subsidiaries which were based in low cost developing countries. The OEMs, ESPs and FTS in-depth analysis is explained in sections 4.4, 4.5 and 4.6 with a combined view of all three clusters shown in Figure 4.28.

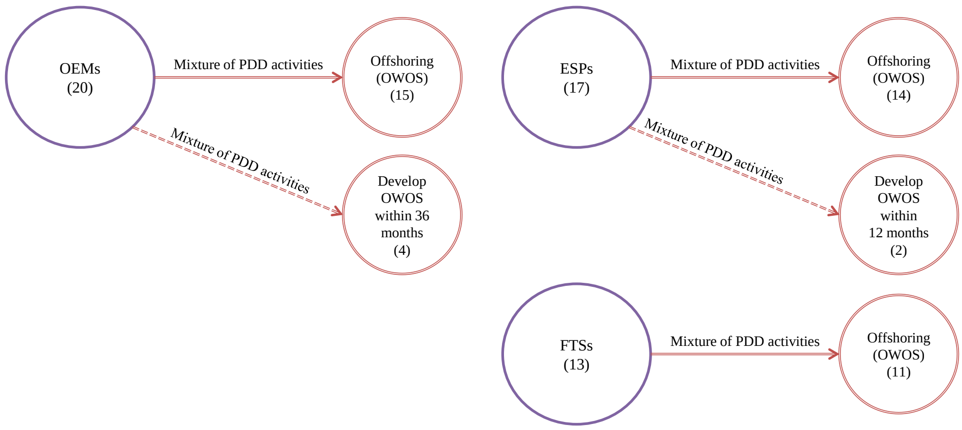


Figure 4.28. Offshore outsourcing of PDD activities to OEMs, ESPs FTSs.

From the 20 OEMs analysed, 15 had developed OWOS based in various offshore locations with another four OEMs having future development plans within 36 months to create new OWOS. Four OEMs had a short term vision and unclear strategy that did not meet the business objectives as costs offshore were creeping high. There was no decision making process within these four OEMs. 11 OEMs developed committed to a long term plan based offshore and underpinned by cost reduction. However, even having a long term plan these organisations had minimal decision making process for key decisions and lacked the capability and the skill sets necessary for the PDD activities.

Of the 17 EPSs 14 developed offshore wholly owned subsidiaries with another two ESPs having plans within 12 months. However, the ESPs based their drivers on developing an offshore wholly-owned subsidiary solely to reduce cost of the PDD activities where four had a short term plan without a clear strategy. 10 ESPs had a long term vision when offshoring also based on cost reduction and no clear decision making models or strategies were apparent.

From the 13 FTSs analysed, 11 had developed their OWOS, of which six were developed from new and five FTSs failed with ESPs only then developing their OWOS. The failures between the onshore and offshore organisations were used in the development phases of their wholly owned subsidiary and these organisations took best practice learning by applying the knowledge to smooth the offshore journey.

The OEMs took a different approach when developing their wholly owned subsidiaries compared to ESPs and FTSs as they had financial capital available, having the resources necessary to carry out PDD activities and being part of a large organisation, the infrastructure was more developed.

However, the decision making processes in these organisations were unclear and lacked clarity and robustness resulting in these organisations developing offshore wholly owned subsidiaries.

A mixture of PDD activities were offshored to the organisation's wholly-owned subsidiaries with core, near core and non core that required a range of skills and competencies. For instance, the near core and core activities were backshored to the organisations HQ as the offshore employees lacked the capability to complete these activities successfully.

Chapter 5 . In-depth case studies and cross case analysis

5.1. Introduction

This chapter presents an in-depth review of the study and six in-depth case studies which are presented in the following format:

1. The six organisations are explained and their background to outsourcing and offshoring PDD activities.
2. Findings from the organisations are outlined.

The case study findings analyse five key areas as follows:

1. How was outsourcing/offshoring of the PDD activities conducted.
2. Challenges experienced when outsourcing/offshoring PDD activities
3. Actions implemented to address the challenges.
4. Implications to the PDD activities.
5. Decision making when outsourcing/offshoring PDD activities

Two organisations are used for the case study each taken from segment OEM, ESP, and FTS as these organisations conducted outsourcing and offshoring of PDD activities. The organisations had different contributions as identified throughout this chapter.

A cross case analysis is presented amongst the three segments to further understanding the outsourcing and offshoring phenomena within these segments.

5.2. Interview Structure for Case Studies

The case study analysis consisted of additional interviews carried out within the three segments to fully explore outsourcing and offshoring of PDD activities.

Table 5.1 provides an in-depth view into the number of interviews carried out within each segment, the role of the interviewee and a total duration for each organisation.

Segment	*Interviews*	*Role of interviewee*	*Total interview duration*
OEM A	4	Engineering group director = 1 Group chief engineer = 1 Line Manger (2) = 1 Engineer = 1	Total interview duration approx. 16 hours.
OEM C	4	Purchasing director = 1 Engineering group director = 1 Line Manager = 1 Engineer (2) = 1	Total interview duration approx. 11 hours.
ESP D	4	CEO = 1 Head of offshoring = 1 Line Manger = 1 Engineer (2) = 1	Total interview duration approx. 11 hours.
ESP L	4	CEO = 1 Engineering director = 1 Line Manger (2) = 1 Engineer (2) = 1	Total interview duration approx. 12 hours.
FTS C	4	Engineering director = 1 MD = 1 Line Manager = 1 Engineer = 1	Total interview duration approx. 12 hours.
FTS J	4	Group VP engineering = 1 Business development director = 1 Line manager (2) = 1 Engineer (2) = 1	Total interview duration approx. 13 hours.

Table 5.1. Case Study Interviews

The duration of interviews across the six case studies totalled to 75 hours across all three segments. In OEM A, C, ESP D, L and FTS J there were two participants during the interview session allowing the researcher to fully develop the case studies.

5.3. Case Organisation OEM A

OEM A an automotive manufacturer of luxury vehicles based in the UK consisting of two automotive brands that were acquired by OEM C in 1994 to expand their product range of vehicles, giving them access to a market which the organisation did not have. The acquisition in 1994 enabled OEM C to have access overnight to cutting edge technology and a wider product range, making them even more competitive. During 1994 to 1989 there was minimal investment on research and development and also investing in new vehicle development. In 1989 OEM A was acquired by a large OEM with headquarters based in USA where the first brand was acquired in 1989 and the other acquisition followed in 2000 with a combined acquisition investment of $5.7 billion. One brand of OEM A is stronger than the other. In 2006 the parent organisation lost around $9.38 billion and was on route to recover the loss. Between 2002 and 2008 the organisation experienced poor growth where the parent organisation contributed minimally to their PDD, and research and development of the organisation’s future and core competitiveness was non-existent. No investment was added to the business and year on year the organisation was constantly losing money.

In 2008, OEM A was acquired by a large automotive OEM based in a developing country and became part of a subsidiary group. In 2013 the organisation's revenue was $24.71 billion and had over 16,000 employees globally in 2010 which increased to over 25,000 globally in 2013.

There are also additional plans in developing manufacturing facilities globally to retain competitive advantage and locations of automotive vehicles to avoid high import taxes and free capacity in the local production facilities. In 2013, the organisation produced over 374,000 vehicles compared to the previous owner producing over 6.3 million vehicles.

A new management team was appointed in 2010 across different verticals of the business structure and since appointment the organisation has grown from strength to strength to a condition where the organisation is now launching a new vehicle every six months. Launching a vehicle every six months is a very complex activity for any organisation in particular OEM A as they have been run during 1994 by a high mass volume producer whereas the volumes are significantly lower. Thus, the processes and systems are rather antiquated and are undergoing the transition phase. Increasing the product portfolio required additional engineering resources after exhaustively adding internal engineering resources.
However, the organisation has completed the tasks of increasing internal resources and are looking for further engineering resources.

To reduce the organisation's PDD costs the subsidiaries offshore engineering centre was utilised where during the latter part of 2013 the organisation had an offshore headcount of 1000 employees. This was the start of offshore journey and outsourcing also followed to local ESPs. The outsourcing journey began in 2009 when the organisation outsourced a derivative not going to plan and in 2013 had outsourced over four vehicle derivatives (also called top hat).

The organisation has the need to outsource further vehicle derivatives due to their aggressive portfolio and launching a new vehicle every six months. Therefore, the case study will concentrate on outsourcing and offshoring of their PDD activities and the process they implemented.
The sections below highlights key findings from OEM A.

5.3.1. How was outsourcing/offshoring of the PDD activities conducted

Outsourcing became a necessity as OEM A was increasing their product portfolio without understanding fully the effects on the business in terms of engineering resource, infrastructure and more importantly which PDD activities the organisation could outsource to an ESP. Other departments in the organisation already outsourced to ESPs in areas such as electrical and powertrain but minimal outsourcing took place in body engineering. Each department within OEM A operated in isolation and no lessons learnt on areas where the organisation failed had been discussed with the wider organisation to avoid the same inaccuracies re-occurring.

OEM A's first outsourcing project started with a derivative vehicle that was in serial production built on the same platform but required an adaptation to develop a new model. Through a number of sourcing events the project was outsourced to a local ESP based within a short proximity from the HQ as regular face to face meetings were required with the senior management team on progress and presence of engineers on site to discuss the development phase with co-employees. The ESP working on this project also shared the same offshore engineering centre as the parent organisation, so there was already some offshoring of PDD activities.

OEM A had only used offshore outsourcing on a small scale consisting of 20 employees max and based in India around 2007. During the takeover of OEM A, the parent organisation had an offshore wholly owned subsidiary (engineering centre) where it supported their OEM based in India and technical engineering centre based in Europe. The CEO from the parent organisation had a vision of integrating the offshore engineering centre with OEM A's PDD activities to take advantage of lower costs and also free some of the internal engineering resources that were deployed on other activities that could be done offshore. The offshore centre was engaged around 2008/2009 where OEM A started offshoring their PDD activities without developing a strategy or process and activities sent offshore in the lens of OEM A consisted of back office activities the organisation did not want to perform onshore. Over a period of five years the offshore subsidiary grew to 1000 people dedicated to support OEM A on PDD activities.

5.3.2. Challenges experienced when outsourcing/offshoring PDD activities

The challenges experience with outsourcing were that the management team involved at OEM A lacked knowledge and training on how to manage an external ESP being responsible for a key part of their vehicle development program. These activities had always been done internally within OEM A and key information was available between employees who had worked on multiple activities where the knowledge was common but not common for an external organisation.

The onshore ESP struggled with obtaining information necessary to complete the PDD activities and while waiting for this information the project got delayed. The ESP employees also noticed an ‘us and them’ culture within OEM A and in general the employees/management were reluctant to share any information with the third-party organisation. As OEM A was not ready for outsourcing or offshoring, information within the organisation was mainly tacit and embedded taking time to document in such a way that it was readable and understandable for an external organisation.

During an interview with a senior manager from OEM A strategic department mentioned:

> There was no process of outsourcing but used their experiences to keep all the good activities internally and outsource the activities that had no contribution to innovation or creativity within the organisation. We have made mistakes by sending the wrong activities out for instance, we are outsourcing some parts of our core development process which we are looking at bringing back in house. To gain real benefit from offshoring your PDD activities you need critical mass and over 150 people to become successful.

When OEM A first engaged the offshore organisation which was already running in India, there were new people, new challenges, new hurdles that all had to be overcome and the communication and understanding required improvement. As mentioned by a senior manager:

> This is not an overnight job, you cannot build trust, skills, competence within 24 hours and it has taken us around three years for our organisation to reach this level, but we are still not there and have another few years to go. We had to use additional communication.

OEM A did not have the knowledge or training to manage an offshore engineering centre and therefore challenges arose during the journey which they did not expect to experience. The offshoring challenges involved high attrition rates as the facility was used as a jobbing shop when required and employees struggled with the PDD activities so 20 per cent left the organisation and were offered more advanced salaries from other automotive organisations within the area, impacting continuity and flow.

The offshore organisation had little knowledge about OEM A’s process and system which led to poor quality of work and these employees lacked the experience compared to their counterparts based in the UK.

5.3.3. Actions implemented to address challenges

OEM A started to document tacit knowledge which was known internally to become more explicit and follow a process approach so anyone within the organisation could use this knowledge. However, was not an overnight activity and has taken over three years for the organisation to develop explicit knowledge and they are still in the process of continuing to document.

During an interview with an engineer working for ESP mentioned:

> OEM A was resistant to share any experience or knowledge with our organisation as we were seen as a threat; we just had to get on with the work and escalated this to senior management. Only after escalation we got some of the information.

As there was no clear documentation for the outsourcing organisations to follow, several training sessions were held either at the HQ or ESP locations for engineers and managers. These training sessions helped the engineers/managers understand the systems and processes at OEM A, but not all training was covered. For instance each milestone in a vehicle delivery program consisted of key deliverables that required completion but the immaturity of OEM A's processes missed the deliverables.

An interview with a senior manager stated:

> Generally you will find that the outsourcing ESPs are good at doing the drawing side, but less good at OEM specifics such as releasing the PDD activities, managing processes internally, reporting status etc. It is difficult for suppliers to recognise outsourcing providers as OEM A's people, they are classified sometimes competitors.

Offshoring for OEM A was a demanding task as they had never used an Indian company to offshore hundreds of PDD activities across the organisation with employees on both sides clueless to deliver. To minimise the challenges, OEM A sent out an expat team that was based in India for four-year duration to take ownership and daily running of the wholly owned engineering centre. The expat team was never thought off and created additional resources and cost to OEM. The expats were there to coach and educate the employees who were struggling with the PDD activities, in particular the working methodologies and processes required for each task.

The solutions to retain employees was to offer incentives such as sick pay, holiday pay and offered a variety of placements to work in UK to retain them within the offshore organisation. Thus, these incentives offered help retain the employees offshore that avoided additional employee attrition.

A senior manager responsible for offshoring mentioned:

> OEM A is not saving any money offshoring as the work done offshore is a little more inefficient; however the cost base is cheaper so in the long term there are some savings but having an engineer from India based in UK costs me the same as my permanent staff.

5.3.4. Implications to the PDD activities

Implications ranged from the PDD activities not being correctly outsourced or offshored and were backshored to HQ adding multiple complexities and delays during this process. The offshore employees did not have the relevant competence to complete these activities. Activities that were outsourced as part of a large programme consisted of core activities which the outsourcing ESP required much assistance to get these completed.

Offshore outsourcing implications required the onshore employees to regenerate and correct the work received from offshore, adding additional time and delays in the project. The key elements during the design phase had not been cascaded correctly and data was incomplete where OEM A experienced further delays and around 15 per cent reworking took place.

5.3.5. Decision making when outsourcing/offshoring PDD activities

The outsourcing and offshore outsourcing decisions were conducted at top level within OEM A and there was no clear decision-making model or processes apparent when the organisation outsourced or offshored their PDD activities. As there was no clear strategy within OEM A the outsourcing project lost a few hundred thousand dollars as the challenges were discovered in the latter stage of the project and OEM A lacked the underpinning requirements for outsourcing of the PDD activities.

Decision-making on outsourcing or offshoring of PDD activities was conducted by one person within OEM A and such decisions created additional complexities by not fully understanding the impact of outsourcing or offshoring activities that were required to be retained internally. As shown in Table 5.2.

OEM A's senior manager also mentioned that:

> Outsourcing enabled them to develop flexibility within the workforce between employees.

Type of contract	Fixed or Flexible costs
OEM A	Fixed Costs
Offshore Engineering Centre	Fixed Costs
Contractors	Fixed/Flexible Costs
Outsourcing	Flexible Costs

Table 5.2. Fixed and flexible costs

The senior manager then stated:

> If there are financial difficulties and a downturn in the economy its more difficult to make my own employees which are permanent redundant due to causes and costs associated with the business and it requires a great deal of money for redundancies. With our offshore engineering centre the employees are full-time but on a lower wage, therefore the impact is less severe whereas contractors are fixed/flexible and can be easily withdrawn from the business. Outsourcing organisations are flexible. Outsourcing is more expensive than contractors but our infrastructure does not allow further contractors and therefore any fluctuations in the business I would say outsourcing organisations would be the first to go. The biggest mistake we made was running the offshore centre with 30 people as the PDD requires circa over 100 people for profitability.

OEM A has outsourced complete vehicle derivatives and also model year changes to ESPs and has not identified any time reduction in the PDD phase as their cycle times for launching a vehicle remain the same but allow the organisation to develop a vehicle into the market according to their cycle plan.

The key executives interviewed as part of this research were unaware if offshoring provided any cost benefits to the organisation and how its success was measured.

Figure 5.1 identifies the engagement model used by OEM A. Since 2009 OEM A has developed a number of strategic ESP partners to conduct outsourcing of PDD activities. These ESPs were based onshore and had offices within a short proximity from HQ. Two of the ESPs had wholly owned subsidiaries based offshore whereas the other was in the process of engaging with a third party to reduce the PDD cost by taking advantage of lower wages in developing countries. OEM A also had a shared offshore third-party subsidiary which was utilised for cost-reduction purposes.

For OEM A to retain its position within the automotive industry and take on competitors the product range is becoming more diversified, leading to new ESPs being awarded projects whereas the outsourcing and offshoring strategies are far from covering the basics for a successful engagement.

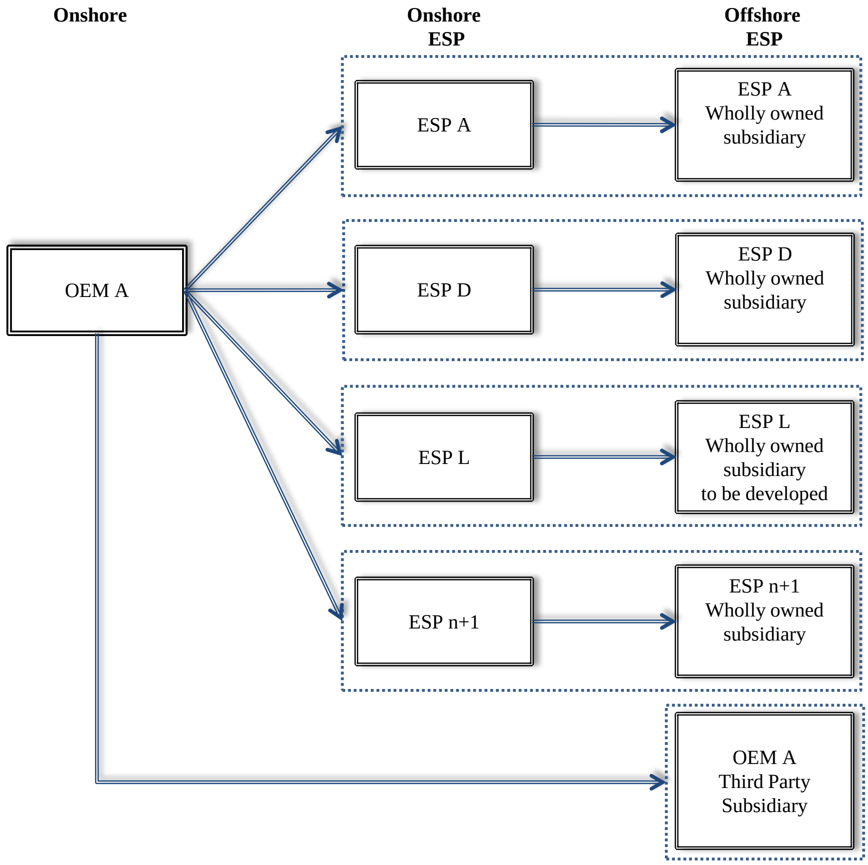


Figure 5.1. OEM A - outsourcing/offshoring engagement model

5.4. Case Organisation OEM C

OEM C is a large German automotive OEM with headquarters based in Europe employing over 110,000 people in 2013 with an annual turnover of $101 billion and independently owned. OEM C is part of the big three German luxury automakers. The organisation includes three separate automotive brands which are all run independently and are competitors of each other. The total annual production in 2013 was over 2 million vehicles globally with the largest a brand contributing to 1.7 million vehicles globally. The organisation also has other subsidiaries such as motorcycles, motorsports and several others. There is a strong emphasis to invest in research and development where in 2013 the annual spend was $6.01 billion of the annual revenue (six per cent of annual revenue) an increase of about $796.71 million from the previous year. The research and development underpins the organisation's future in terms of new technologies, PDD, lightweight composites, and many other future opportunities.

To keep up with the competitiveness in the automotive industry and reduce emissions of their vehicles, the organisation in 2011 introduced a new brand for electric vehicles to compete and retain their position in the automotive industry for electric vehicles where the key learning and electrical development is being carried over to other vehicle platforms to develop hybrids and reduce emissions. The full electric vehicles are developed using low-cost weight solutions making them even lighter than conventional steel with a strategic plan to start using the low weight technology into vehicles which are mainstream to reduce weight.

The organisation is introducing 20 new models/derivatives by 2020 with a vision to overtake OEM E which creates additional challenges for the organisation as the PDD cannot be done internally due to the engineering resources already being engaged on other programmes and projects. Their outsourcing of PDD activities increased since 2011 being witnessed through aggressive growth as new models and derivatives are being introduced to compete against competitors and increase their market share by giving a wider range of vehicles to customers, ranging from small vehicles to large SUVs. The outsourcing of vehicle development programmes to ESPs has increased in size from simple tasks to more complex complete vehicle development with their strategic alliances based mainly in Germany and the smaller PDD work packets are either sent onshore to smaller ESPs or offshore to their third-party ESP.

OEM C faced difficulties between 2007 and 2008 due to increasingly challenging market conditions. In an attempt to reduce costs they decided to outsource their entire vehicle body engineering design, consisting of interior design, exterior design, Body in White (BIW), CAE and other technical engineering services. Their vehicle design cycle plan is, on average, 36 months from the start of a project to job one where a finished vehicle rolls off the product line or 24 months for derivative and even shorter time for face lifts. The organisation's strategic business plan was focused solely on reducing cost by offshoring the PDD activities. It worked to improve cash flow within the business and take advantage of a low-cost developed country; having access to educated engineers, time zone differences and having a perspective that offshoring would reduce the PDD cycle time to market an automotive vehicle quicker and cheaper than its competitors. A detailed analysis of their offshoring is presented later.

In 2013, there were 922 additional employees working on PDD through their engagement with ESPs based onshore and 35 additional employees working offshore through a third-party ESP. The organisation has two wholly owned subsidiaries in China that conduct research and development consisting of 250 people and also a 50/50 joint venture. However, the China subsidiaries consist of many expats from Germany who are the key knowledge/fact holders.

The research will concentrate on how OEM C has outsourced and offshored outsourcing and offshoring PDD activities to their strategic alliances based onshore and offshore and the process used throughout their journey.

The sections below highlight key findings from OEM C.

5.4.1. How was outsourcing/offshoring of the PDD activities conducted

The offshore outsourcing project started in 2008 with a preliminary phase in order to prepare the organisation for transitional changes. OEM C's senior management team regularly travelled to the offshore ESP, ensuring that business objectives and deliverables were fully understood and management commitment was embraced within the project. During this stage the project teams (both onshore and offshore) met in person and shared information about each other in order to establish trust and common understandings. OEM C also dispatched a skilled workforce to the ESP based in India to support with transitioning the project.

OEM C committed to a three-year plan with their offshore ESP in order for them to become an offshore ESP delivering high-end and complete automotive vehicle solutions at low cost from India. The offshore proposition was to increase workforce from a small number to a few hundred in order to deliver the project at reduced costs. Therefore, the outsourcing offshoring business model was constructed to leverage more engineering design work offshore by taking advantage of labour arbitrage and simultaneously building the employees competencies. The project consisted of a complete vehicle development activity to be conducted in an offshore location.

5.4.2. Challenges experienced when outsourcing/offshoring PDD activities

The offshore ESP had difficulties in recruiting competent staff to complete the necessary work streams involved in offshoring engineering design work. OEM C management felt that the offshore ESP was moving ahead too slowly, which caused OEM C to lose confidence and trust in the management team based offshore with additional onshore employees moving to India. A number of engineers were recruited especially for this project, but OEM C felt that the daily work streams for executing knowledge-based PDD activities had been poorly managed, causing frustration and turbulence within the workforce.

The offshore ESP was also struggling with employee retention within the organisation, although this is a common issue in Indian engineering organisations. The initial phase of PDD offshoring started with OEM C sending out engineering design packages for Computer-Aided Design (CAD) modelling. The offshore model was developed such that OEM C's CAD co-ordinators onshore would liaise with counterparts based in India (using email, desktop sharing software, conference calling) to ensure that the work streams were sent out correctly and that sufficient information was provided to complete the task. A few months into the project and OEM C was facing communication problems with the offshore ESP, especially in the early design phase, which included unclear messages, not having the necessary level of CAD knowledge and a lack of competencies in automotive design. OEM C identified that the CAE engineers working on CAD design work lacked knowledge of the fundamental design rules and also had few surfacing skills due to the unavailability of skilled labour. In addition, OEM C identified that the background of the CAD engineers was mainly that of the information technology sector and that they lacked the necessary competence needed to develop a complete solution in PDD.

OEM C identified that there were further limitations in communication and was concerned with domain knowledge experience within their offshore ESP. The communication problems involved design work being reworked by OEM C's onshore teams or the offshore design not being used as it was incomplete, thus introducing additional billable hours into the project and adding costs not originally anticipated or considered. Due to the lack of domain knowledge expertise, this brought about additional interaction between onshore and offshore designers, leading to the redesign of work packets that resulted in hidden costs being added to the project.

During an interview, a senior manager at OEM C stated that:

> Work was sent back and forth around three times before it was correct and the information received from offshore ESP was not clear and the fundamental principles were not understood.

During another interview, the director of engineering at OEM C stated that:

> OEM C has the core capability to design a complete vehicle and the offshore ESP as an partner has less domain knowledge the information received from OEM C was not at a level easily readable, so requesting for further clarification caused delays in the design and created a number of iterations before completion. There is also another problem here; our management team do not have much experience on managing an offshore ESP located thousands of miles away.

At this stage OEM C identified that the project had started to deteriorate, so they decided to review the offshore business model. OEM C decided to change the offshoring model to reflect the recent challenges by positioning the offshore ESPs CAD co-ordinators at OEM C's headquarters in Germany, these would then become the main point of contact for liaising with engineers based onshore and provide feedback to offshore teams. The model was executed for a few months and failed to meet deliverables as the workforce within the offshore ESP was not able to produce the level of quality, design innovation or creativity that OEM C required.

The poor quality of the engineering work was identified at OEM C's onshore location where interfacing with other design components was incompatible, thus raising further questions regarding the craftsmanship of general engineering.

Figure 5.2 illustrates the outsourcing offshoring activity presented in a timeline format and illustrates the events that occurred in chronological order.

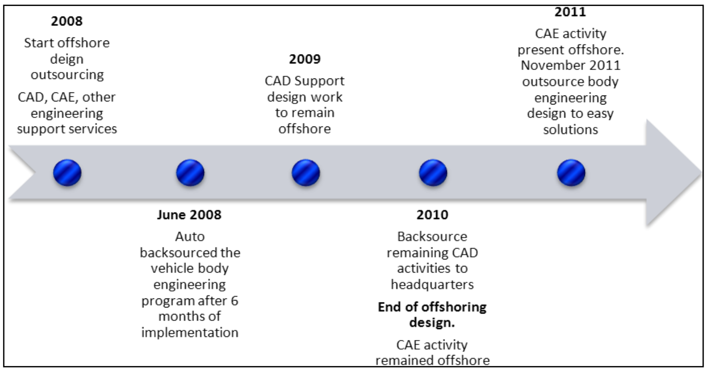


Figure 5.2. OEM C Offshore Outsourcing Activity

5.4.3. Actions implemented to address challenges

The challenges with the offshore ESP resulted in areas such as culture, communication, quality, knowledge transfer and a shortage of quality engineering resource.

A number of training sessions were implemented for both sides of the organisations in order to allow these employees to understand the importance of virtual collaboration and interaction which the organisation was not used to. There were a number of sessions to improve the communications and cultures between the two organisations as this method enabled their employees to work better collaboratively than in isolation.

After implementing these changes, the challenges still existed with the organisation experiencing problems and therefore the revised offshore business model was implemented. This consisted of allocating a key CAD coordinator from the offshore ESP into OEM C's HQ based in Germany. This person was responsible for co-ordinating the onshore activities and discussing with counterparts packed in India. This addressed the quality and communication challenges and was effective but did not resolve key quality issues which stemmed from the offshore capabilities and lack of engineering skill. There was little discipline in managing an organisation with a different time zone as most activities were sent over during evening hours in Germany and upon receiving these activities there was no support or guidance on what was required. A change was implemented to ensure activities were sent during working hours and the offshore employees understood what was required.

A different strategy was implemented whereby OEM C's PDD employees were instructed to define exactly the requirements of each activity and give the offshore ESP more information to conduct such activities.

The senior management team in both organisations lacked the experience in how to manage offshore outsourcing especially as this was the first offshored project from OEM C. There were learning difficulties on both sides and even with additional training and learning on the job there were challenges still present as the offshored activities required high levels of interaction and face to face communications (drafting of designs, group meetings and assessing physical prototypes).

5.4.4. Implications to the PDD activities

The offshored PDD activities consisted of non core, near core and core where the near core and core activities were not transferrable overnight to OEM C's HQ. This was because of the intensive work in progress and backsourcing would impact loss of knowledge and delayed time to market further. OEM C felt that their offshore ESP had underestimated the project size and that in particular the organisation was struggling to find the right talent with the required educational and practical experience to fulfil project expectations; impacting the PDD activities.

In June 2008, OEM C was still facing difficulties, in particular with the PDD activities and communications/commitments where they failed on many instances to deliver. Therefore, a corporate decision was made that involved backshoring the entire body engineering function from the offshore ESP to OEM C's headquarters in Germany as the risk of continuing the project included significant financial impact and a further delayed launch of the vehicle into the market. Consequently, the body engineering design phase was completed in-house where 65 per cent of the PDD activities had been restarted because the data was incomplete and there was insufficient detail behind these activities. The 35 per cent of activities already completed through the offshore ESP with extensive support from OEM C, where 25 per cent of these activities were reworked and adjusted onshore.

OEM C identified potential in retaining their offshore ESP to conduct the basic PDD activities such as CAD/CAE engineering support tasks, and decided to develop this relationship by retaining these activities offshore to avoid further implications and delays.

These offshore PDD activities required less experience and domain knowledge and helped to build competences within the workforce. All CAE related activities remained offshore, but quality challenges were still present as a number of activities involved complexity that was difficult for the offshore ESP to provide solutions and a mixture of core tasks had been bundled within the PDD activities sent offshore. In 2010, 24 months after engagement, all PDD activities were reviewed and the progress made was an improvement since engagement so OEM C decided to retain the highly labour intensive activities requiring a minimal level of communication /interaction, knowledge transfer and tacit knowledge offshore.

5.4.5. Decision making when outsourcing/offshoring PDD activities

There was a vague offshore decision-making model OEM C followed when offshoring their PDD activities: in this case the majority of PDD activities that contribute to vehicle development. The decision- making process was underpinned through cost reduction by offshoring the PDD activities to an offshore ESP.

Three months into the project OEM C accepted that outsourcing offshoring a complete body of engineering design was not as easy as originally anticipated, and required additional support from cross-functional areas during the PDD phase. For example, there had been disconnects between Body in White, interior, exterior, cabin and other areas that did not help the design process. These key areas required for a successful PDD integration did not take part in the initial decision-making process.

An offshoring business model was constructed to transfer the engineering PDD activities to lower the development costs but the underpinning activities were missing. The model was revised after OEM C experienced challenges and identified some risks that could cause delays to launch the vehicle into the market and increase the overall engineering development cost. Thus, the offshore model was changed such that OEM C's offshore ESPs CAD co-ordinators would transfer to Germany where they could liaise with counterparts based in India but co-ordinate all the activities from the onshore employees with a single point of contact.

After a few months of executing the revised offshore model to address the challenges OEM C were still faced with quality, innovation and creativity challenges and therefore decided to terminate the engagement and backsource the PDD activities to their HQ in Germany.

Figure 5.3 shows the different ESPs, OWOS used by OEM C when outsourcing/offshoring their PDD activities. OEM C is using a number of ESPs which are based onshore to the engineering headquarters outsourcing a large number of PDD activities; whole vehicle development, testing and other areas within the vehicle development are outsourced.

The ESPs which are based onshore also had wholly owned offshore subsidiaries where PDD activities were offshored and in some instances activities that required a high level of skill had been nearshored to their wholly owned subsidiary as shown by ESP D. Some of the ESPs did not do any offshoring as they failed previously, had bad experience with PDD activities but instead they nearshored to their wholly owned subsidiary based within a short traveling time as shown by ESP O.

OEM C has a wholly owned offshore subsidiary based in China where they are producing automotive vehicles and also conducting some engineering activities for the local market. The organisation based in China does not support any regional hubs with PDD activities and are limited to their competences. OEM C is also using an offshore ESP based in India for conducting PDD activities based around cost saving within the organisation.

However, through outsourcing and offshoring OEM C shifted their fixed costs that would have occurred internally if the headcount were increased into flexible costs through the use of an external organisation. The advantage of this was a number of vehicle programs during the early stage of development had been cancelled as the business case was not feasible. This allowed OEM C to leverage the external ESP.

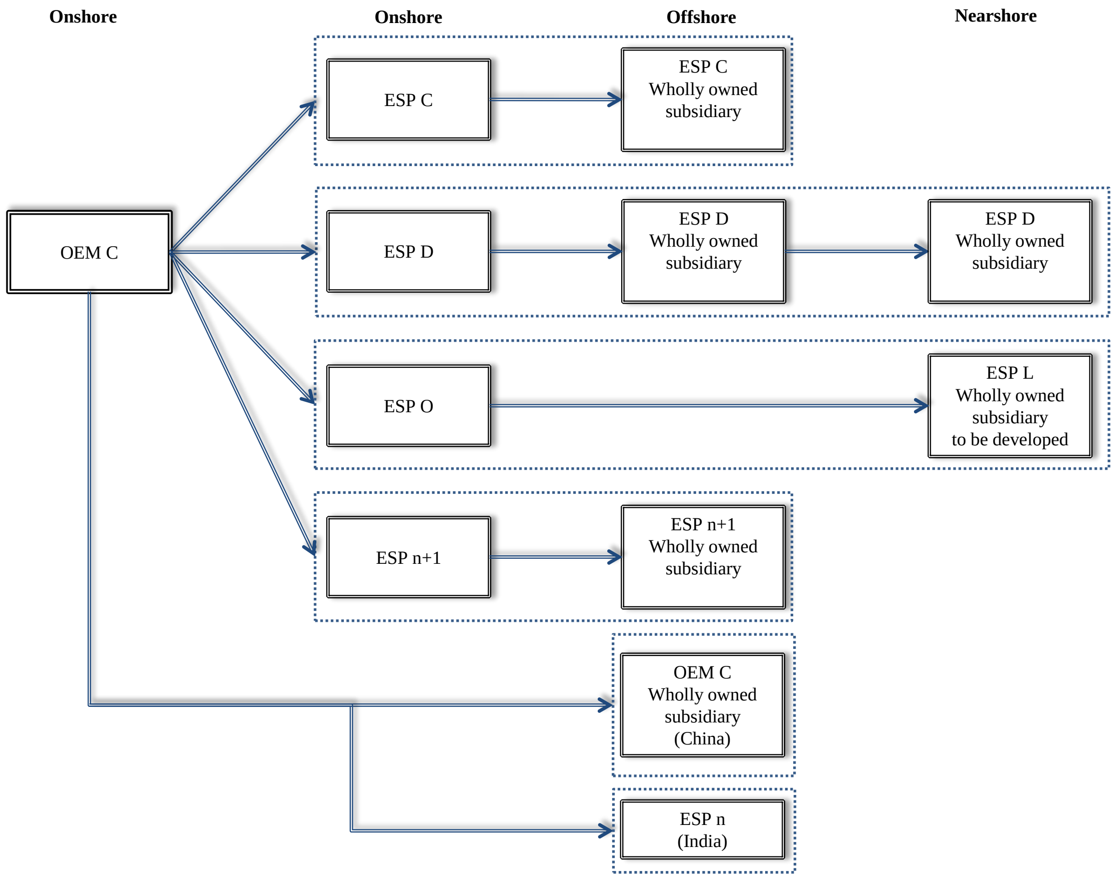


Figure 5.3. OEM C - outsourcing/offshoring engagement model

5.5. Case Organisation ESP D

ESP D is a service provider that supports automotive OEMs, FTSs and other ESPs in PDD providing innovative and unique solutions with headquarters in Germany. The organisation consists of three subsidiaries. The first subsidiary is vehicle development, the second production solutions and third electronic and vehicle mobility. The vehicle development subsidiary has grown significantly over the last few years whereas the other two subsidiaries are developing steady growth. ESP D is also part of a wider subsidiary that is independently owned. ESP D emphasises research and development, in particular researching of new technologies to become more competitive in the market and provide customers with innovative solutions, making them more unique and favourable to customers.

In 2012, ESP D consisted of 3,900 employees which are mainly situated in their own offices next to the OEMs PDD facility with annual revenue of 350 million euro. The organisation has wholly owned subsidiaries in China, India, Malaysia, Hungary and other nearshore countries. Of the 3,900 employees there are around 320 in China, 150 in India, 30 in Malaysia and 150 in Hungary. The organisation also has wholly owned sales/project offices subsidiaries in Sao Paulo, Spartanburg, Seoul and many other locations follow their customer when required.

ESP D has experienced global growth through M&A's than rather developing organic growth, competence internally. To stay competitive the organisation addressed inefficiencies in areas consisting of electronics and PDD for automotive and aerospace sectors.

During the start of 2013, ESP D acquired a manufacturer of independent engineering services for the automotive industry aerospace industry and had over 650 employees working at two sites consisting of engineers working on procurement and PDD. The acquired organisation provides key engineering product development solutions to OEMs G, F, J, and R with core development in automotive electronics and engineering testing and development. The acquisition was underpinned to become more diversified in the ESP domain.

During the latter part of 2013, ESP D acquired ESP P to address their PDD gap and build new competencies in areas to provide better competiveness and ensure cutting edge solutions were provided to their customers. A large organisation for engineering services in based in Germany with wholly owned centres in global locations. ESP D is ranked the second amongst the ESP industry. The acquisition was underpinned due to the competencies and skills resources readily available in PDD which will enable the organisation to take on complete vehicle development from initial concept to build and manufacture.

In 2013, the number of employees working at ESP D was 7,300; a rise of 3,400 employees with a wide diversification within the organisation for automotive, aerospace, rail, and other services. With the two acquisitions revenue was increased from $464.7million to $844.5 million equating to 80 per cent increase in revenue. For pure engineering services $528 million dollars contributes towards the overall revenue which is a substantial amount compared to smaller ESPs.

ESP D project sizes were in the region of $86.31 million to $112.866 million with the smaller projects offering around $15.93 million onwards. ESP D had three subsidiaries, the research study concentrated on their automotive vehicle development (product design and development) and how PDD activities had been outsourced, offshored and development of an OWOS.

The sections below highlight key findings from ESP D.

5.5.1. How was outsourcing/offshoring of the PDD activities conducted

The decision on outsourcing and offshoring PDD activities was at executive level, focused on cost reduction and ad hoc decisions. The COO explained:

> The business plans were rather grey and we were not in a position to conduct any outsourcing or offshoring but due to engineering capacity constraints for onshoring we had no option and for offshoring. The organisations approach was rather undeveloped and was very immature in this approach.

Outsourcing became a necessity within the organisation due to the lack of engineering capacity and the organisation required additional people to carry out these activities. The outsourcing engagement with an ESP had been restricted to onshore organisations to avoid communication problems because the level of interaction and work involvement would cause difficulties when offshored. ESP D had a decentralised strategy where they would develop a wholly owned subsidiary based onshore and next to the customer's PDD centre.

The offshoring journey started because there was a drive to reduce cost internally and externally from their customers. Thus, ESP D had to address this requirement to further improve costs when quoting for new work and also reduce the internal PDD costs, making the organisation competitive. Offshore outsourcing started in India because there was a large talent pool of educated people and ESP D wanted to take advantage of the talent pool. As the organisation had German heritage they were reluctant to develop a wholly owned subsidiary because their knowledge on offshoring to India was rather limited and the costs of failure could have positioned ESP D in financial difficulties. Therefore, in 2008, ESP D engaged with an offshore ESP for this organisation to carry out PDD activities.

5.5.2. Challenges experienced when outsourcing/offshoring PDD activities

The initial offshore engagement started with a third-party ESP where challenges arose when offshoring to India that ESP D did not consider. Firstly, there was difficulty with communication and especially with the engineers working on PDD activities. The communication issues caused delays in meeting gateways and further difficulties arose in maintaining the level of quality necessary and skills required for the offshored PDD activities.

A senior executive within the organisation playing an instrumental part of ESP D's offshoring move stated:

> The offshore organisation was only working to the level of data they had from our organisation, we still have a learning curve to go through because writing and doing an activity is completely different which cannot develop overnight.

ESP D identify there were communication barriers on both sides of the organisation.

Engaging with an offshore third-party ESP based several thousand miles away from the outsourcing organisation which could not manage the centre directly and therefore the management commitment to ensure activities and tasks are completed on time and within budget was not met. The two organisations had different business objectives as ESP D aspirations were to develop offshore competency and skill sets whereas the offshoring ESP was only interested in delivering the PDD activities and not developing the organisation's employees and ensuring maximum profit from the engagement.

One of the senior managers from ESP D who managed the offshore ESP stated during an interview:

> It's a shame that our business has lost time, money and confidence from an offshore company and from our learning with an offshore ESP I will not develop another engagement because it's just too complex and the challenges did not really get resolved.

Due to the communication barriers between onshore and offshore employees, the quality of data was jeopardised and resulted in a number of work activities being reworked by the onshore employees and subsequently the cost perspective of offshoring was no longer present.

The challenges outlined resulted in additional costs, resources, delays in completing PDD activities, lack of commitment from the management team and additional time was required to manage the offshore ESP. As these challenges had a negative impact to ESP D's organisation the management decided to terminate the offshore ESPs contract and develop their wholly owned subsidiary.

The senior manager part of ESP D's management team stated:

> Developing a wholly owned subsidiary allows our organisation to control our own management and have full commitment in providing PDD activities.

Additionally, ESP D was on a growth trajectory and the offshore third-party organisation did not provide the benefits and was not prepared to grow with the organisation.

ESP D developed a wholly owned subsidiary based offshore in 2008, located in India where they could overcome these challenges encountered with a third-party offshore ESP. However, during the engagement, challenges still existed even though the subsidiary was wholly owned. The local offshore management team were responsible for the development of the organisation and 12 months into the offshoring journey management challenges, commitment and dedication was lacking.

The poor quality of work carried out by the offshore organisation resulted in ESP D spending additional time onshore to correct mistakes. The CEO of ESP D mentioned:

> Our challenge is to take care of the right quality and not to rework much of the design that is coming from the offshoring centres. Currently we are spending about 20 per cent of our time reworking the design work which seems to consume over a month a great deal of time especially on German rates.

ESP D also had challenges in trusting their management in their offshore subsidiary which was located several thousand miles away from the HQ. The COO of ESP D mentioned during an interview:

> We identified that the local managers based in India had been transferring money into their own accounts and were not committed to the offshore facility. I then went over to India to run the offshore subsidiary. We also identified that the number of people used for offshore outsourcing could not be carried over when developing our wholly owned subsidiary and required over 100 people for financial benefits.

ESP D had challenges to retain their employees where employee retention became an issue and in excess of 10 per cent of employees were leaving the organisation each year. Engineers leaving the organisation who had specific knowledge on certain PDD activities created further challenges because knowledge transfer was missed and the activities took twice as long to complete.

The CEO mentioned during an interview:

> We need to build a stable team as there is much fluctuation with offshoring as you know in areas of India is higher than EU. Training relevant people and promoting them has worked in some instances but there are companies down the road that are offering better salaries, making it a motivation for our employees to leave and join them. As a business this creates challenges as the experience people leave and we are faced with reintroducing training and coaching, ultimately starting again.

5.5.3. Actions implemented to address challenges

ESP D implemented a number of actions to counteract the challenges. The communication challenges were addressed by ESP D to clearly defining exactly what activities were required from the offshore organisation, but required ESP D to be knowledgeable on how to describe a work activity and the procedure required. A number of illustrations and supporting documents were used to help aid the offshore ESP which helps ease confusion.

The lack of management commitment was addressed by having an expat employee from ESP D based in India for several months, this was a long and costly process funded by ESP D.

A number of strategies were used to engage the offshore ESP to develop a long-term vision but the management team were concentrating on squeezing costs and making profits from the engagement. There were conflicts between the management teams from both organisations having different objectives. When ESP D developed their offshore wholly owned subsidiary they implemented a transition team which consisted of an expat who would be responsible for the organisation, and for specialists in the field of PDD to educate/coach the offshore employees and achieve the level of control required. The expat was based in India for a duration of four years, even after this period, there were challenges remaining on which PDD activities the organisation could offshore without facing these additional complexities.

The poor quality of work was down to a number of reasons; firstly the offshore ESP employed graduates who were fresh from university and they had minimal experience and secondly full information was not cascaded correctly. The offshore ESP shuffled their employees to make improvements by adding an experienced engineer to a team of five graduates who would then liaise between the team members. This did not really work as the team members lacked basic fundamentals of PDD, and ESP D supported the organisation when necessary. Even after implementing these actions to address the challenges ESP D struggled to maintain offshore efficiency.

However, these challenges still existed and little improvement was made.

5.5.4. Implications to the PDD activities

The PDD activities sent offshore had been incorrectly specified by ESP D as there was no process or clear objective on which activities are most suited an offshore ESP. These PDD activities suffered the lack of knowledge contained within the activity and a number of changes made had implications in the development process where engineering designs could not be integrated with other parts of the vehicle because employees work independently and more importantly the design activities had been downloaded offline which were out of date and progressed through. The offshore reworking of PDD activities was approximately 15 per cent.

5.5.5. Decision making when outsourcing/offshoring PDD activities

There was no clear decision-making procedure or process that were used in ESP D but the overall approach was more of an ad hoc strategy when outsourcing/offshoring their PDD activities. The decision was based on cost reduction where most of the decisions had been made at top level (single executive) within the organisation and minimal consulting of other managers in the organisation who had a deeper knowledge and understanding of the PDD activities.

The offshore employees were unable to complete the PDD activities work because they involved a high-level of interaction and internal knowledge which was within the ESP D's organisation. These activities required extensive periods of communications between the two organisations and PDD reviews resulted in them being transitioned back to ESP D due to their complex nature and level of skills and competence required. The decision-making on outsourcing or offshoring has not improved ESP D's way of delivering products to the market any faster.

ESP had a long-term plan for their wholly owned subsidiary based offshore and was planning on a 3-5 year payback period where only 10 per cent of their total PDD activities had been offshored. The development of ESP D's wholly owned subsidiary was $2.19 million which included works stations, catia licences and other consumables which was only spent after they failed with an offshore third party provider and fully tested the offshore outsourcing proposition. The organisation has not benefited any time savings while outsourcing or offshoring their PDD activity.

5.6. Case Organisation ESP L

ESP L is an independent engineering services organisation that also supports automotive OEMs PDD with headquarters in United Kingdom. The organisation has an automotive division, automotive manufacturing facility along with aerospace and other sectors. There is a strong presence of research and development within the organisation to provide its customers with cutting edge solutions and collaboration with local universities.

The organisation is owned by three shareholders who are working as executives within the organisation and liaise with customers and employees on a daily basis.

In 2013, the organisation's revenue was $32.9 million dollar where the automotive engineering revenue was $26.6 million with 190 people working in United Kingdom as this organisation does not have any wholly owned subsidiaries but was in the planning stage to develop either a wholly owned subsidiary offshore or engaging with a third-party service provider based in an offshore location.

The organisation has an ambitious strategy to grow the annual revenue from $32.9 million to $78.3 million through the development of smaller acquisitions of organisations and offshoring the PDD activities where the organisation can leverage from a lower cost and enable the onshore employees to concentrate on higher value activities.

The project sizes vary from small work packages in the region of $6.10 million to the largest currently $15.64 million with future projects to reach over $31.28 million.

There is a strong emphasis from the customer that ESP L should reduce the PDD costs as the cost base currently is relatively high, in excess of 20 per cent. Therefore, to address this request, ESP L is looking at a number of options to develop a wholly owned subsidiary offshore or engage with an offshore ESP.

The case study focuses on the automotive division, in particular PDD, and how this organisation is planning to offshore its PDD activities to an organisation based in India.

5.6.1. How was outsourcing/offshoring of the PDD activities conducted

ESP L is currently not outsourcing any PDD activities because there is no demand within the organisation and there are sufficient engineering resources internally. The management team did mention that once they become more established and further projects/programmes have been secured there will be a requirement to outsource these activities locally or through a nearshore ESP, but there was no organisational decision or strategy within the business plans. Due to competitive pressures in the automotive industry, the customers of ESP L are requesting cost reductions in the PDD phase and ESP L is reviewing the proposal to engage with a larger offshore ESP which they already have used for almost six months through offshore outsourcing short work packets consisting of PDD activities and almost any activity is offshored.

5.6.2. Challenges experienced when outsourcing/offshoring PDD activities

Communication was the key challenge experienced by ESP L and resulted in other inefficiencies within the organisation. The short work packages (consisting of PDD activities) sent to the offshore ESP involved a high level of skills set and knowhow knowledge which was limited in the organisation. These work packages ended up with the offshore ESP communicating very poorly, timescales were never met and there was no urgency within the organisation to deliver these work packets on time. The engineering director mentioned:

> When the offshore organisation based in India failed to deliver, have no urgency drive and so forth you automatically lose confidence and trust with this organisation. From here onwards the offshoring journey became even more complicated. We had to increase the PDD activities to free internal resources and to gain better cost advantage.
>
> The offshore ESP based in India had a culture of saying *"yes yes yes we understand everything during communicating"* but actually there were open questions that never got asked. This led to design not being complete, quality of activities lacking attention to detail.

The engineering director further mentioned:

> There is no bravery with an offshore provider based in India we have no trust, commitment and reinsurance the guys can deliver. Because we have not had a successful outcome we are looking at different ways to make offshore more efficient but the time you invest in making this work outweighs by us just doing it yourself internally.

5.6.3. Actions implemented to address challenges

The key challenge of communication was addressed through deployment of additional work activities and supporting documentation which supported the offshore employees complete the PDD activities.

The offshore management team were requested to employ a skilled workforce who could work on high value PDD activities at a cost base lower than the UK. The offshore ESP first reviewed internally to understand if there were any capable employees. As the organisation did not have any internal capable employees, they searched on the market to acquire three skilled people in automotive PDD. The offshore ESP even tried their most skilful people but their knowledge was not suitable. This activity of recruitment took over three months by then ESP L lost faith and trust and was spending more time onshore correcting the offshore mistakes. This engagement did not include any expats as ESP L.

A PDD phase requires the engineers to be innovative and creative through challenging one another by asking questions about the PDD phase and understanding if the selected method is the most efficient. The offshore organisation was coached and trained to persuade them to ask questions during the design phase and when they interacted with the onshore organisation. ESP L used virtual communications to support the offshore ESP and provided clear instructions on what was expected, something that was not done before. Documenting what was required from the offshore ESP helped with the challenges. Thus, the challenges experienced resulted in ESP L terminating the offshoring engagement and all activities being backsourced to UK.

5.6.4. Implications to the PDD activities

The core PDD activities belonging to ESP L had been offshored to their ESP without knowing which internal activity was non core, near core or core and the core activities could not be completed as the offshore ESP did not have core capabilities.

A number of PDD activities ranging from non core and core had been offshored to the ESP without analysing the consequences and importance of each offshored activity. The core activities over a period of time lost their heritage within ESP L where in a few instances the onshore employees left and the offshore employees who worked on the core activities had more knowledge than ESP L.

5.6.5. Decision making when outsourcing/offshoring PDD activities

The management team in ESP L are knowledgeable on outsourcing and offshoring of PDD activities due to their past involvements and achievements throughout their working career at different automotive organisations. However, in this instance, ESP L did not have a clear strategy on how offshore outsourcing with a newly engaged partner based in India was to be conducted. One of the management team did mention during an interview:

> Our offshoring model would be based on cost and therefore we don't really need to understand which activities can or cannot be offshore.

During another interview, the CEO mentioned:

> When offshoring you need a long-term plan, commitment, dedication to ensure there is good payback and the approach we had taken was not the most efficient.

5.7. Case Organisation FTS C

FTS C is a first-tier supplier and has two main divisions, seating and electrical systems, to the automotive industry with headquarters in Michigan USA where the company was founded in 1917. The organisation designs, engineers, and manufacturers the components whether single or complete systems and delivers to the customers. Their electrical division has the same business model.

In 2013, the organisation had 218 locations in 35 countries; annual revenue is $16.2 billion, and employs over 122,300 people globally. For instance their seating statistics identified that in 2013 the organisation shipped 786 million parts globally and their electrical statistics identified 8.5 billion parts were shipped globally.

The organisation is growing quite remarkably but they are rather constrained in employing people to carry out the PDD activities. The customers are demanding a cost reduction in the PDD phase so this organisation is required to address the customer's needs. The organisation has therefore developed over 100 manufacturing facilities in offshore and nearshore locations, to name some; India, China, Philippines, South Africa, Poland, Vietnam and concurrently uses onshore ESPs for capabilities and engineering capacity shortages. FTS C can utilise their low-cost country engineering and manufacturing facilities to provide their customers with cost competitive prices. The organisation has two core engineering technical centres which are wholly owned and based in North America (HQ) and Europe and three low-cost engineering centres based in India, China, and Philippines. Table 5.3 identifies the locations, number of people employed and where the wholly owned centres are developed.

Location	***People***	***Developed***
Europe (not low cost)	175	1990’s
China	10	2010
India	150	2008
Philippines	175	2002

Table 5.3. FTS C Engineering centres

However, there is a gap in the competence and capabilities between these wholly owned engineering centres in particular the low cost countries. In Europe there are 175 people, China consists of 10 people, India consists of 150 people and Philippines consist of 175 people.

This research will concentrate on the organisation's low cost engineering centres and which activities are outsourced and offshored and the approach taken when developing a wholly owned subsidiary.

Section 5.7.1 highlights the key findings from FTS C.

5.7.1. How was outsourcing/offshoring of the PDD activities conducted

The need to outsource arose as FTS C was required to increase their internal engineering resources as the project demand was increasing with new projects being secured and the number of engineering resources necessary to perform these activities was lacking. As they had already outsourced to a few ESPs based locally and in nearshore locations, the organisation wanted to take advantage of cost reductions at the same time as employing educated people. The organisation was looking at developing a wholly owned subsidiary but the management team were hesitant in spending millions of dollars in completing this activity as they did not fully understanding the different countries, the people and more importantly the management did not know enough about outsourcing and offshoring of PDD.

Therefore the organisation engaged with an offshore ESP based in India which claimed to have some experience in automotive PDD. The approach FTS C used was to offshore any activity to their selected ESP without considering the consequences or taking into account the sensitivity of the activities followed by effects they have on the organisation's competitive advantage. The director from FTS C stated:

> Pre study activities such as, can we adopt this product for a particular new vehicle development and check package studies are offshored which are easier than others.

The level of detail required for each PDD activity was the responsibility of management all who were new to offshoring of engineering services. The executives did not get involved with the level of PDD activities the organisation was offshoring but were more interested in giving an overall offshoring decision to go ahead with the engagement.

The organisation had a business plan to grow and expand in emerging markets and the primary focus was to establish a more defined footprint in this area. Asia in particular has continued to present significant growth opportunities for FTS C and many other major global automotive manufacturers, therefore a number of subsidiaries had been developed in Asia totalling to 18 joint ventures located throughout Asia in 2013.

FTS C's offshoring engagement was over a period of two years and after the first 12 months they decided this engagement was poorly decided so after 18 months they developed their wholly owned subsidiary in 2002 based in Philippines, India was developed in 2008 and China developed in 2010. The director from FTS C mentioned:

> I would never engage with an offshore third-party organisation, if I knew all these problems beforehand I would have gone for a wholly owned subsidiary, have a UK expat in the offshore centres to ensure the quality was good, and answer enquires that people would have ultimately acting as an interface.

5.7.2. Challenges experienced when outsourcing/offshoring PDD activities

There was resistance from the employees based in UK who shared minimal information with the third-party offshore ESP as they were seen as a risk: the employees feared for their jobs. The director of engineering mentioned:

> Managing an offshore external organisation was difficult and we could not get on with the management and spent more time in managing management than actually doing the engineering work activities.

When FTS C created PDD work requests for certain activities sent offshore, the ESP did not completely understand what the engineers were asking, there were some misunderstandings through communications and instead of asking questions the offshore employees just completed the activity and realised errors after spending hours in some instances days up to one week.

There was no formal process on how activities should be offshored and the level of information required for such activities.

The level of quality from the offshore organisation was poor, this included tasks such as 2D drawings, 3D data and the level of engineering competence was lacking from what our expectations were from an ESP. A senior manager who worked with offshoring on a daily basis stated:

> The competencies between centres are different. Let's take China for instance. They are very technically competent in package studies but they lack simple engineering detail. It comes back to having practical knowledge that is learnt or made available for one to understand. Most of our employees are green straight out from university.

As there was no offshoring strategy behind the engagement FTS C offshored a complete development programme that faced difficulties and challenges to their offshore ESP. FTS C lacked having experienced people who knew the product and this became a challenge internally. During the early phases of the development programme it required both organisations to significantly interactions with the customer which was lacking as the offshore organisation was used as a job shop where continuity had become an issue and people were employed on jobs no fully complete.

These challenges ended with FTS C deciding not to work with the offshore organisation so the highly intensive and critical PDD activities were backsourced and the organisation started to limit the amount of activities sent offshore that required intensive knowledge. The challenge of increasing the PDD activities within FTS C's own subsidiary was rather important as they needed to develop a workload content of 100 people to justify the existence.

5.7.3. Actions implemented to address challenges

The employees feared their jobs as the offshore employees were paid a lower rate and therefore they had the perception that jobs would be taken away from them. The actions implemented by

FTS C were to educate and train their employees to allow them to understand the benefits offshoring and how critical it was to the business success.

The communication challenges were addressed by having an expat present on all conference calls between the onshore and offshore employees, making it easier for the two organisations to communicate. The expat had a role of describing to the engineers what the onshore team was describing. This activity went on for a few months but there was no real improvement because the information was translated a number of times and was time consuming on the activities the offshoring organisation was developing.

Managing the offshore ESP organisation involved sending a local manager from the UK over to India at the expense of FTS C which cost over $300k. The manager’s role was to supervise and coach the offshore organisation to allow them understand the philosophies and how we work as an organisation. As there was barriers in communication and the management lacked the skills of delivering and committing the journey was rather difficult and very time-consuming. The engineering director at FTS C who had first-hand experience of these challenges stated:

> There are many cultural differences between countries. So for instance in India, there is a mentality of ‘I will not ask questions’ because it almost looks shameful. This leads to other problems; as if they do not ask questions regularly then the output of designs will be incorrect. We cannot afford to run our business based on not asking questions, the entire PDD requires interactions and through questions to be asked.

The onshore engineers tried to convert knowledge which was commonly known internally to explicit knowledge in order for the offshore employees to provide the level of maturity required for these activities. The duration of this task took over several months and during that period there was minimal improvement because the offshore organisation was already working on these activities and there was insufficient time to conduct training and documentation. The director from FTS C stated:

> It a bit difficult to try and design if you are not over the shoulders of the designers, a bit hard to understand if this design will work, etc. shoulder engineering – no feedback can be challenging.

In addition FTS C had a number of people from the offshore organisation based in Europe who could assist their offshore colleagues with the exact requirements from the engineers in Europe. There was an improvement but the management were unprepared to commit for a long-term engagement because the cost of having an offshore engineer in Europe was twice or three times the salary of an Indian employee under an offshore ESP, but was used when they developed their wholly owned subsidiary.

5.7.4. Implications to the PDD activities

The PDD activities became disruptive because there was no clear strategy regarding which activities could be offshored and FTS C backsourced a number of activities, resulting in additional time required by the employees based onshore at high rates to rework the errors, customer delays in launching and supporting projects.

FTS C used the offshore organisation as a jobbing shop which meant that consistency throughout the development process was not adhered to and continuity for each activity was disrupted. For instance, the engineering director at FTS C mentioned:

> Using the offshore organisation as a jobbing shop created difficulties for the engineers to follow through the PDD activities which became muddled and the overall effect was more time and resources required to put things right, which could have been avoided if there was upfront planning.

Due to the lack of competence based offshore, these activities lacked attention to detail which is required in PDD affected these activities due to the fact that simple underpinning engineering rules were missing. The onshore organisation decided to restart these activities because the time taken to review each stage equated to the total time taken to redevelop the activities.

The rework rates with an offshore ESP or a wholly owned subsidiary were in the region of 20 per cent but after some changes in addressing the challenges the reworks had been reduced to 15 per cent but the onshore employees still check the data thoroughly with a low confidence level. However, this took over 6 years to develop a long-term plan.

5.7.5. Decision making when outsourcing/offshoring PDD activities

The management team in FTS C took the approach to outsource and offshore PDD activities based on a ‘me too’ decision and imitated other organisations in the industry with a team of inexperienced members. The team that was allocated for this task was new to outsourcing and offshoring and already had committed, engaged and offshored activities so these decisions could not be easily reversed. The managers working in PDD will usually have a request from the engineering director to use their offshore facilities on program/projects to reduce the costs; these managers randomly offshore any PDD activity to their ESP without understanding the consequences of each activity and what underpinning information is required for these activities so the external organisation can ensure efficient delivery. The outsourcing or offshoring decision did not improve the time to market of their products but supported in launching products on time or in some instances later than expected.

The negative experience with their offshore ESP steered FTS C to develop a wholly owned subsidiary which was first opened in the Philippines to take advantage of the very low costs associated with this country. It was opened in 2002 and is only providing administrative support, while drawing support and test report writing for the European centres. The people working in the offshore subsidiary for instance are educated to degree level but the rate is much lower than China and India. The centre in the Philippines was developed with an expat who was there for a number of years and trained the people offshore.

The engineering director responsible for the development stated:

> We had not really developed a decision-making process when we outsourced our activities; it was more of a quick reaction from the business to reduce costs and save money. We have identified there is a critical mass required to make offshoring work and

> we will use this learning in future wholly owned subsidiary developments whereas the centre was making a significant loss due to our incomplete strategy.

In 2008, FTS C developed a wholly owned subsidiary in India because they had negative experience with the offshore ESP and wanted to avoid the challenges of the experience with a third party. However, the organisation thought they could develop their offshore subsidiary without implementing the key learning challenges from their current engagement and have faced all the learning difficulties again but this time they had more control and better management commitments because these were internal employees.
The engineering director mentioned:

> I will never use another third-party organisation based in India, now there is no need and I have an extended headcount which these countries are dedicated to our organisation and our reporting to our UK organisation. It is much easier to manage our internal subsidiary having all the billing structures are in a single place and the key enablers are present such as cost, resources and infrastructure.
>
> One big lesson that we have learned as an organisation is to bring over the offshore colleagues as early as possible during the PDD face so they can learn and understand our systems and processes, which is a key item from a hindsight perspective.

In 2010, FTS C developed another wholly owned subsidiary but this time based in China and was due to the growing market and to support the customer on a number of projects.
The engineering director mentioned:

> We are still learning new challenges and ways on how to offshore PDD activities efficiently and smoothly to our wholly owned subsidiaries. The offshoring strategy is based on cost reduction so we will keep on chasing the cost advantage and not use a long-term strategy so for instance if country A is lower than country B on costs we will remain in country B and then if necessary move to country C which may have even lower labour rates.

FTS C does not know whether there is a cost saving when offshoring and they are not tracking this cost. The engineering director stated:

> The costs are not tracked so we do not know if this is costing the business less and in terms of value for money we do not know whether, offshore subsidiaries provide value for money. Our offshore facilities are being used for overflow of engineering capacity because we can source them overnight but these centres are not fully capable in terms of attention to detail and the ability to design. There is no hands-on experience to deliver a project.

5.8. Case Organisation FTS J

FTS J is a first-tier supplier and a leading supplier of safety components within the automotive industry and headquarters in Sweden with a global presence serving customers around the world. In total, it has operations in 29 countries.

Its revenue in 2013 was over $8.8 billion and it employs over 66,000 employees globally, ranging from PDD, manufacturing, research and development.
Sales were typically 32 per cent Europe, 33 per cent America and the remainder from the rest of the world. In terms of contribution 54 per cent was from the top five customers.

As the automotive industry is becoming even competitive due to the cost element becoming an important factor in the product design and element phase, FTS J is required to address the needs as their customers have demanded a cost reduction of the product developed and designed. Cost reduction was not only the issue as the internal engineering capacity was employed on other projects so the organisation wanted to free up engineers in order for them to concentrate on other programs/projects.

The two main areas of concentration for this research study was how the organisation outsourced locally to ESPs and more, in particular, the engagement with the offshore ESPs which phased into a number of challenges they faced leading to FTS J developing a wholly owned subsidiary. Currently the organisation is offshoring its PDD activities to its wholly owned subsidiary in India, and the China facility is only supporting the local region whereas the India engineering centre also supports the global business.

The sections below highlight key findings from FTS J.

5.8.1. How was outsourcing/offshoring of the PDD activities conducted

The FTS J approach to outsourcing and offshoring started initially with outsourcing to local ESPs based locally as they did not have the internal engineering resources to conduct PDD activities. The majority of the PDD activities are retained internally but when these activities were outsourced to ESP J for instance difficulties arose in understanding activities that could be outsourced. The FTS J approach was to outsource any PDD activity to free up the internal engineering resources.

FTS J initially started offshoring with a third-party ESP in 2008 to reduce costs and have an extended engineering resource they could use as and when required. The cost reduction was driven by their top five customers requiring an element of low-cost country development. These customers contributed to 54 per cent of FTS J's revenue so cost reduction through offshore outsourcing was critical for the organisation. FTS J's offshore engagement contract was for a period of two years and then extendable if required.

In terms of outsourcing and offshoring FTS J is using offshoring for software development more than PDD activities for which the centre was originally set up. The engineering VP stated during an interview:

> We are offshoring only some design but I would say this equates to a small amount.

5.8.2. Challenges experienced when outsourcing/offshoring PDD activities

The challenges are analysed separately for outsourcing and offshoring. With outsourcing the challenges were the following:

The onshore challenges with FTS J had been that their processes lacked the ability of being used by an external organisation, creating communication issues and impacting the quality of work. The executive vice president responsible for engineering at FTS J mentioned:

> I would say that our processes are not that strong which means that we needed more management control with these employees being overworked. We as an organisation should have identified this beforehand rather than getting to this state in the project.

The external ESP who had engaged with FTS J had little knowledge about the organisation's design phase and most of the knowledge internally was tacit which was retained internally between the engineers as they did not want to share this information because of IP. It became a challenge when going through the design phase for further information was required leading to delays and reliance on the outsourcing organisation to feed this information.

Below are the challenges with offshoring:

FTS J biggest challenge was based on critical mass as the volume of work content was very low and a good pay off was not reached as the man years were two, three or even four. This for offshoring this was too small which was identified during the latter part of the engagement.

There were cultural aspects with the offshore ESP where they lacked understanding of the onshore engineer's requests that produced a different output where the PDD activities took longer than expected. PDD activities were converted into work packages and were transferred back and forth because of the quality issues, due to FTS J's inability to document or specify what was required. Overall offshore outsourcing was more expensive than retaining the activities internally as additional resources and money was spent in managing and controlling the offshore organisation, as the director mentioned from FTS J:

> We have spent an extra $400 thousand from our organisation that should not have happened.

FTS J's OWOS also conducted work with its sister company based in Japan and there were communication challenges with the two organisations not understanding each other and work activities became long, difficult with key information missing to complete the PDD activities. The offshore management team employed were inexperienced including the wholly owned subsidiaries' CEO where promises had been broken, projects had been late and the general culture and behaviour caused additional challenges and complexities for both organisations.

Due to a number of complex challenges and difficulties that arose with the offshore ESP, they utilised their current manufacturing facility which was developed around 1980 and added an engineering department to the existing organisation located in Bangalore, India which consisted of 20 employees serving the local market.

The organisation did not want to increase costs and therefore utilised their current facility which already had experience in manufacturing of these components. In Bangalore FTS J employed 100 people to work on PDD activities mainly in the area of CAE and CAD.

5.8.3. Actions implemented to address challenges

For onshore outsourcing the challenges with communication were addressed by documenting a clear work package to the offshore organisation and a change in work processes and procedures for an external organisation to use. However, changing the organisation's working procedures which have been embedded within the organisation for almost decades cannot be easily changed overnight and was a task taking over almost 12 months. In the interim supplement documentation was provided to teach and educate the external organisations. Tacit knowledge became a problem as the information was stored within the employees at FTS J and they were reluctant in some instances to give all of the knowledge to an external organisation supporting their capacity resource peaks. Therefore, FTS J decided to start the process of documenting engineering processes useable within any organisation. The short-term solution consisted of FTS J providing the necessary support at additional cost and time billable to the FTS J organisation. For offshoring to ESPs the challenge with low volumes of work could not be resolved instantly as the organisation did not know which PDD activities could be outsourced or offshored. PDD activities were offshored but developed knowledge which is a key ingredient for PDD activities was lacking and therefore no cost advantage was gained.

During an interview, the executive vice president of engineering stated:

> Offshoring PDD activities only works when you increase your volume which we have learnt is a key factor when offshoring engineering activities. If you cannot achieve the ideal man years then you spend so much time going through inefficiencies and you will just keep on losing money like we did … You need to be clear with what you want an offshore ESP to do, have a good plan in terms of how you manage the offshore resource and with small volume work you get caught up with the ESP on delivery and how you set up an efficient handover process.

FTS J had committed a lot of time and money towards improving the communication between the two organisations but in particular with India. For instance, the engagement with Japan was rather difficult due to language barriers so FTS J employed a Japanese manager to improve the communications, the PDD had been defined and further documented with clear illustrations and additional data in English more than any other language. In total there were four people from FTS J's offshore wholly owned subsidiary based in Sweden who would become local co-ordinators. During an interview the executive vice president of engineering stated:

> We failed because our PDD activities were not sufficient (volume) and not detail enough. You need to have a very clear streamlined process when ordering and delivering the work

otherwise you would just fail. We have learnt a lot with the third-party provider something that we should have not really learned with a financial burden, but what we have learned has been used today […] when defining work packages if your own organisation does not have any work packages this is also leading to a disaster. For a stable platform your own processes need to be in depth and fully aligned with offshoring. It starts with homework from your own site.

5.8.4. Implications to the PDD activities

FTS J did not develop any methodology or any decision-making model or associated documentation that allowed them to offshore in an effective manner. There was a management appreciation that all PDD activities were offshoreable, leading to catastrophic failure where these activities which consisted of non core and core were offshored to both wholly owned subsidiary and also a third-party ESP. The offshore ESP became aware how FTS J used their core activities for competitive advantage, which the organisation could share with their competitors to win business. These activities went from onshore to offshore but during this period such activities that required a high knowledge field could not be completed by either the wholly organisation or their third-party ESP, both located in India.

The vice president mentioned during an interview:

> When going offshore it is different than outsourcing locally to a ESP you need to have a pragmatic approach as to what activities can be moved from high cost countries to low-cost countries and this is where our organisation has failed dramatically by assuming that one model fits all and taking our current outsourcing business and applying to offshoring which just has not worked.

Even after addressing the challenges FTS J's reworking of PDD activities is 20 per cent and still requires the onshore organisations to review and change the activities.

5.8.5. Decision making when outsourcing/offshoring PDD activities

FTS J did not use any decision-making process or methodologies to outsource or offshore their PDD activities. In fact the executive vice president mentioned during an interview:

> I would love to have something like a model for outsourcing and more importantly offshoring and in many cases no methodology had been used, which is a pity as we have learnt the hard way by spending additional money and failing on activities. I also need to say that outsourcing or offshoring has not impacted the overall timing of our products where they are launched to the market any quicker.

The learning cycle when FTS J engaged with their offshore ESP is that you need local management support from the onshore organisation to drive the organisation's growth.

Thus, this learning was carried out when FTS J develop their wholly own offshore subsidiary as it was managed by their expat (executive vice president) responsible for engineering who moved to India for 3.5 years to execute their offshoring of PDD activities and also having on-site engineers from India in Sweden which was a great advantage.

Another key learning was PDD activities that are customer interfacing have limitations as they cannot be offshored that easily, but this was discovered by FTS J after they offshored these activities, as the executive vice president mentioned:

> The lead of an application program will always be with the customer, and what can be centralised to low-cost countries needs to be done in the backend and cannot be just distributed. This is one of the main reasons why we cannot just put an entire project into a low-cost country.

5.9. Cross Case Analysis

This section concentrates on conducting a cross case analysis on the six case study organisations analysed as part of the data collection. Two organisations from each sector OEMs, ESPs and FTSs have gone through a detailed examination on how they conducted outsourcing and offshoring of their PDD activities, the challenges experienced, actions implemented, the implications on PDD activities and the decision-making strategies used. In some cases, the management practices are reinforced to what is already known within the literature and applied to the automotive industry. The five examining areas are summarised in Table 5.4 which maps all six case studies highlighting the key findings.

5.9.1. OEMs

The two OEMs used for the case study analysis undergo a cross case analysis to understand the common themes and patterns when these organisations outsourced and offshore their PDD activities.

5.9.1.1. How was outsourcing/offshoring of the PDD activities conducted by OEMs

The OEMs started to suffer with engineering resources internally so outsourcing was implemented as the product portfolio was expanded to include derivative and new vehicles across their platforms. Cost within the automotive industry is becoming an even important element. Offshoring PDD activities to countries where the labour rates were lower compared to Western Europe was a motivation for these OEMs.

During outsourcing and offshoring PDD activities had not been defined correctly or understood within the organisations and they struggled to identify which were non core, core and near core.

OEM A's department that had already outsourced and offshored had been were working in isolation and not sharing their mistakes or knowledge learnt through collaboration with ESPs. However, the OEM C had a controlled approach to outsourcing and offshoring, in particular offshoring involved the senior management team to liaise with their counterparts face to face in India to ensure objectives and organisation structures were understood. This was a transition phase with structured team and senior management involvement.

Offshoring in in OEM A was driven by the executive to reduce costs within the organisation without evaluating the direct benefits and there was no clear plan or direction on how to offshore whereas OEM C also based their offshoring of PDD activities on cost reduction but had an expat team sent offshore. The offshoring from OEM C consisted of large vehicle development activity.

India was used in both OEMs to offshore PDD activities where these organisations took advantage of the educated people at low cost whereas China was used for localisation of the organisations and only conducted local work whereas India would carry out global activities.

5.9.1.2. Challenges experienced by OEMs when outsourcing/offshoring PDD activities

Communication onshore and offshore was the largest challenge for both OEMs whether it was a new engagement or an existing contract. These challenges resulted in the PDD activities being delayed.

The ESPs struggled with obtaining necessary information to complete the PDD activities. OEM A had no processes, lacked knowledge and experience on offshoring which resulted in the output of the work being poor, with additional checking of data. These organisations faced difficulties with obtaining experienced people offshore.

The management team was not trained on how to manage such a large project that was being delivered from a remote location and knowledge was developed after mistakes.

Knowledge sharing with external organisations was rather poor and consisted mainly of tacit knowledge which was required explicitly impacting how these organisations delivered the PDD activities. The ESPs struggled to obtain the necessary information that led to reworking of designs at hidden project costs.

The two OEMs identified when offshoring either to a wholly owned subsidiary or ESP critical mass of PDD activities is required to achieve cost benefits and over 100 people required for a wholly owned subsidiary justification.

5.9.1.3. Actions implemented by OEMs to address challenges

The communication challenges were improved through training of employees making them aware on the importance of collaboration and how to communicate clearly and effectively between each other. These training sessions were conducted in both OEMs and with their outsourcing and offshoring ESPs. The training improved the employees understanding on sharing critical data required for an external organisation to conduct activities.

OEM A, C both relocated employees from the offshore organisations into their PDD to provide a more structured approach when offshoring and the employees became co-ordinators within the organisation between the onshore and offshore organisations.

The use of expats was common in both OEMs and provided her successful outcome where these employees would teach and educate face to face their offshore employees.

Both OEMs started to convert tacit knowledge into explicit knowledge which was required for the external organisations, but this could not be completed overnight and a long process.

Documenting what was required explicitly from the onshore and offshore ESPs was critical to the success of completing a PDD activity within a time and with a minimal amount of reworking.

5.9.1.4. Implications to the OEMs PDD activities

The PDD activities in both OEM A and C had been correctly identified in terms of their core, non core and near core activities which were backsourced to their HQ after the onshore and offshore organisations were unable to complete due to the lack of capability and competence in their skills and ability. Critical activities consisting of core competitiveness having the greatest impact within the organisation had been offshored to their ESPs.

In total, there were approximately 15 per cent of offshore PDD activities reworked in OEM A by onshore employees and OEM C was reworking in excess of twenty five per cent.

5.9.1.5. The decision making when outsourcing/offshoring OEMs PDD activities

OEM A had no clear decision-making model or strategy when outsourcing or offshoring its PDD activities. Most of the information was tacit and not aligned with the wider part of the organisation. The key decisions were conducted at top level by one executive within the organisation and there was no cohesion with other stakeholders in the organisation during this process. The offshoring decisions were based on cost reduction within the organisation. OEM C had a vague offshoring model that was representable on how they thought offshoring could be implemented but there was no cohesion with other stakeholders in the organisation and it was developed on the basis of cost reduction.

OEM A were unaware of the implications to the PDD activities by not having a strategy or decision model and management not fully understanding outsourcing or offshoring whereas OEM C reacted after they experienced challenges and adjusted their offshore model to move offshore employees to onshore locations.

Both of the OEMs reported that there was no cycle time reduction or compression through outsourcing or offshoring their PDD activities as their perceptions had been crafted such that these activities would reduce the time to market of an automotive vehicle. However, outsourcing and offshoring allowed the OEMs to meet their product portfolio targets.

5.9.2. ESP

The two ESPs used for the case study analysis undergo a cross case analysis to understand the common themes and patterns when these organisations outsourced and offshore their PDD activities.

5.9.2.1. How was outsourcing/offshoring of the PDD activities conducted by ESPs

ESP D started to outsource locally as there was a shortage of engineering resources and offshoring was undertaken because the cost of outsourcing was higher than offshoring and there was a drive to develop an extended engineering resource at lower costs. ESP L did not outsource locally as they had sufficient engineering resources to keep up with the project demand but offshoring was used to extend the organisation’s engineering resource at a reduced cost.

Both of the ESPs had unclear business plans on how outsourcing or offshoring was to be conducted and the PDD activities were offshored without taking into account the sensitivity of such activities. Decisions in ESP D were taken at top level without consulting the wider management team whereas ESP L also had no management cohesion and there were disconnects within the organisation on how offshoring was to be conducted.

Offshoring in both ESPs was implemented to reduce costs internally and externally for their customers and retain competitive. ESP D used India and Malaysia for their PDD activities where they could access people who were educated to a degree level whereas China was developed for their localisation and PDD activities were overseen by expats. ESP L used India for offshoring the PDD activities and also to take advantage of the educated people.

5.9.2.2. Challenges experienced by ESPs when outsourcing/offshoring PDD activities

Challenges were evident in both ESPs and caused delays with delivering the PDD activities. ESP D identified that the offshore employees did not have the relevant skills or capability required for these activities and in ESP L high-level activities that required skills and knowledge had been offshored where the organisations knowledge was limited on their capabilities.

ESP D had challenges with controlling the offshore management and there was a lack of management commitment to ensure these activities were completed on time and within budget. ESP L also faced similar challenges with management commitment and their understanding on urgency of these activities, creating delays.

ESP D identified that the PDD activities were completed with poor quality and that additional hours from the onshore employees were necessary to rework the activities. ESP L also found similar occurrences but the offshore culture was to agree with all statements and not understand the activities in detail.

ESP D faced more challenges than ESP L as they had been offshoring for more than 10 years with their offshore ESP as this organisation had different business objectives and did not want to develop a long term plan. There was a continuous focus on making profit rather than growing the organisation’s capability.

Trusting the offshore management team became rather difficult for the reasons stated above and employee retention was poor within the organisation.

This challenge lasted a good several months and was costing the organisation time and money and therefore ESP D to develop a wholly owned subsidiary based offshore. Throughout this journey, they identified that for a wholly owned subsidiary to achieve the financial benefits, they had to increase their PDD activities offshore. ESP L also increased their PDD activities to free internal engineering resource and benefit from better cost reduction.

5.9.2.3. Actions implemented by ESPs to address challenges

ESP D and L both improved communications through defining the tasks, documenting clearly what exactly was required and questioning the PDD activities and developing more teamwork and integration when outsourcing and offshoring. Additional efforts were provided by ESP D onshore employees to ensure illustrations and supporting documents were sent with each activity whereas ESP L provided additional coaching and training on innovation and creativity.

ESP D had a expat team based offshore that addressed the lack of management commitment with an offshore ESP and when developing their wholly owned subsidiary they took the same approach by using an expat for the transitional phase and ensuring a local guy was based offshore to run the organisation. ESP L did not use an expat for their short offshore engagement but relied on their offshoring ESP.

Internal knowledge in both ESPs was not shared with these organisations or when they developed their wholly owned subsidiary so both organisations started to document their knowledge to allow these external organisations to work more efficiently.

5.9.2.4. Implications to the ESPs PDD activities

ESP D and L both did not correctly identify their PDD activities it was a on the spot decision to what could be outsourced and offshored. ESP L offshored their core tasks to an external ESP without knowing the risks or understanding the implications. In actual fact ESP D offshored all PDD activities whereas ESP L after making the mistakes identify that high knowledge activities could not be done offshore as there was a gap in the knowledge and skills required.

Both ESPs engaging with offshore ESPs or wholly owned subsidiaries had a rework rate of 15 per cent even after ESP D had been affiliated with offshoring for over 10 years.

5.9.2.5. The decision making when outsourcing/offshoring ESPs PDD activities

EDP D had no clear decision-making procedures or strategies when outsourcing and offshoring with no management cohesiveness whereas ESP L was not outsourcing but the offshoring decision were disconnected internally within the management structure.

ESP D strategy was ad hoc and underpinned by cost reduction from the organisation where the outsourcing and offshoring decisions were conducted by one top executive. ESP L did not forward plan any tasks and reacted after they failed.

5.9.3. FTS

The two FTSs used for the case study analysis undergo a cross case analysis to understand the common themes and patterns when these organisations outsourced and offshore there PDD activities.

5.9.3.1. How was outsourcing/offshoring of the PDD activities conducted by FTSs

FTS C and J are expanding their product range and therefore outsourcing and offshoring is conducted due to the lack of internal engineering resources required to fulfil the project demands. Costs are also becoming important so both organisations have implemented offshoring to benefit from lower costs. These two organisations face difficulties in understanding which PDD activities could be outsourced or offshored, in particular FTS J not taking into consideration the consequences of sensitive PDD activities.

Management support in FTS C reacted in areas where they were failing whereas FTS J had the management team working cohesively and collectively during outsourcing and offshoring.

FTS C and J used offshoring solely for reducing costs within the organisation. FTS C increased engineering resources through offshoring at lower rates and the customers demanded a cost reduction on the PDD activities.

FTS C used Philippines and India for PDD activities which had a lower skill base compared to Europe HQ and China developed for localisation. FTS J also used India for PDD activities.

5.9.3.2. Challenges experienced by FTSs when outsourcing/offshoring PDD activities

Communication challenges arose in both FTS where quality was impacted and not understanding the PDD activities. There was resistance from the employees in FTS C as they were worried about third-party organisations coming and taking their jobs. FTS J had a slightly different approach where the data was not shared for PDD activities as the employee's risk that IP can potentially be known by an external organisation. The PDD activities in FTS J were sporadically outsourced to onshore ESPs.

The internal processes at FTS C were not robust to be used by an external organisation and involved more management control to oversee activities, and knowledge transfer to external organisations was rather poor. FTS J faced similar problems as their ESP had little knowledge about the design process and was unable to extract this information from the organisation as the knowledge was tacit and not explicit.

FTS C's offshore ESP did not understand activities which created additional challenges as they were reworked onshore, involving hidden time bridging these activities to a high level of engineering standard. FTS J PDD activities that were offshored took longer than expected as the offshore employees did not understand onshore requests.

There was no outsourcing or offshoring process available in either organisation which developed poor quality from the offshore organisations as they lacked the engineering capability.

The offshore challenges experienced by both FTS led them to develop a wholly owned subsidiary and a substantial amount PDD activities were required to be offshored to justify their existence otherwise the engagement will generate poor pay offs.

5.9.3.3. Actions implemented by FTSs to address challenges

Different strategies and tactics were used by both FTSs however, there were some overlaps to what was applied and not by the other organisation. The communication in FTS C was improved using an expat who was present on the telephone calls between the onshore and offshore employees and was the mediator in translating the languages whereas in FTS J communication was addressed through documenting a clear work package and describing to the employees exactly what was required. A number of coaching and educational sessions with the offshore employees were required whether it was a wholly owned subsidiary or a third party ESP the approach was the same.

Knowledge within the FTS C and J became an issue when using external organisations and therefore was documented in small stages enabling this to be explicitly viewed. FTS C and J had success when locating offshore employees in their onshore organisation where there was one central co-ordinator and point of contact.

5.9.3.4. Implications to the FTSs PDD activities

FTS C and J did not correctly identify the PDD activities where the highly knowledgeable activities which are critical to these organisations had been backsourced because there was minimum capability to complete these offshore. FTS J Management had the appreciation that all PDD activities were offshoreable until they discovered this was not possible.
FTS C offshore all of their PDD activities randomly whereas FTS J offshore their core activities to their ESP based offshore, developing a risk to their competitive advantage.

FTS C used their wholly owned subsidiary offshore as a jobbing shop by only offshoring activities as and when creating additional complexities and challenges. However the offshore rework rate was 15 per cent of PDD activities reworked onshore.
FTS J was unable to build the offshore capability overnight and faced a 20 per cent rate of reworking PDD activities.

5.9.3.5. The decision making when outsourcing/offshoring FTSs PDD activities

FTS J had no decision-making process or methodology when outsourcing or offshoring their PDD activities to external organisations or their wholly owned subsidiaries. FTS C also had no process or methodology but decisions were based on cost reductions within the organisation following a “me too” strategy, following other organisations.

FTS C identified their management team had minimal outsourcing and offshoring experience whereas FTS J learnt that management support was required from the onshore organisation during an engagement.

However, both FTSs benefited in no way in launching their products into the market any quicker through outsourcing or offshoring as the time to market the products was still the same.

Activity	OEM A	OEM C	ESP D	ESP L	FTS C	FTS J
How was outsourcing/ offshoring of the PDD activities conducted	Outsourcing locally followed by offshoring due to expansion of product portfolio and lack of engineering resources and cost reduction.	Outsourcing locally followed by offshoring due to expansion of product portfolio and lack of engineering resources and cost reduction.	Outsourcing locally followed by offshoring due to lack of engineering resources and cost reduction.	Not outsourcing locally but offshoring for cost reduction and increase engineering resources.	Outsourcing locally and offshoring due to lack of engineering resources cost reduction and product range expansion.	Outsourcing locally due to lack of engineering resources, cost reduction and product range expansion.
	PDD activities not defined to understanding the effects on organisation.	Multiple of PDD activities offshored no strategy on tasks.	Business plans unclear on how outsourcing or offshoring is conducted.	Any PDD activity was offshored to the ESP without considering the sensitivity.	Difficulties in understanding which PDD activities could be outsourced or offshored.	Any activity was offshored to ESP s without reviewing the consequences of sensitive PDD activities.
	Departments not working cooperatively	Controlled approach with a preliminary phase to outsourcing and offshoring. Senior management involvement with offshore team.	Decisions grounded at top level for outsourcing/offshoring and no consulting of management team.	No management cohesive disconnects within the organisation.	Management supported in areas after failing.	Management cohesiveness working collectively.
	Offshoring direction from executive to reduce costs without evaluating benefits. Offshoring to no clear plan.	Offshoring based on cost reduction with expat team sent offshore. Large vehicle development activity.	Offshoring due to cost reduction internally and externally from customers.	Offshoring as customers require cost reduction and engineering resources	Offshoring conducted to reduce costs and have an extended engineering resource. Cost reduction driven by their customers	Offshoring based on cost reduction and employing educated people.

Activity	OEM A	OEM C	ESP D	ESP L	FTS C	FTS J
	India used for offshoring PDD activities and tapping into the educated pool. China developed for localisation.	India used for offshoring PDD activities and tapping into educated pool. China developed for localisation.	India and Malaysia used for PDD activities and access to educated pool, whereas China developed for localisation.	India used for offshoring PDD activities and tapping into the educated pool.	India used for offshoring PDD activities, Philippines used for low cost PDD activities and China for localisation.	India used for offshoring PDD activities and tapping into educated pool.
The challenges experienced through outsourcing/ offshoring PDD activities	Communication challenges when a new engagement was signed resulted in delays to PDD activities. ESP struggled to obtain necessary information for PDD activities. No process, lack of knowledge, experience on offshoring, poor quality of work Management team not trained on how to manage external organisations and lacked knowledge.	Communication challenges in understanding domain experience causing delays with PDD activities. Poor quality of work from offshore organisation that required additional checking of data. Lack of experienced people offshore Management team lacking offshore knowledge.	Communication challenges caused delays with the delivery of PDD activities with offshore employees not having the relevant skills Challenges with controlling offshore. Lack of management commitment to ensure activities and within budget Poor quality of work at additional costs, resources and delays in completing activities and reworking of data.	PDD activities sent offshore were incorrect and required high level of skill sets and knowledge is limited to the organisation resulting in communication issues and poor timescales Challenges with management commitment understanding urgency of activities offshored and delivery of the PDD activities. Culture of saying yes yes yes, not really understanding activities.	Communication challenges impacting quality of work and not understanding each other. Resistance from employees to share information with third party organisation and employees seen as a risk for their jobs. Internal processes not robust to be used externally and more management controls were implemented with poor knowledge transfer.	Communication challenges with understanding what was required from the PDD activities impacting the quality. Data was not shared for PDD activities as risk of IP leakage with external organisation. PDD activities involved sporadic outsourcing. ESP had little knowledge about the design process. Most of knowledge was tacit and retained within engineers.

Activity	OEM A	OEM C	ESP D	ESP L	FTS C	FTS J
	Internal tasks conducted externally lacked knowledge sharing where tacit knowledge was required explicitly. ESP struggled to obtain necessary information for PDD activities.	Offshore employees having poor knowledge of PDD activities not shared externally. Reworking of design work adding additional hidden cost into project Outsourcing organisation not ready to engage with an external ESP.	Both organisations having different business objectives (growth vs. profit). Trusting the management team and poor employee retention. Challenges led to development of wholly owned organisation.	Lack of capability internally within the offshore organisation.	Activities have not been completely understood by offshore ESP leading to activities incorrect and additional hidden time in correcting. No process was available for offshored activities and poor quality from offshore organisations where they lacked the engineering capability.	Offshoring involved cultural aspects lacking understanding of onshore engineers requests Activities taking longer than expected. General culture and behaviour not adequate. FTS J inability to document or specify what is required Management team inexperienced project dates not promised Products were late
	Ramp up of PDD activities to achieve critical mass for cost benefits when using wholly owned subsidiary.	Large program offshored to ESP for cost advantages with development plan for a wholly owned subsidiary in India.	Increased the number of offshore activities to wholly owned subsidiary for financial benefits.	No wholly owned subsidiary developed so offshore ESP PDD activities increased to free internal resource and gain better cost reduction.	Increasing the amount of PDD activities to justify the offshore existence.	Lack of critical mass offshore involving poor payoffs.

Activity	OEM A	OEM C	ESP D	ESP L	FTS C	FTS J
What actions were implemented to address the challenges	Communication improved through training of employees. Importance of employees at OEM a resistant to share knowledge as external organisation was seen as a threat. Expat team sent to India for four years to take ownership of offshore centre. Converting of tacit knowledge into explicit knowledge.	Training sessions to improve the collaboration, and communication. Offshore model revised to relocate employees into onshore locations. Expat teams sent to offshore subsidiaries. Development of knowledge transfer internally for externally organisations.	Communication improved by clearly defining exactly what was required through offshore/outsourcing organisations. Additional efforts in providing illustrations and supporting documents. Expat offshore to address lack of management commitment and wholly owned subsidiary consisted of expat transition team Started knowledge documentation.	Communications improved through questioning work and more team work. Additional coaching and training innovation and creativity, use of virtual communications and documenting what actions were required No expat used for short offshore engagement. Improving documenting knowledge or processes.	Communication improved using expat for conference calls between onshore / offshore employees. Tasks included coaching, educating and supervising offshore employees. Expat team located in offshore wholly owned subsidiary with senior executive responsible for operations. Documenting of tacit knowledge to help support external organisations and internal processes.	Communication was addressed through documenting a clear work package. Additional teaching and educating the external ESP based offshore. Expat team offshore in particular an experienced manager to run the organisation. Tacit knowledge was slowly converted into explicit Short-term solution to provide necessary support at additional costs.

Activity	OEM A	OEM C	ESP D	ESP L	FTS C	FTS J
	Training of employees by OEM A as there was no system processes in place. Additional training and education for offshore employees conducted by expats Offshore employees incentives offered to work in UK to retain jobs.	Clearly define activity requirements and working with time zone efficiency	Shuffle of employees to have a key knowledgeable person in the group.	Offshore ESP requested to employ skilled workforce capable of working on high-value PDD activities.	Locating offshore employees in onshore organisation to become coordinators. Managing offshore organisation involves sending local employee from UK over to India at additional costs.	Locating offshore employees in onshore locations.
The implications of the actions on PDD activities	PDD activities not correctly identified leading to backshoring to HQ as there minimum capability offshore ESP Mixture of activities also consisting of core sent offshore which could not be completed Offshore activities were15% reworked by onshore employees.	PDD activities not correctly identified and backsourced critical activities onshore from ESP. Offshoring of non-core, near core and core activities to offshore ESP. Under estimated offshore project with extensive reworking in excess of 25%.	PDD activities not correctly identified leading to insufficient offshore knowledge for completion. All PDD activities offshored. Offshore PDD activities were reworked 15%.	PDD activities not correctly identified leading to offshoring of core tasks without knowing. High-value activities could not be completed offshore to the knowledge and skills required Offshore ESP became core knowledge holders for these activities with 15% of rework.	PDD activities not correctly identified with high knowledgeable activities backsourced. All PDD activities offshored. Use of jobbing shop for PDD activities with 15% of activities reworked.	PDD activities not correctly identified and management appreciation that all activities were offshoreable with core activities backsourced. FTS J offshored their core activities to the ESP based offshore. Lack of knowledge of offshore to conduct core activities without building confidence and reworking 20% of PDD activities

Activity	OEM A	OEM C	ESP D	ESP L	FTS C	FTS J
The decision making/ processes were involved when outsourcing/ offshoring PDD activities	No clear decision model or strategy used for outsourcing/offshoring with decision made by a single person and based on cost.	Vague offshoring model and developed on cost reduction with no collaboration of working.	No clear decision making procedure for outsourcing or offshoring no management cohesive.	No clear decisions or strategy and disconnects internally within the management structure.	No process or methodology when outsourcing or offshoring, decisions made on cost reduction me two strategies.	No decision-making process used or methodology for outsourcing or offshoring.
	Implications offshoring/ outsourcing and offshoring not fully understood by management team.	Reaction after experiencing challenges, offshore model adjusted for offshore employees to be based onshore.	Ad hoc strategy and based on cost reduction Decision from one top exec and activities sent offshore.	Forward planning of tasks not conducted reaction after failure.	Outsourcing and offshoring management had minimal experience.	Learnt that local management support was required from the onshore organisation.
	Outsourcing or offshoring has not reduced the cycle time of PDD activities or time to market of a vehicle.	No time compression on vehicle projects through outsourcing or offshoring.	No benefits on time reduction through standard process of work when outsourcing or offshoring.	Outsourcing or offshoring not provided benefits in delivering products to the market quicker.	Launching of products into the market not advanced any quicker through outsourcing or offshoring.	Time to market of products still same duration no improvements during outsourcing or offshoring.

Table 5.4. Summary of cross case analyses.

Chapter 6 . Discussion of Results

6.1. Introduction

This chapter discusses the research findings/results from Chapters 4 and 5 which are compared with the key findings from the literature. Three theories are discussed in Chapter 2 (literature review) to provide explanations of the findings for this research study. The theories are listed below.

1. Transaction cost economies – see section 2.12.1.
2. Resource-based view – see section 2.12.2.
3. Resource dependency theory – see section 2.12.3.

The key findings from the data analysis stage (Chapter 4 and Chapter 5) including the cross case analysis are discussed to ensure a thorough examination and the research aims and objectives are fulfilled. To ensure the key PDD findings are discussed in-depth across the three segments (OEMs, ESPs and FTSs) outsourcing, offshore outsourcing and offshoring are reviewed independently ensuring a comprehensive understanding of the drivers/ challenges and decision making.

Previous studies have not drilled down to understand the drivers or attempted to establish the significance or importance of these drivers across the three industry segments when outsourcing, offshore outsourcing and offshoring within the automotive sector. Thus, the study contributes to the literature by identifying these drivers across three industry segments which is new knowledge in this field.

6.2. Onshore outsourcing – drivers amongst OEMs, ESPs, FTSs

Based on the data analysis presented in Chapter 4, sections 4.4.1.1, 4.5.1.1 and 4.6.1.1, the top five key drivers amongst the three segments are discussed when onshore outsourcing the PDD activities to external organisations.

This study has identified the three segments experienced different drivers which have been classified uniquely to each organisation examined, each having a different output. However, the ESPs and FTSs had common drivers when outsourcing their PDD activities compared to the OEMs.

6.2.1. Engineering capacity

The first driver identified from the research was the shortage of engineering resources within all three segments and was common throughout when these organisations outsourced their PDD activities. These findings discovered a shortage of skilled engineering resources in the automotive sector and a driver for these organisations to outsource their PDD activities. However, before outsourcing the PDD activities, the organisations based in all three segments exhausted internal opportunities such as increasing the FTEs and internal contractors before the PDD activities were outsourced. It is argued here that a lack of engineering resources within the three segments was the primary driver for these organisations to onshore outsource their PDD activities to external organisations specifically ESPs. An automotive study conducted by Sako (2005) highlights that outsourcing of production occurs when organisations do not have the internal capacity. This study further develops the findings of Sako (2005) and identifies that the drivers to outsourcing of PDD activities within the automotive industry occurs when these organisations lack the internal engineering resources to complete these activities. Thus, these findings within this study add another new dimension when outsourcing within the automotive industry. The finding can be related to the RDT as these organisations were reliant on external capabilities not belonging to the outsourcing organisations.

Further, in another study by Narula (2001) sees the importance of outsourcing within the automotive industry as when engineering resources are scarce.

The key finding in this study is new as automotive organisations were outsourcing to increase their engineering resources. This new finding contributes to the work done in this area by adding new dimensions when automotive organisations outsource their PDD activities to external onshore organisations.

6.2.2. Cost reduction

The second driver identified in this study is cost reduction and was directly related with the first driver where these organisations lacked engineering capacity/resources. The organisations based in all three segments required outsourcing at competitive prices and therefore this area was focused with detail.

Costs reduction in outsourcing has been a primary topic since the start of the phenomenon and there is evidence that cost reduction is still a key driver when automotive organisations are outsourcing PDD activities. The management teams in all three segments strived to reduce the costs when outsourcing PDD activities as it enabled the organisations to become more competitive.

The key findings in this study are consistent with the results reported for other non automotive sectors such as ITO, BPO, Aerospace sector (Aubert *et al.* 1996, Barthelemy and Adsit 2003, Burdon and Bhalla 2005, Crone 1992, Dubbs 1992, Kakabadse and Kakabadse 2000, Quinn and Hilmer 1994, Willcocks *et al.* 1995b).

6.2.3. Flexibility

This study has identified the third driver is flexibility gained by the OEMs when outsourcing the PDD activities which enabled these organisations to utilise external engineering resources at no risk to their business. The development of a new vehicle is reviewed at key milestones during the program cycle and involves a large engineering committee. However, if the engineering committee identifies the program as a risk whereby market share, ROI or other parameters cannot be achieved then the program could become terminated. Thus, the flexibility involved with an external organisation allows the outsourcing partner to switch on/off engineering resources if required.

During an interview with OEMs D vice president of engineering mentioned;

> "The automotive industry goes through peaks and troughs where if you develop internal resources and there is an economic or financial situation then OEM D faces greater financial loss and therefore flexibility with outsourcing allows us to leverage the workforce required for certain projects".

The finding in this study is novel, adding new dimensions to other non-automotive studies (Jennings 1997b, Quinn and Hilmer 1994, Willcocks et al. 1995a). These studies are limited to non-automotive sectors which only touch the surface of flexibility in outsourcing. This finding is consistent with the results reported for other non-automotive sectors.

6.2.4. Local presence

The third driver identified in this study for ESPs and FTSs is developing local presence. This was significantly important for the ESPs and FTSs when they outsourced their PDD activities to ESPs. Therefore, the findings have discovered that a close proximity to the engineering centres was critical as the outsourced PDD activities consisted of near core that required a high level of skill, knowledge and competence within the outsourcing organisation.

This driver adds a new dimension to the work of Morris *et al.* (2004) which revealed local presence of manufacturing organisations was crucial for producing a vehicle and this study identified local presence of ESPs was also critical in particular during the designing phase.

6.2.5. Time to market

This study has identified the fourth driver for OEMs is time to market of new vehicles and was an important driver as their product portfolio had been rapidly expanded and these products required delivering into the market. If these products were not delivered in accordance to their competitor's timings, the competitive advantage of the organisation and loss of market share would impact the organisation. To meet this demand the OEMs outsourced the PDD activities that enabled time to market delivery and no disruptions to the product cycle plan.

The findings analysed across 50 organisations where 39 outsourced their PDD activities (shown in Figure 4.26) with no reduction in design cycle time. However, these organisations achieved the time to market commitments with products being launched on time but within the same development cycle. The other remaining 11 organisations did not outsource but had business plans to develop strategic alliances with external organisations.

It is argued here the finding of this study in the automotive sector is novel and not consistent with previous literature in non-automotive sectors. Studies conducted by Quinn (2000), Holcomb and Hitt (2007), Power et al. (2004) identified outsourcing reduces the design cycle times and enables organisations to capitalise on their outsourcing ventures. It is further argued here the OEMs along with the wider part of the data collected through ESPs and FTSs discovered no time to market reductions when outsourcing the PDD activities to ESPs. This can be explained as PDD activities require more thorough connectivity between people with a high level of interaction (Stringfellow et al. 2008). Thus, outsourcing of PDD activities within the automotive sector *cannot be interchangeably used with the wider literature in non-automotive sectors as time to market is considered not to improve the speed of introduction.*

This significant fact is novel and adds new knowledge into the field of outsourcing PDD activities within the automotive industry in particular adds value to the work of Clark and Fujimoto (1991) who only reviewed time to market from a process and managerial perspective and not from an outsourcing angle.

6.2.6. Engineering capability

The fourth/fifth driver identified in this study is the lack of engineering capability within OEMs, ESPs and FTSs where these organisations outsourced their PDD activities to external organisations (ESPs). These organisations lacked capability in certain areas within the PDD activities and did not have the sufficient skills and knowledge required to fulfil these activities. The approach taken through outsourcing can be explained using the RDT (Preffer and Salancik 1978) where external resources were acquired through an external organisation. The driver of obtaining engineering resources can also be explained using the TCE theory (Williamson 1985) as the cost of developing capability internally was more expensive than acquiring from the market. The OEMs had a slightly different approach as outsourcing was conducted in niche areas where there was minimal capability and upon outsourcing over several months and understating the external organisations model they were acquired by the OEMs.

The key observation from this study is new to the automotive industry where previous studies fail to identify the engineering capability required from external organisations when outsourcing PDD activities.

6.2.7. Failure with strategic alliance

This study has identified the fifth driver for ESPs and FTSs is outsourcing again their PDD activities after failing with their strategic alliances. This was down to the challenges experienced during the outsourcing/offshore outsourcing engagements, further discussed in section 6.5.

Sitkin (1992) clearly identifies that information about organisations that have failed or are failing is kept extremely confidential as publicising could damage their reputation. Further, Barthélemy (2003) also states that organisations are reluctant to make information public and no underlying reasons usually get stated. Therefore, the data collected in this study was fortunate to capture the automotive organisations that failed with outsourcing/offshoring and incorporate these findings into the model developed in Chapter 7.

6.3. Offshore outsourcing – drivers amongst OEMs, ESPs, FTSs

Based on the results presented in Chapter 4 sections 4.4.2.1, 4.5.2.1and 4.6.2.1, the top five key drivers amongst the three segments are discussed when the organisations offshore outsourced their PDD activities to external organisations.

The study has identified that OEMs had different drivers compared to ESPs and FTSs. These drivers within ESPs and FTSs when offshore outsourcing was common and is presented in Figure 7.8 and Figure 7.9.

Eppinger and Chitakara (2009), Westpal and Sohal (2013) identified that senior managers struggle when making offshore outsourcing decisions. Thus, this study contributes to the literature by identifying these drivers across the three industry segments and new knowledge is added to the current literature.

6.3.1. Cost reduction

There is a large pool of literature that discusses cost reduction in general terms when organisations are offshore outsourcing services. As the automotive industry is transitioning from local to global organisations, cost reduction is becoming a key driver, in particular the overall cost of developing an engineering vehicle. All automotive organisations experience a PDD phase that involves high development costs down to the hourly rate paid to the employees.

This study has identified the first driver across all three segments is to reduce the hourly cost of employees. The findings identified that automotive organisations were experimenting with offshore outsourcing their PDD activities to low-cost countries to reduce the hourly labour rate. The cost reduction was solely based on the hourly rate of a person (known as fixed costs). Engagement with an offshore outsourcing organisation based in a low-cost country transferred the direct costs internally to variable costs (Corbett 2004, Ellram *et al.* 2008).

A key finding in this study is the reduction in costs achieved by transferring fixed costs into variable costs in all three segments. This finding is consistent with the results reported for other non automotive sectors where costs reductions when offshore outsourcing were a key driver (Jahns *et al.* 2006, Khurana 2006, Maskell *et al.* 2007, Ramamurti 2004). Further, the TCE theory can also be related to how organisations are acquiring resources externally at lower prices (Williamson 1985).

6.3.2. Indirect costs

The second driver identified in this study for OEMs is based on indirect costs related with offshore outsourcing and engaging with a strategic alliance. The advantage of engaging with an offshore outsourcing organisation was that no upfront costs were required as there are when developing an OWOS. There are risks associated with OWOS that includes organisations not aware on how offshoring is conducted, lack of management experience in offshore locations and a substantial upfront investment.

6.3.3. Customer driven

This study has identified the second driver within ESPs and FTSs were both aligned as there is immense pressure from their customers to reduce the cost of the PDD activities. The approach taken by these two organisations was to offshore outsource PDD activities where they could obtain a lower cost in the region of a 30 per cent reduction compared to their current western employees. These organisations did not take a pragmatic approach and offshored any PDD activity due to their inexperience with offshore outsourcing. The findings of this study have revealed that customers are reducing cost on PDD through their supply chain, in particular which affects ESPs and FTSs.

6.3.4. Engineering capacity

The third driver identified for OEMs is to increase their engineering resources through offshore outsourcing their PDD activities which enabled the onshore employees to work on more value added activities such as core tasks for the organisations.

The study has identified this finding novel and contributes new knowledge within the automotive sector when organisations offshore outsource their PDD activities. These findings were presented as part of a conference paper (Simplay and Anderson 2014a, Simplay and Anderson 2014b).

6.3.5. No upfront investment

This study has identified the third driver for ESPs and FTSs is that no upfront investments are required when engaging with an offshore outsourcing organisation.
As noted by Eppinger and Chitakara (2009), large organisations which are classified as automotive OEMs have the resources and finance available and are more likely to invest than a medium or small-sized organisation. The explanation behind this is that when a small and medium-size organisation fails with offshore outsourcing it could impact the stability of the organisation both financially and physically in terms of getting products into the market.

The facts of this study are consistent with the results reported for other non-automotive organisations but are novel within the automotive industry where previous research has not highlighted upfront investment requirements when offshore outsourcing.

6.3.6. Flexibility

The fourth driver identified in this study for OEMs is the flexibility they achieved through offshore outsourcing to third party ESPs. The flexibility consisted of moving time-consuming tasks offshore and leveraging the onshore/offshore employees which created spare internal resources.
The other advantage enabled the OEMs to smooth off peaks which occurred, ensuring the project phase that required additional resources were accommodated.

The key finding of this study is consistent with the results reported for other non-automotive organisations and provides new insights within the automotive industry (Lewin et al. 2008).

6.3.7. Engineering capacity

This study has identified the fourth driver for ESPs and FTSs is different compared to the OEMs. ESPs and FTSs required additional engineering resources which were not available internally to work on PDD activities. A study conducted by Simplay and Anderson (2014b) within the automotive sector identifies how these organisations are struggling for engineering resources. Therefore, these organisations offshore outsourced the PDD activities conducted internally to external organisations.

The ESPs and FTSs increased their engineering resources and was a key driver for the two segments when offshore outsourcing. This fact is new within the automotive sector and previous literature is inadequate when analysing both ESPs and FTSs. These results were presented as part of a conference paper (Simplay and Anderson 2014a).

6.3.8. Capability

The fifth driver identified in this study for OEMs is the lack of internal capability in niche areas. The OEMs highlighted that developing capability either with a supplier or an onshore organisation did not provide the cost benefits, therefore offshore outsourcing was used. The capability was a twofold approach. Firstly, the three OEMs based in offshore locations lacked a high level of PDD capability when developing a vehicle and development of a new architecture in specific vehicle commodities (electrical, software development). A new architecture has a cycle of four years.

During an interview, the vice president of engineering at OEM M mentioned:

> We develop a new vehicle electrical architecture every four or five years and there is no real benefit of having these skills internally at very high costs. We offshore this part of the electrical design process.

Secondly, the OEMs based in Western countries also offshored for capability in niche areas within the PDD phases.

Eppinger and Chitakara (2009) call this *"the outsourcing trap"* when offshoring for capability becomes a trap and the organisation becomes dependant on the external organisation.

This study has highlighted novelty but adds a further dimension to the work of Eppinger and Chitakara (2009) as the offshoring organisations based in low-cost countries offshored their PDD activities to Western countries where the skills base and PDD knowledge (know how) was further advanced. The offshore organisations learned and developed their employees, subsequently building their capability and competences for current/future activities.

6.3.9. Retain competitiveness

The fifth driver identified from the study within ESPs and FTSs is different to the OEMs and consisted of retaining their competitiveness positions through offshore outsourcing the PDD activities. The two organisations in this segment were required to reduce their PDD costs and this was achieved through offshore outsourcing. The approach can also be explained using the TCE theory (Williamson 1985) whereby resources were acquired to reduce the costs of the PDD activities to enable these organisations to become competitive.

This finding is consistent with the results reported for other non-automotive sectors (Coucke and Sleuwaegen 2008, Farrell 2005) but more focused within the automotive industry.

6.4. OWOS - drivers amongst OEMs, ESPs, FTSs

Based on the results presented in Chapter 4 sections 4.4.3.1, 4.5.3.1and 4.6.3.1, the top five key drivers amongst the three segments are discussed when offshoring their PDD activities to OWOS.

The findings from this study have identified different drivers within OEMs, ESPs and FTSs whereas the latter two had similar drivers.

6.4.1. Cost reduction

The first driver identified from this study across all three segments is common and consisted of reducing the labour costs associated with the PDD phase which all consisted of similar engineering activities, each segment having their own breadth and depth of knowledge.

There is a great amount of literature across different industries that discuss cost reduction of labour with the automotive sector being non-exempt. As mentioned in the previous section due to the automotive sector transitioning from local to global organisations, cost reduction is also becoming a key element when automotive organisations are offshoring their PDD activity to wholly owned subsidiaries. This finding is consistent with the results reported for other non-automotive sectors where costs reductions when offshore outsourcing were a key driver (Jahns *et al.* 2006, Khurana 2006, Maskell *et al.* 2007, Ramamurti 2004). Further, the TCE theory can also be related on how organisations are acquiring resources externally at lower prices can explain the use of TCE (Williamson 1985).

6.4.2. Engineering capacity

The second driver identified from this study within all three segments is the lack of engineering resources available at 30 per cent reduction compared to western employees. These organisations increased the number of resources after exhaustively increasing the FTEs and contractors that were permitted within the infrastructure of the business.

The key fact in this study is new and contributes new knowledge within the automotive sector where previous studies are inadequate. Other industries such as ITO and BPO solely offshore for cost purposes (Ketler and Walstrom 1992, Mandel and Engardio 2007).

6.4.3. Local market presence

This study has identified the third driver is only pertinent to the OEMs as they developed an OWOS in growing/emerging markets for local presence. This enabled them to understand how products could be tuned to satisfy local requirements.

During an interview with the COO of OEM D stated:

> We are developing offshore subsidiaries in markets which are growing, inevitably you need to have presence there otherwise you are easily ruled out. These products are not meant for the European markets which are pretty more advanced and local tuning requires skill and capabilities not equal to western countries.

Eppinger and Chitkara (2009) also conducted a large manufacturing study on product development and identified that organisations developed offshore wholly owned subsidiaries for local market presence and this finding is consistent with literature in other non-automotive organisations. The finding in this study is consistent with the results reported in non-automotive sectors (Amaral *et al.* 2011, Gassmann and von Zedtwitz 1999, Meyer-Krahmer and Reger 1999) but more focused within the automotive industry.

6.4.4. Protect IP

The third driver identified in this study for ESPs is protection of their IP relating to the PDD activities, and therefore developed an OWOS. These organisations did not engage with a strategic alliance based offshore as IP leakage was at risk (Lai *et al.* 2009). The findings of this study are consistent with the results in other non-automotive sectors on globalising PDD (Eppinger and Chitkara 2009, Levina and Vaast 2008).

6.4.5. Proximity to customers

This study has identified the fourth driver for FTSs is to develop a location within close proximity to their customers followed by developing an engineering centre in emerging/growing markets. These organisations were required to develop local presence to support their customers on the PDD activities and also utilise their OWOS as low cost.

This observation in this study is consistent with the results in other non-automotive sectors. It contributes to the work conducted by Morris *et al.* (2004) who identified that automotive organisations have developed manufacturing operations close to their customer's site whereas this study discovers automotive FTSs also develop OWOS engineering sites.

6.4.6. Access to educated people

The fourth driver identified in this study for OEMs is access to an educated workforce in particular India where the minimum level of qualification was either a degree or master degree. The key finding in this study is consistent with the results reported in automotive and non-automotive sectors (Jennings 1997b, Lankford and Parsa 1999, Moran 1997, Willcocks *et al.* 1995b).

Further, Lewin *et al.* (2008) concluded from their study that organisations are striving to develop OWOS where they can access qualified resources to ensure the growth of the business. The findings in this study have discovered within the automotive sector that developing an OWOS to access an educated workforce does not always provide the level of skills and knowledge instantly as identified within the literature. For instance, OEM E has an established OWOS, a dedicated engineering centre which has been developed over 17 years but only in the last 10 years has this subsidiary been able to reach a competence level of developing larger PDD activities.

6.4.7. Control

This study has identified the fourth driver for ESPs is to develop a OWOS to ensure they had better control over their own organisations than using external organisations where challenges occurred with managing people, commitments and overall trust when offshoring. The finding has revealed that offshore outsourcing organisations were strategically positioned such that their business objectives contradicted the outsourcing organisations. This was identified after challenges were difficult to resolve.

*This study has identified a key novel finding where automotive ESPs first engaged with offshore outsourcing organisations before developing their OWOS to gain better control. This finding is consistent and novel with the results reported for other non-automotive sectors (*Youngdahl et *al. 2008) and more focused within the automotive industry.*

The FTSs approach was different as they developed an OWOS from existing manufacturing operations, saving on development associated with a new start-up and internal recruitment provided better understanding of the product. The employees that already worked in the manufacturing operations were transferred to help support and develop PDD solutions concurrently having the expertise and knowledge learnt from the manufacturing side of the business.

The observation in this study is unique to the automotive sector and adds new findings where current manufacturing facilities were developed into offshore engineering centres within the automotive industry where previous studies are inadequate.

6.4.8. Capability

This study has identified the fifth driver for the OEMs is to develop an OWOS for capability located in Western countries where the skill set and knowledge was more advanced than offshore locations. These subsidiaries were developed solely for capability advantages and addressing the skill shortage.

This fact has identified new insights within the automotive sector and not consistent with previous results in other non-automotive organisations. This adds a new dimension within the automotive sector where previous studies are inadequate.

6.4.9. Failure with offshore alliances

This study has identified the fifth driver for both ESPs and FTSs is the development of an OWOS based offshore after they failed with an offshore organisation. The findings have revealed that four ESPs and five FTSs failed and terminated their contracts. The failures for the ESPs and FTSs included insufficient knowledge, no strategy from the outsourcing organisation, lack of management support (Iacovou and Nakatsu 2008), lack of decision-making models leading to poor decisions, management conflicts and poor engagement. This is further discussed in the challenges section 6.7.

The findings of this study in the automotive sector are consistent with the results reported for other non-automotive which indicates organisations that failed with offshore outsourcing develop their OWOS.

6.5. Onshore outsourcing - challenges amongst OEMs, ESPs, FTSs

Based on the results presented in Chapter 4 sections 4.4.1.2, 4.5.1.2 and 4.6.1.2, the top five key onshore outsourcing challenges are discussed when all three segments outsourced their PDD activities to external organisations. This study has identified that some challenges experienced by the OEMs were different compared to ESPs and FTSs where the challenges were more common and are discussed in further detail.

New findings and insights are discussed within this section and their contributions to new knowledge in the field of outsourcing of PDD activities within the automotive industry.

6.5.1. Communication

The first challenge identified in this study is communication between two organisations across all three segments. These organisations faced similar communication challenges when engaging with external organisations which consisted of local language barriers between two employees on a working level with reference to the PDD activities. There were two independent people having two meanings which were different to resolve the same problem.

The communication challenges onshore derived from the lack of training given to the employees, and lack of understanding on how to outsource and manage an external organisation. The external organisations were responsible for key PDD activities, and the engagement required was different from FTSs which is usually responsible for component-level design.

The findings from this study are consistent with the results reported for other non-automotive sectors where communication barriers are the most difficult and complex to resolve (Rayner 2005). The solutions implemented are further discussed in 6.10.

6.5.2. Quality of work

This study has identified the second challenge for OEMs is the poor quality of work received from their external organisations (ESPs) based onshore. The OEMs failed to provide a structured approach to outsourcing and lacked the level of training and methodology when outsourcing their PDD activities to external organisations (ESPs).

There were other internal constraints with employees where managers did not share the correct information that was required for an external organisation to succeed on a task.

The challenge highlighted from this study concerning quality of work was novel and highlighted poor quality of PDD activities received from the onshore outsourcing organisations. The challenge is consistent with results reported for other non-automotive sectors which only touch the surface and do not provide solution for organisations.

The solutions used to improve the quality of work were the following;

1. Cascade all relevant information required for the PDD activities including bill of designs and other engineering-related documentation.
2. Additional support from the customer to ensure external organisations was fully aware of the requirements.
3. Senior management support to ensure employees were working with external organisations.

For an external organisation to work successfully the customer is required to ensure the correct working practices are highlighted and in place otherwise the outsourcing journey loses traction and challenges occur as highlighted.

6.5.3. Resistance from customer

The second challenge identified in this study for ESPs is their customers not sharing the data required to complete the PDD activities. When data was shared it took between one or two weeks before it was available bearing in mind a vehicle development time is around three years, so timing is very important. The delay in getting the data further created complexities when PDD activities were reviewed due to their incompleteness. There was also resistance from the customer as they viewed the external ESPs who would take over their jobs and there was fear during the engagement.

The observations in this study provide new findings which are consistent with the results reported for other non-automotive sectors where employees did not outsource as there was fear of job losses (Amiti and Wei 2005, Stack and Downing 2005).

6.5.4. Resistance to work with ESP

This study has identified the second challenge for the FTSs is resistance to engage with an ESP as their employees were more powerful and knowledgeable than their own employees causing these organisations to work at arm’s length.
Having an outsourcing contract at arm’s length creates additional problems as identified by Araujo *et al.*(1999) where the FTSs failed to understand.

The challenge when viewed from an automotive perspective provides new information where previous studies for other non-automotive sectors lack reviewing the automotive industry.

6.5.5. Reluctance to engage with outsourcing partner

The third challenge identified from this study is different across the three segments. The OEMs had difficulties as their employees were not briefed on the responsibilities of the external organisations, secondly the employees feared for their jobs as they perceived the ESP organisations would take their jobs. These OEMs failed to develop special instructions or processes for these external organisations as per section 6.5.3. The finding from this study is consistent with the results reported for other non-automotive sectors.

6.5.6. Lack of knowledge transfer from customer

The third challenge identified in this study for ESPs was poor knowledge transfer from their customers on information required to succeed with the PDD activities. The knowledge kept internally was not documented or cascaded correctly and the type of activities outsourced required specialist knowledge that was only known internally. See section 6.5.12 for further details on knowledge transfer as the FTSs experienced the same challenges. The findings in this study are consistent with the results reported in other non-automotive sectors.

6.5.7. Additional resource required to manage external organisations

This study has identified the third challenge for FTSs is the inefficiencies with outsourcing meant additional resources were deployed to manage their external organisations to ensure systems and processes had been fully understood. When outsourcing, the customer must be accountable to ensure all deliverables and necessary information regarding the outsourcing journey have been met and in this case the FTSs failed. Further, in all cases the FTSs failed to deliver as they were unsure themselves on how to conduct outsourcing.

The finding in this study is new within the automotive sector where previous studies provide inadequate finding.

The solutions implemented resulted in the following;

1. Additional costs not anticipated in the project as additional resources were used.
2. Additional coaching and educating for the external organisations.
3. Additional time for explanation and cascading of information where both partners spent more effort ensuring PDD activities were completed to a high standard.

6.5.8. Not cascading internal processes

The fourth challenge identified in this study is different across the three segments. Firstly, the OEMs admitted during the interviews they failed to provide the relevant information to the ESPs.

Half of these OEMs implemented training, coaching, on-site support to ensure their external ESPs were trained whereas the other half continued and suffered taking a fix on failure approach. The below strategies were used to cascade the internal processes;

1. The approach taken by half the OEMs improved the communications, team culture between the two organisations, and providing support at all times helped the two organisations secure a better success rate on the outsourcing of projects.
2. More face to face reviews when discussing PDD activities that ensured data was retired efficiently from the customers.
3. Improve management cohesiveness with external organisations through team build events regarding the PDD activities.

The finding in this study provides novelty within the automotive sector where no previous studies have identified the customers not cascading internal process, not providing the correct level of support and additional training is required on outsourcing engagements.

6.5.9. Outsourcing any PDD activities

The fourth challenge highlighted in this study with regards to the ESPs and FTSs were outsourcing any PDD activity to their external ESPs without understanding or considering which activities generated the most competitive advantage for their business. These PDD activities were sensitive, and outsourcing without any strategy was close to jeopardising the organisation's core competence. The two automotive organisations that did not fully understanding the competitive advantage of the businesses ended up with spending additional cost and contributing additional time not planned accounted for. These organisations all lacked clear outsourcing decision-making models and processes when outsourcing PDD activities.

These organisations were unaware which PDD activities were non core, near core and core. According to Gilley and Rasheed (2000), Quinn and Hilmer (1994), Prahalad and Hamel (1990a), and McIvor (2000b) organisations are required to understand which activities are core and non core before outsourcing, and the ESPs and FTSs failed.

The majority of the decisions were ad hoc and activities which contributed to the core knowledge of the organisation had been outsourced and then backshored.

The key finding in this study are novel by identified that ESPs and FTSs had been outsourcing any PDD activity including their core competence. The key finding provides new insights into the automotive industry but the results are consistent with other non-automotive sectors (Eppinger and Chitkara 2009).

6.5.10. Additional coaching and control required for external organisations

The fifth challenge identified in this study between the three segments is different as they all experienced challenges when outsourcing to external organisations namely ESPs who provided more high-end PDD capabilities than offshore organisations. The OEMs could not continue and had to change and educate their external organisations as the PDD activities were suffering. Before the project health started to deteriorate the following solutions were implemented to improve the current condition;

1. The OEMs used their own resources to provide additional coaching and training for the external ESPs. This consisted of training and making aware to the ESPs the different milestones in a project and the delivery requirements necessary for each stage.
2. The OEMs training the external ESPs was a hidden cost not associated with the project deliverables and they failed to identify this early on (Barthélemy 2001, Barthélemy 2003, Larkin 2008, Larsen *et al.* 2013).
3. Additionally there was a further element of control required from the management team to ensure the technical/design abilities were aligned with the OEM.

4. Control became an important factor when outsourcing locally as mentioned by a director at OEM B who stated:

   When outsourcing you cannot let the organisation to just get on with it the management team are required to stay on top of these people. The OEMs did not include a certain element of control that was required from their own resources add hidden costs into the project.

The study has identified a new significant fact that additional coaching and control is required when outsourcing. The result is consistent with findings reported in other non-automotive sectors. However, the finding is unique to the automotive industry where literature is inadequate and does not provide solutions for organisations as outlined in this section.

6.5.11. Not understanding customers systems and processes

The research study has identified the fifth challenge for ESPs as they did not understand customers complicated processes and systems. It must be noted that outsourcing to an external organisation requires robust systems and processes and in 80 per cent of the cases the OEMs lacked the ability to achieve this. This was down to the following;

1. These organisations were not aware of how to conduct outsourcing and the relevant tools required for external organisations. This can be related to lack of knowledge when outsourcing.
2. These organisations assumed that outsourcing did not require the use of such systems and processes internally. This can be related to lack of management experience when outsourcing.
3. Lack of ESPs awareness on outsourcing and deliverables required on PDD activities.

The large organisations such as OEMSs which are more complex and sophisticated than smaller organisations, there was ambiguity between departments on what was actually required from external ESPs. This challenge also leads to not having a key team involving key stakeholders while forming the outsourcing proposition.

The finding presented here in this study regarding not understanding customers systems and processes is new to the automotive sector and organisation are required to be cautioned when developing their outsourcing contracts. Previous results are inadequate within the automotive industry.

6.5.12. Knowledge transfer

The fifth challenge for FTSs identified in this research is the lack of knowledge transfer between the two organisations. Knowledge was not cascaded correctly to the onshore outsourcing organisations, in this case the ESPs. The onshore organisation that was outsourcing the PDD activities was lacking the capability in developing a clear product specification.
A key challenge when this organisation outsourced PDD activities was that the format of the work streams was inconsistent (Castells 2011, Polanyi 1997, Takeuchi and Nonaka 1986).

The following solutions were used to ensure that knowledge was transferred sufficiently after these organisations failed to understand the requirements from the onshore organisations.

1. Training was given to all employees on the importance of knowledge transfer when using external organisations.
2. Tacit knowledge was documented in critical PDD activities offshore.
3. Tacit knowledge was also documented in general as this was the key to ensuring that activities were completed successfully.
4. Use of multimedia tools to ensure better communications between the two organisations.

Eighty per cent of the FTSs had been transferring knowledge for over 12 months whereas the other 20 per cent could not commit the time or dedication and failed.

The finding presented from this study highlights that outsourcing of high value PDD activities required a sufficient level of knowledge transfer which was not present in these organisations. Knowledge transfer was not an hourly task as perceived by the management team and this finding is new to the automotive sector.

6.6. Offshore outsourcing - challenges amongst OEMs, ESPs, FTSs

Based on the results presented in Chapter 4 sections 4.4.2.2, 4.5.2.2 and 4.6.2.2, the top five key challenges are discussed when all three segments conducted offshore outsourcing of their PDD activities to external organisations. The offshore organisations were responsible for the development and delivery of the PDD activities. The key findings from this study are discussed with the current literature.

Rilla and Squicciarini (2011) conclude from their study that offshore outsourcing has been overlooked in the academic literature and requires more studies to understand the extremely complex phenomenon. This research contributes to add new knowledge and insights to offshore outsourcing literature from an automotive perspective.

6.6.1. Communication

The study has identified the first challenge experienced by all three segments is communication barriers when offshore outsourcing the PDD activities to offshore ESPs. The communication challenges are further discussed from the in-depth case studies in section 6.10 and the solutions implemented.

6.6.2. Additional checking of data

The second challenge identified in this study for the OEMs is additional checking of data received from their offshore outsourcing organisations. This can be explained as a range of PDD activities were offshored to their external ESPs which consisted of non core, near core and core tasks. The offshore outsourcing organisations did not have the core competencies and know-how knowledge to carry out core activities where these organisations struggled to deliver complex activities. This was also the findings identified by Iacovou and Nakatsu (2008) conducted in non-automotive industries in particular IT organisations which cannot be compared to offshore outsourcing of PDD activities due to the complexities involved.

The additional checking of data was down to the lack of practical experience in developing countries and poor management within these offshore outsourcing organisations. There was a lack of strategy in terms of which PDD activities were offshoreable ranging from non core to core tasks. The additional challenges could have been prevented if there was a decision-making model or if the organisation fully mapped out there PDD requirements to understand the interactions and communications.

The checking of additional data was a fact within the automotive industry, as all organisations that offshore outsourced PDD activities experienced poor quality. This study adds a new finding to the automotive sector.

6.6.3. Controlling offshore

The second challenge identified in this study for ESPs is controlling the offshore outsourcing organisations at each stage of the development process. In fact more control was required when executing the PDD activities.
As these organisations were third parties, that outsourcing companies were reluctant to invest financially as the objective of cost reduction was then defeated. Therefore, the following solutions were implemented;

1. Ensure all data was provided with any activity sent offshore.
2. More focused management in particular regarding the PDD activities.
3. Onshore management teams provided support to offshore employees where required and consisted of providing information that was required to develop a fruitful activity such as design processes, engineering experiences and rule of thumb ideas to accelerate the PDD activities.

During an interview with an executive from ESP N mentioned:

> I would not do offshore outsourcing again with a third party as there are too many risks involved. The management teams have different commitments and on a different level to the customer. The challenges experienced by the ESPs could have been avoided if there was a strategy and a decision making model to understand which PDD activities were outsourceable and offshoreable. However, the learning experienced through offshore outsourcing has opened our eyes into having robust decision-making processes and controls in place for the future.

The challenge of controlling an offshore outsourcing organisation highlights novelty from this research and is new to the automotive sector. The solutions implemented by ESPs are provided in this study where previous studies are inadequate.

6.6.4. Additional time in managing people

The second challenge experienced by the FTSs was additional time in managing the people (and management) within the offshore outsourcing ESPs. When more time was required with managing the people based offshore it jeopardised the value adding activities and reduced the output level. This required additional 10 per cent of resources onshore. The additional time required to manage people is explained by the lack of knowledge and experience as highlighted in section 6.6.3.

This involved the FTSs to spend a great deal of time during the offshore engagement to react to these challenges which could have been resolved at an earlier stage. The upfront planning and decision making did not take place. The lack of managing and urgency from the management teams based offshore contributed to this failure. The solutions implemented consisted of the following;

1. As the FTSs did not want the offshore projects to fail they reinforced the management commitments and dedication towards offshore outsourcing and provided additional resources to support these activities.
2. The offshore management team were trained so they could understand how these organisations functioned and run their businesses. This was lacking from the offshore management as they had different cultures and working practices.
3. Additional time was spent to ensure the costs were accurate and the organisations achieve value for money which was measured by analysing the actual and planned hours required for the PDD activities.

This study has identified a novel finding within the automotive industry as offshore outsourcing required additional people to manage the engagement.

6.6.5. Unclear PDD specifications

This study has identified the third challenge experienced is different amongst the three segments. The OEMs developed unclear PDD specifications that were sent out to their offshore ESPs creating challenges between the two organisations. The specifications lacked the relevant information required for the offshore ESPs to complete the PDD activities. The strategies applied in section 6.7.8 were also applicable to the challenges experienced by the OEMs when offshore outsourcing there PDD activities.

The key finding has identified that the OEMS were unable to develop a clear specification as internal jobs onshore which have been repeated for several years and potentially over a decade became a norm to the organisation and therefore documenting was difficult.

The key finding is novel within the automotive industry and the results from previous studies overlook all three segments in this field (Barthélemy 2001, Ellram et al. 2008, Overhage et al. 2010).

6.6.6. Management commitment

The third challenge for ESPs identified in this study is the lack of management commitment and their failure to deliver on critical milestones. In summary the two organisations had different business objectives that evolved into further challenges during the engagement. These consisted of;

1. During the sourcing events more experience and knowledge was declared than actually known by these organisations.
2. After signing the contracts the management within the offshore outsourcing organisations took a laid-back approach and did not fully support their customers.
3. The offshore organisations did not commit to making a mistake and inherited a blame culture which caused other difficulties in these organisations.
4. When the offshore employees struggled with activities help was not requested and the activities were completed incorrectly.

The offshore ESPs management teams realised that the level of competence within their organisations was under estimated as this was revealed in a number of PDD activities reviews with their customers.

The tasks which required a high level of competence and skills were unable to be completed offshore and these were backsourced. The simplest tasks (known as non core) also required a significant amount of coaching and educating to the employees which built their knowledge and experience. The onshore management teams experimented with different solutions to resolve these issues but it was realised halfway through the contract it had been mapped out incorrectly. As identified by Loch and Kavadias (2008) strong management commitment is required in PDD to ensure the necessary functions have full support and further ensures the design stage is fully supported. These organisations had poor management commitments which can explain the reasons behind these challenges and failures.

The key finding identified is novel and highlights that ESPs had challenges with management commitment from their offshore organisations and even after supporting and coaching the employees, challenges did not get resolved. This finding in the automotive sector was not identified by the results reported for other non-automotive industries (Iacovou and Nakatsu 2008, Lacity and Hirschheim 1993).

6.6.7. Cascading of information

This study has identified the third challenge experienced by FTSs is the lack of information cascaded to external organisations which was critical for the success of each PDD activity.

The onshore organisations reported their PDD work packages received from their offshore organisations were incomplete and lacked the necessary depth. The incompleteness of PDD activities can be explained using the garbage bin approach (Cohen *et al.* 1972). These organisations provided insufficient or in 70 per cent of cases no information regarding on what was clearly required from the PDD activities.

Much time was lost in communicating between the two organisations on what data was required than adding value to the PDD activities. It can be concluded the FTSs failed to understand their own requirements which was evident throughout the case studies and data analysis stage from Chapter 4.

Further, the PDD activities had been offshore outsourced to an external organisation but they did not understand the necessary details and work streams required without giving a comprehensive explanation that took additional time.

The outcome of this study has provided a new finding which is consistent with the results in other non-automotive sectors on how the lack of information caused challenges between the organisations. This finding is new to the automotive industry adding to the wider literature on outsourcing and offshoring of PDD.

6.6.8. Lack of employee experience

The study has identified the fourth challenge was different across all three sectors. The OEMs had difficulties with ensuring the offshore ESPs used employees on PDD activities with sufficient engineering experience and was discovered employees with minimal experienced were used. The PDD activities were conducted predominantly in India where the level of experience was low and the employees who delivered the activities were fresh from university.

As identified by Ellram *et al.* (2008) offshore outsourcing of services requires unique skills from the organisations to satisfy the ongoing needs and the offshore organisations failed to deliver. In this case the offshore outsourcing organisations did not have the unique skills required and the employees lacked basic engineering experience which was required for the PDD activities. This created additional challenges as the OEMs offshored sporadically PDD activities which ranged from low to high level complexity without considering the skills and capabilities from their offshore outsourcing organisations. The offshored PDD activities consisted of no structure or plan as they were just sent offshore. These challenges were addressed as below;

1. Backsourced high value activities to onshore locations, this included core and near core tasks.
2. Retain simple activities offshore that required less coordination and interaction.
3. A group consisting of 10 people had at least one or two experienced offshore employees.

Gassmann and Han (2004) identified developing countries lack the experience and specialist knowledge in PDD which could explain why these originations were unable to deliver these activities.

The OEMs did not have a clear or consistent plan when offshoring the PDD activities which also contributed to the offshore outsourcing organisation unable to carry out these activities.

This finding identified in this study is consistent with the results reported for other non-automotive sectors on how the lack of experiences caused challenges in executing the PDD activities.

6.6.9. Lack of skills

The fourth challenge identified in this study for ESPs is the lack of skills offshore within these organisations as they portrayed cutting edge knowledge and experience during the sourcing stage. However, as there was no structure to the PDD activities it was evident very minimum or no upfront work streams had been conducted to analyse the level of knowledge required for these activities. These activities which required a high knowledge and skills base affected the performance output. To address the lack of skills and a large number of PDD activities not completed correctly the ESPs had to implement additional training sessions for the offshore employees to make them aware of their organisations PDD activities and more experienced offshore employees were used where the skills were lacking.

6.6.10. Reworking of data

This study has identified the fourth challenge for FTSs is reworking data that was received from the offshore outsourcing organisations. Reworking of data was down to the lack of information cascaded (see section 6.6.7) and lack of employee experience (see section 6.6.8) and lack of skills (see section 6.6.9) where solutions are provided to address the challenges experienced by these organisations.

The finding for this study are novel as reworking of PDD activities is not reported in the automotive industry apart from software development and information technologies (Carmel and Tjia 2005, Rottman 2008).

6.6.11. Employee attrition

The fifth challenge identified in this study across the three segments is different. The OEMs experienced on average 15 to 20 per cent of employee attrition when using offshore outsourcing organisations. Attrition in developing countries is well documented in the literature (Dibbern *et al.* 2008, Gopal *et al.* 2003, Levina and Vaast 2008, Lewin *et al.* 2008). Employee attrition was an oversight with fifty per cent of the OEMs not taking this into account when engaging with their offshore ESPs and the offshore organisations quoted lower attrition numbers.

6.6.12. Reworking of data

This study has identified the fifth challenge the ESPs experienced with reworking the offshore PDD data and was in excess of 20 per cent. The reworking of PDD activities had been completed onshore, adding further costs into the project. This was a hidden cost and not accounted for during the offshore engagement. The cost benefit started to become questionable as the PDD activities were rectified onshore. Due to the lack of skills and competency available offshore the reworking of data was conducted at the ESPs onshore location to avoid further delays in the project. Additional strategies were implemented to support and educate the offshore employees but this was not an overnight development and took several months before there was any real improvement.
See section 6.6.10 for further information regarding reworking of data.

6.6.13. Developing capability

The fifth challenge identified in this study for FTSs is developing capability with an external organisation that is not wholly owned by parent organisation. The FTSs all reported that the activities offshored ranged from non core and core as they were unable to identify them within a short time period due to pressures to reduce cost. There was an internal drive to accelerate the offshore outsourcing process quickly as possible to achieve cost reductions. After several months into the offshore outsourcing journey the FTSs identified the PDD activities were actually their core competence and they had been identified incorrectly due to cost reduction being the strategic driver than analysing which PDD activities were offshoreable. The offshore outsourcing organisations became the fact holders when PDD core activities were discussed. This was a risk for the FTSs as core activities which were sensitive to these organisations had been conducted externally. This is known as the *"outsourcing trap"* (Eppinger and Chitkara 2009), described in section 6.4.8.

The fragmentation of capability to another organisation can be explained with the RBV theory which focuses on developing competence within the internal resources and building their capability to achieve distinctive and novel capabilities (Barney 1991). FTSs offshore outsourced these capabilities the organisations lost control over these activities until they were slowly backsourced (Wernerfelt 1984) and did not align with the RBV theory. The offshoring within FTSs is better explained using the RDT where external organisations based offshore were used for cost reduction purposes and adding additional engineering resources. As the FTSs had no clear strategy when offshoring core PDD activities had been offshored and the FTSs became dependent on these external organisations not belonging to the FTSs (Pfeffer and Salancik 2003)

To address the offshore outsourcing of core activities the following strategies were implemented;

1. These activities without any plan (core tasks) were backsourced to their engineering design centres. It was rather clear that these activities were core because the FTSs invested and built the offshore capabilities. Management teams recognised that any highly sensitive activities had to be backshored.
2. The five contracts terminated (FTS C, D, E, F, J) all followed the route of failing to identify their core PDD activities and three organisations developed their OWOS.
3. Knowledge was transferred over a six month period to the onshore organisation where these organisations lost financially over millions of dollars.

The finding of this study provides novel facts and highlights how FTSs offshored core competencies without understanding which activities were critical and provide competitive advantage within the automotive industry. However, studies in other sectors overlooked the automotive industry (Aron and Singh 2005, Barney 1991, Eppinger and Chitkara 2009, Quinn and Hilmer 1994).

6.7. OWOS - challenges amongst OEMs, ESPs, FTSs

Based on the results presented in Chapter 4 sections 4.4.3.2, 4.5.3.2 and 4.6.3.2, the top five key challenges are discussed when all three segments offshored their PDD activities to wholly owned subsidiaries. The OWOS organisations were responsible for the development and delivery of the PDD activities. This study has identified the three segments experienced similar challenges when offshoring their PDD activities and is discussed in detail.

6.7.1. Communication

This study has identified the first challenge amongst all three segments is communication issues faced when offshoring the PDD activities to their wholly owned subsidiaries. The academic community has concentrated and focused on analysing non-automotive organisations in regards to the communication challenges they face when activities/tasks have been offshored to their OWOS. These challenges within the automotive industry are further discussed in section 6.10.

6.7.2. Rework of data

The second challenge identified in this study is common amongst all three segments and consisted of those organisations reworking the PDD activities. The design data maturity was poor, incomplete and not representative for an engineering sign off. Thus, the design rectifications had been completed by the onshore employees to ensure quality and design maturity was achieved. The organisations based in all three segments did not comprehend that design offshoring was more complicated and challenging than outsourcing until the offshoring journey was started (Zirpoli and Becker 2011).

The first solution implemented was to co-locate a key member from the offshore team into the parent organisation based onshore to become the local coordinator and coach the offshore employees. Before data was sent to the parent organisation it was screened by the offshore coordinator based onshore who improved the quality throughput but this resulted in further delays in completing the PDD activities as they were reworked onshore/offshore. The second solution implemented involved an expat team based offshore for several months to educate, guide and coach the employees which was also successful but rather expensive solution. The offshore cost advantage starts to neutralise.

This key finding in this study is novel to the automotive industry where previous studies overlook the reworking of data within this sector (Jensen et al. 2007, Rottman 2008).

6.7.3. Lack of experience

The study has identified the third challenge being different amongst the three segments. The OEMs had a lack of experienced employees working on PDD activities that required significantly well-thought out and innovative solutions. These activities as highlighted in Chapter 5 (In-depth case study analysis) consisted of non core, near core and core activities which required a wide spectrum of skills set not available offshore.

In an interview, the engineering director from OEM D mentioned:

> The offshore employees could not think in three dimensional formats. Our offshore people are working according to the "cookbook" if I should say it is all written down and they work exactly to this. Something obvious is not applicable and do not see common sense [...].

The culture associated with offshoring impacted the employee's capability of thinking and can be explained why loss of know-how occurs (Gassmann and von Zedtwitz 1999). It was also discovered that offshore employees were only engaged on a single task that as the thinking capabilities were of an individualistic nature then analysing a whole system.

As mentioned by OEM Q's engineering director, "The biggest problem about Indian companies is that they all claim they've done more work than they have and we need to be careful not to fall into a trap".

The finding in this study presented within the automotive sector revealed the challenges organisations experienced when offshoring the PDD activities when there was a lack of experienced people. This finding is new to the automotive industry and consistent with results reported in non-automotive sectors (Iacovou and Nakatsu 2008).

6.7.4. Management trust

The third challenge identified in this study for the ESPs when operating their OWOS is ensuring a reliable management team which could be trusted as the parent organisations were based thousands of miles away. The management teams in the offshore subsidiaries had a laid-back approach and this can be explained with different working cultures and ethics based in particular India (Lankford and Parsa 1999). The employees based offshore were identified as key ingredients for the success of an OWOS.

The solution to their management trust challenges consisted of the below;

1. Deployment of an expat based offshore to operate the subsidiary. As described by Berthoin Antal *et al.* (2000) expats gained knowledge about the differences of customers, how cultures work together, how to delegate tasks to people in a different country, and when to react on different timing situations that could affect the project's performance and deliverables.
2. Frequent offshore management team visits both virtually and physically to onshore locations for training and learning of the organisation.

3. Weekly meetings to understand PDD activity progress and general status of the subsidiary.

The challenges of trusting management within the offshore locations in this study have provided new findings to the automotive industry.

6.7.5. Lack of capability

The third challenge identified in this study for the FTSs when operating their OWOS is the lack of capability within their employees. The offshore subsidiaries were used as a job shop, which is against the offshoring practice with high level complex activities such as PDD (Hirschheim *et al.* 2009). The use of a job shop further caused other complications with inconsistency of the PDD activities where building capability became difficult. The employees based offshore were educated to degree level but they lacked the experience required to develop robust engineering PDD solutions. This is a typical mistake organisations make when developing an OWOS and further created additional challenges due to no decision-making processes used. The parent organisations assumed a high level of skilled workforce until their OWOS was developed and operating. Additionally the lack of a decision-making model within the FTSs also contributed to this challenge not being identified at an earlier stage. The solutions implemented to address the lack of capability based offshore was the parent organisation sending out an expat who was based offshore and the management teams based onshore supported the offshore employees through virtual communications and one or two visits annual to the offshore location.

The key finding in this study is novel to the automotive sector and provides new insights on how to not use an OWOS. The findings also highlight that when a job shop approach is used, the organisation is faced with difficulties in maintaining product knowledge, information knowledge, building capability and continuity on PDD activities.

6.7.6. Employee attrition

This study identified the fourth challenge for OEMs is employee attrition where OEMs experienced challenges with retaining employees. The attrition rates were in excess of 20 to 30 per cent and 10 per cent higher than the ESPs identified in section 6.7.9.

To reduce the number of people leaving the OEMs, they implemented the following strategies:

1. Training employees and promoting them within the organisation.
2. Offer to take placements in the onshore parent organisation.
3. Yearly salary increments and bonuses based on performance.
4. Management incentives for meeting PDD quality levels.
5. Flexible working hours for employees.

The key findings from this study are consistent with the results reported in other non-automotive sectors (Lewin *et al.* 2008, Penter *et al.* 2009, Upadhya 2009) as per section 6.7.9.

6.7.7. Control

The fourth challenge identified in this study for both ESPs and FTSs is common when operating OWOS. These organisations were required to spend more time in controlling the offshore PDD activities than their own internal departments. Further, the study also revealed that without this control in place the data and management from their offshore subsidiaries would not meet the expected performance.

The challenges both ESPs and FTSs experienced with controlling their offshore subsidiaries was common and the following was implemented to provide a better control of their organisations:

1. Co-locating the employees onshore made them aware of the different processes and systems used.
2. Offshore employees not fully understanding technical capabilities or PDD activities which meant that additional onshore control was required to guide and educate the employees.
3. Use of expat (sometimes teams) to ensure management team delivered PDD activities and delivery timings were fully understood.

The key fact and observation of this study has highlighted that even though these organisations are OWOS, control was still required to ensure the accuracy and robustness of the PDD activities along with efficient running of the department. The key finding highlights novelty and new insights into the automotive sector where previous studies are inadequate.

6.7.8. Unclear specifications

This study identified the fifth challenge experienced by the OEMs is their inability to write a detail specification for their OWOS employees when working on PDD activities. For an offshore organisation either an OWOS or an offshore third party, a clear and concise specification is required. The key findings revealed that these organisations were unable to develop a clear specification that could be used without questioning or requiring further supplement data to support the PDD activities. In all cases these documents were incomplete and employees onshore assumed their counterparts based in their OWOS would understand the use of abbreviations, and technical language which was known internally.

The following strategies were used to help these organisations develop clear specifications:

1. Training was given to the onshore employees on how to write a clearer specification. This was not an overnight task and throughout the learning process the onshore employees identified that their knowledge was also limited on how they could describe the activities. This can be linked to a task which is repeatedly conducted that becomes a normal process for humans and difficult to explain and document; this was the case in the OEM organisations.
2. Additional use of online multimedia tools with screen sharing capability to explain the PDD work streams required. The employees making use of online communications, video calling helped supported the clarity required on the specifications. However, this process

was a long process and extremely time consuming and most OEMs reporting it taking over 12 - 24 months.
3. Additional training given to offshore management team enabled them to critique the specifications.
4. Offshore employees were encouraged to ask more questions and not just accept the status quo, which was an important factor when carrying out the PDD activities.

The key finding has identified that OEMs were unable to develop a clear specification as internal jobs onshore which have been repeated for several years and potentially over a decade become a norm to the organisation and therefore documenting became difficult.

The significant fact is novel in this study within the automotive industry on the difficulties OEMs experience when developing a PDD specification. Other studies not relating to the automotive sector report similar findings (Barthélemy 2001, Ellram et al. 2008, Overhage et al. 2010).

6.7.9. Employee attrition

The fifth challenge identified in this study is ESPs employee attrition within their OWOS and was between 10 to 15 per cent, more towards the latter part. Employee attrition was experienced for a number of reasons which are listed below:

1. No job security within the organisation.
2. Operated as jobbing shop where no continuity was within jobs leading to poor outputs.
3. Lack of management experience when working with a parent organisation.
4. Poor running of the offshore organisation.

The current literature is rather limited on how automotive organisations can reduce their labour attrition; the following strategies used helped these organisations.

As noted in section 6.7.6, the OEMs were able to offer a large scope of development within their OWOS compared to the ESPs due to the size differences. The following strategies were used to improve employee attrition and provide better prospects for the offshore employees.

1. Incentives to work in a Western country.
2. Opportunities to move with the organisation when learning technical knowledge.
3. Salary increments if targets were reached.
4. Better job benefits; holiday pay, flexible working.

This study has identified the different solutions applied within the automotive industry and is not consistent with the results reported in other sectors (Lewin et al. 2008, Penter et al. 2009, Upadhya 2009).

6.7.10. Management buy-in

This study identified the fifth challenge for the FTSs in getting their management teams to understand the benefits why the organisation has conducted offshoring of PDD activities. The study discovered that half of the FTSs partially engaged their management teams whereas the remaining did not make any attempts in making management aware of why offshoring was necessary. The result of this was negative and the management teams were reluctant in appreciating the organisation's need for offshoring where it created additional complexities while addressing the challenges.

Different strategies were applied which included the following:

1. Management buy-in from the onshore employees to understand the benefits associated with offshoring which took additional time and resources. This activity should have happened during the initial stages.
2. Ensuring the front line teams supported the offshoring PDD activities.
3. Educating the expat personnel on offshoring as this person was not involved during the initial discussion when these organisations decided to offshore the PDD activities.
4. Offshore management were coached on the importance of dedicating time to ensure the PDD activities were analysed and completed successfully and where required to seek help from the onshore employees.

This finding is a significant fact and novelty is presented in this study providing new insights on how management failed to involve other team members when offshoring and a new development in the automotive sector. As highlighted by Kern and Willcocks (2001) outsourcing organisations do not have the sufficient management programmes in place to develop their understanding which was also a failure in the FTSs.

6.8. Onshore outsourcing of PDD activities amongst OEM, ESP and FTS

This section discusses the key findings from Chapter 5 where the in-depth cross case analysis was conducted. Further data is used from the analysis conducted in Chapter 4 amongst the three sectors to enable a comprehensive contribution to the discussion.

Onshore outsourcing of PDD activities across all three segments, OEMs, ESPs, and FTSs, followed a similar approach as these organisations increased their product portfolio to become more competitive in the automotive industry to provide their customers a wider flexibility of products. However, increasing the product portfolio these organisations lacked to provide the necessary resources internally as the project demand was greater than the engineering resources required to complete the PDD activities and therefore onshore outsourcing was used. The driver within the three segments was based on increasing the engineering capacity/resources for developing the PDD activities. This can be explained using the RDT where external resources were acquired using the TCE approach. External resources were responsible for PDD activities whereas the internal resource approach can be explained using the RBV theory where core competence was developed internally from existing resources.

Thus, due to infrastructure and direct cost constraints associated with engineering employees the three segments increased their internal FTE's, added contractors to the business and also outsourced to ESPs. To become more competitive, organisation’s resources are reassessed and were deployed into other areas (Jennings 1997b, Quinn 1999).

Outsourcing of PDD activities across all three segments followed a similar approach where there was lack of strategy when outsourcing the PDD activities to external onshore organisations. These activities were known as the near core activities that were outsourced to onshore ESPs. The term near core is used to identify PDD activities which were positioned close to the organisation’s core capabilities and did not directly impact the competitive advantage. Near core is further explained in section 2.13.1.2, Figure 2.3.

Gilley and Rasheed (2000) identify that outsourcing the near core activities places an organisation’s future performance in jeopardy. The authors also mentioned that the near-core outsourcing activities will achieve lower levels of performance.

The significant findings below are new to the automotive industry.

Therefore, it is argued here that the key findings within this study in the automotive sector have revealed near-core outsourcing of PDD activities did not jeopardise the organisation’s performance when a strategy or decision-making process was implemented. In fact, the automotive organisations taking a strategic perspective experienced the same or better performance levels from external organisations than those not taking such approach. The near core findings are used to develop the strategic decision-making model which is discussed in Chapter 7. These findings are also triangulated with the focus workgroup activities which were used as an input into the model development.

The near core finding in this study is new to the automotive industry as in other industries onshore outsourcing consists of non core activities than near core. These organisations that engaged with onshore service providers also had OWOS but the PDD activities sent offshore were less complex.

However, to the best of the author's knowledge, there are no automotive studies conducted in this area and these findings add new insights into this inadequately researched topic.

The research highlighted that all three segments outsourced their PDD activities and had strategic alliances with onshore organisations as shown in Figure 4.26. These outsourced activities were near core. All OEMs had onshore strategic alliances and this differed with ESPs and FTSs having 11 and eight respectively. This involved outsourcing of PDD activities that required a high level of engineering capability, skills and competence which was not available internally as the engineering resources were fully engaged on projects/programs.
The ESPs organisations had developed local onshore subsidiaries and when engaging with new customers opened new subsidiaries which were located within a short distance from their engineering centres. This trend was rather common with automotive FTSs setting up manufacturing facilities (co-locate) close to their customers but now it is becoming a more traditional approach for ESPs to follow this practice through a decentralised strategy, by setting up offices within short proximity from their customers.

Handfield *et al.* (1999) identify that developing suppliers and involving them through the PDD stage whereas Morris *et al.* (2004) identify the importance of co-locating suppliers within a short proximity from the customer. The research adds another theme to the literature as the ESPs that had local engineering offices within close proximity of their customers were more favourable in being awarded an outsourcing contract than those not having any presence.

The 'make or buy' decisions across three segments was used as there was a lack of engineering resources required to fulfil the organisation's product portfolios and the top two drivers to outsource their PDD activities was based on engineering capacity and reducing costs from the organisation.

McIvor and Humphreys (2000) identified senior managers are unanimous without considering the make or buy decisions should be part of organisations strategy where in this case short-term decisions made by the three segments developed financial difficulties and these organisations struggled to meet their objectives when outsourcing the PDD activities based on short-term, ad hoc decisions.

This research study is developed one step further by developing a strategic decision-making model for outsourcing, offshore outsourcing and offshoring the PDD activities across all three segments using the key findings discovered from Chapter 4 and Chapter 5. This observation provides new findings within the automotive industry.

The key findings for onshore outsourcing did not coincide with the RBV theory (Wernerfelt 1984) as the organisations based in the three segments did not create value through their internal resources. This research study widely discovered that the three segments outsourced their PDD activities it was in line with the resource dependency theory (Preffer and Salancik 1978). This can explain how engineering resources are required for development of projects, survival and growth containing a very high-level skill required for the engineering PDD activities.

6.9. Offshore outsourcing of PDD activities amongst OEM, ESP and FTS

This section discusses the key findings from Chapter 5 where an in-depth, cross case analysis was conducted. Further data is used from the analysis conducted in Chapter 4 amongst the three sectors to enable a comprehensive contribution to the discussion.

The key driver when these organisations based in the three sectors offshore outsourced their PDD activities was down to reducing the labour costs associated with the PDD phase. This can be explained using the TCE theory where these organisations wanted to reduce the cost of transactions through offshoring. In addition the RDT can explain the acquisition of external resources that were used through offshore outsourcing.

Offshore outsourcing of PDD activities across the three segments followed a similar approach where there was a lack of decision-making and an unclear strategy on which activities were offshoreable. All 16 offshore outsourcing organisations were initially used as an experiment to test the low cost countries. The four ESPs that terminated their offshore outsourcing contracts had no clear strategies on which activities were offshoreable and this can be explained as the following:

1. Lack of engineering resources required additional capacity and therefore ESP made poor decisions on the PDD activities that were offshored.
2. Offshore outsourcing was a cost-driven strategy and key elements of the PDD activities were overlooked.
3. Lack of management knowledge on offshore outsourcing and assumptions that skilled workforce was available immediately in offshore locations.
4. Not understanding how interactions within the organisations were conducted.
5. Unable to identify non core PDD activities and mixed with near core activities.
6. Unable to identify near core PDD activities which were mixed with core activities.
7. Unable to identify core PDD activities which had been offshored.
8. Poor knowledge transfer of the PDD activities.

The failures of these ESPs organisations are further discussed below.

Firstly, only top level management were involved with offshore outsourcing and short-term strategies were applied to increase the engineering resources without taking a broader view of the organisation. The decision-making process involved a rational view where the management assumed the PDD activities outsourced onshore could also be offshored ranging from near core, non core and core activities.

Secondly, the lack of decision-making created additional challenges as the complications within their organisations and the solutions implemented indicate a garbage can model approach (Cohen *et al.* 1972). These organisations lacked the knowledge on the overall problem and a best available solution was used rather than understanding which areas required a different approach to resolve the problems (Gigerenzer and Selten 2002, March 1994).

The ESPs had minimum experience with offshore outsourcing organisations and therefore they all went through a ‘learning by doing’ process which resembled their offshore outsourcing strategies. This is defined by Willcocks *et al.* (1995a) as the most time consuming and difficult way in conducting outsourcing and can be applied to offshore outsourcing.

The learning by doing can explain why the four ESPs had terminated their contracts as the outcomes were unsuccessful and they developed OWOS. However, the development of a new contract with an OWOS was more successful because of the learning effects from their offshore outsourcing engagements but challenges were still present. The challenges still present were reduced from taking the learning experience from offshore outsourcing. However, it must be noted that when automotive organisations decide to offshore their PDD activities the learning process within the organisation is required at all levels especially operationally and strategically and not only concentrating on costs reduction.

The three segments all had offshore outsourcing strategic alliances based in China and India where they took advantage of the lower labour rates and capitalised on freeing up internal engineering resources in their engineering centres where labour rates were higher than those countries. The level of competence in these offshore locations was lower than expected and this impacted the PDD activities to an extent where expats were used to share knowledge on the PDD activities (Berthoin Antal *et al.* 2000).

The type of PDD activities sent offshore consisted of a transactional approach across all three segments and was based on an external contract.

Around 70 per cent of ESP organisations had poor processes, lacked good practice methods of working and management knowledge on offshore outsourcing. To achieve a successful outcome, the organisations are required to think globally and have sufficient processes and methods including management which only supported the current way of working but not working on a global level can explain these failures.

6.10. Offshoring of PDD activities amongst OEM, ESP and FTS

This section discusses the key findings from Chapter 5 where an in-depth cross case analysis was conducted. Further data is used from the analysis conducted in Chapter 4 amongst the three sectors to enable a comprehensive contribution to the discussion.

Offshoring of PDD activities across all three segments, OEMs, ESPs, and FTSs, followed a similar approach as these organisations increased their product portfolio to become more competitive in the automotive industry to provide their customers a wider flexibility of products.

The key driver behind offshoring of PDD activities was to reduce the labour cost of employees and was a common driver in all three segments. This can be explained using the TCE theory where these organisations wanted to reduce the cost of transactions through offshoring and developed OWOS.

As shown in Chapter 4 there were 15 OEMs that develop OWOS where a further four had plans in developing a OWOS, 14 ESPs developed OWOS where four offshore outsourcing contracts had been terminated and subsidiaries developed, and 11 FTSs developed OWOS where five were previously offshore outsourcing. These contracts were terminated and OWOS developed.

The findings have revealed that automotive organisations experienced challenges with offshore outsourcing organisations (as identified in sections) and when reacting to the challenges the PDD activities were in mid-flight where it's difficult to switch service providers or backsource these activities.

ESP D, FTS C, FTS J did not develop an OWOS as the risks they identified with other organisation setting up operations in developing countries (mainly China and India) was expensive and therefore engaged with an offshore outsourcing organisation based in India to labour reduce cost by offshoring the PDD activities. ESP D, FTS C, FTS J did not conduct any risk assessments during this process and if these organisations conducted an in-depth offshore analysis their experiences would have been more positive (Aron and Singh 2005, Weidenbaum 2005).

As their strategy and decision analysis was rather poor and lacked detail, ESP D experienced challenges which were out of their depth and scope to be resolved and failed with the offshore organisation. Therefore an OWOS was developed in 2008. The decision in ESP D was based on employee cost reductions and grounded at executive level where management had minimal involvement. FTS C based their decisions on cost reduction but there management team were involved with offshoring where key decisions were made at executive level; a different approach to ESP D and FTS C used a 'me too' approach which according to Jennings (1997b) should be avoid as strategies used for one organisation may not be appropriate for others.

As mentioned by the COO of ESP D;

> The business plans were rather grey and we were not in a position to conduct any outsourcing or offshoring but due to engineering capacity constraints for onshoring we

> had no option and went for offshoring. The organisations approach was rather undeveloped and was very immature in this approach.

This quote clearly demonstrates there was no strategy for decision-making when developing the OWOS and the management teams had no guidance when offshoring (Harland *et al.* 2005). The decision making model in Chapter 7 addresses this gap and provides management teams a comprehensive guide.

FTS C's management when offshoring lacked the know-how knowledge required when developing an OWOS and learned through failing at each stage. Chapter 7 adds a new strategic decision-making model to support management when developing offshoring decisions

There was also no strategy behind FTS C's offshoring proposition that can explain these failures and any PDD activity was offshored. There OWOS was used as a jobbing shop where consistency was not achieved throughout the PDD activities.

ESP D went through a learning cycle where poor decisions resulted in difficulties and challenges which forced the organisation to terminate the offshore outsourcing contract. There were no long-term commitments by management and both organisations had different objectives (Beaumont and Sohal 2004, Hirschheim and Lacity 2000).

ESP D offshored activities that consisted of non core, near core and core only defined out that two activities (near core and core) that required the most interaction and knowledge were unable to be conducted offshore. This can be explained using Stringfellow *et al.* (2008) model for interaction distance where these activities had been backshored.

Willcocks *et al.* (1995a) defines 'learning by doing' as a complex and expensive activity which ESP D failed to apply when they developed their OWOS as the same challenges were experienced. Jensen *et al.* (2013) clearly identify that organisations which offshore outsource have the advantage of applying the learning from their mistakes where these organisations have paid fairly high learning costs. These findings were not apparent in FTS C as minimal learning was used and the similar mistakes were occurring. Kremic *et al.* (2006) identify that the lack of methodologies, skills and management experience is a cause of outsourcing failure which was identified in the case companies and Chapter 4.

However, ESP D identified that offshoring was definitely not a short term strategy and planned a three to five year payback period where only 10 per cent of PDD activities were offshored. ESP L also identified from their learning with an offshore organisation that a long term commitment is required when developing an OWOS. ESP D did not realise that critical mass was required when offshoring as FTS C, J and others (from Chapter 4) identified that over 100 people were required when developing an OWOS. These findings were discovered during the latter part of the engagement.

FTS C was unaware if their OWOS was developing any cost saving to the organisation as the cost savings were not tracked.

The offshored PDD activities consisted of a transactional approach across all three segments and very minimal project based deliverable work existed. This type of offshoring does not add value to the organisation’s competiveness or ability to become innovative (Agndal and Nordin 2009).

6.11. Solutions to challenges implemented within OEM, ESP and FTS

This section discusses the key findings from the organisations across all three segments and the implemented solutions used for their challenges. This data is taken from the in-depth case studies which are analysed in Chapter 5.

6.11.1. OEMs

A number of solutions were used across the three segments which are discussed below.

The key challenge regarding transferring knowledge was the presentation and the format it was presented in (Castells 2011, Chen and McQueen 2010, Polanyi 1997). The PDD activities that were carried out internally within OEM A became difficult when developing a specification for an external organisation whether it was located onshore or offshore. The solution was for the organisation to start documenting tacit knowledge (Baumard 1999, Polanyi 1997) to ensure a detailed specification could be developed and had taken up to three years to fully ensure explicit knowledge had been fully documented. There was a small amount of knowledge transfer during the early stages of the project implementation phase which impacted the organisation. However, transferring tacit knowledge was difficult and not an overnight process as perceived by senior management where the transfer of this knowledge was expensive (Contractor *et al.* 2011).

OEM A and C, with additional OEMs from Chapter 4 also implemented additional training sessions either at HQ locations or conducted virtually to help and educate the engineers/managers to ensure that processes and systems were fully understood. Additional, the training and coaching sessions were only implemented after the external organisations lacked the ability to deliver and understand their customer's processes and systems. This increased the efficiency of people's understanding on process and systems within OEM A's external organisations who were working on outsourcing projects.

When OEM A started to offshore their PDD activities, they went through a development phase where the efficiency of PDD activities within the offshore organisation was rather poor and therefore after recognising this failure they dispatched an expat who was based in India for the duration of four years. During this time a number of key employees from OEM A also visited the offshore organisation over a one or two week period to coach and educate.

Collings *et al.* (2007) and Tungli and Peiperl (2009) define that there are many reasons as to why an organisation may use expats. In the case of OEM A the expat was used to develop the organisation's knowledge, training of employees, and day to day running of the business.

This approach worked very well but there was a negative factor with having an expat based offshore as it was expensive but it provided the additional level of coaching, educating and discipline offshore. Additional costs were also occurred as employees from OEM A would visit the offshore facility over a period of one or two weeks.

OEM C still faced difficulties after developing training sessions for their offshore outsourcing organisations. Firstly, when the onshore employees sent the PDD activities offshore, it was late in the evening, these activities were reviewed where the time zones did not work for the two organisations. OEM C changed their business model to ensure all PDD activities were sent during offshore business hours. This enabled the onshore employees to provide the necessary support when requested by the offshore employees. The PDD activities sent offshore required a higher level of knowledge than originally expected and therefore these activities were back sourced.

Secondly, the solution implemented was to increase the efficiency offshore through relocating a key CAD coordinator from the offshore ESP organisation into the HQ of OEM C based in Germany. This improved the quality and communication challenges but this was not an overnight fix as assumed by OEM C and therefore took over six months before there was any major improvement. The following five advantages were identified.

1. Dedicated contact for all communication regarding PDD activities conducted offshore whereas the old model was more dispersed and uncontrolled.
2. On-site employees communicated through CAD coordinator.
3. Better efficiency through the allocation of PDD activities through a single contact.
4. Improved general quality of work.
5. Inaccurate PDD activities were captured before being presented to the customer through the onsite coordinator.

OME C's management expected results overnight and were rather impatient with offshoring. This is typical when organisations offshore services to low-cost countries and expect overnight benefits with respect to activities and also cost saving by cutting corners (Oshri *et al.* 2011). The solution was for the management team to educate themselves on offshoring which still caused challenges within the two organisations due to the lack of understanding this complex area.

The management teams in both OEM A and C lacked the experience on how to manage an offshore outsourcing organisation which created additional challenges as in both cases these were the first offshore projects. The organisations did not address their management teams lacking the knowledge/experience and therefore learnt through making mistakes throughout the journey which added additional time, up to two weeks of delays and additional costs. These are classified as hidden costs when organisations lack the experience to offshore outsource.

In both cases involving OME A and C, the PDD activities required a high level of interaction which can explain the incorrect type of activity offshored and these activities required face-to-face communications. The organisations did not fully understand the interaction of each PDD activity and only when they failed to deliver, these had been backsourced (Stringfellow *et al.* 2008, Sturgeon 1999).

6.11.2. ESPs

Communication was a key challenge for both ESPs analysed within the in-depth case analysis. The communication was down to the offshore organisation not fully understanding what the onshore EPSs were requesting. It was identified that both ESPs were not aware on how to describe an activity which was repeatedly done internally over a period of years. The solutions used was adding additional illustrations and supporting documents to each offshore PDD activity. This also included additional use of virtual software tools such as screen sharing and group conferences where possible that further enhanced the learning capabilities of the offshore employees. The use of additional tools enabled a more comprehensive transfer off the activity.
The failures in communication can be explained by the different cultures and more importantly as Brown and Eisenhardt (1995) identify that communication is essential for successful product development and organising the work usually get neglected which was the case in these organisations.

The onshore ESPs were lacking simple attention to detail during documenting a PDD activity that required offshore completion. Before the PDD activity and documentation was sent offshore the information was reviewed with the COCs and if necessary further detail was added. This improved the communications between the two organisations but this did not happen instantly.

ESP D used a local onshore employee who became the expat for the organisation to ensure the offshore running of the organisation and encouraged knowledge sharing and knowledge transfer between the two organisations to support the PDD activities. The expat was also located in this organisation to improve the management competence based offshore which helped develop a new culture. However, this took several months and was a long and costly process.

ESP D experienced challenges with their offshore third-party's organisations as the management teams were only concentrating on making profit from the business and both organisations had different objectives. The solution was to use an expat as mentioned earlier who would also coach and mentor the management team.

After several months there was no change and therefore ESP D developed their OWOS based in India and the learning through their journey with an offshore third-party organisation was used during the transition phase into their subsidiary. However, the lessons learnt on the previous engagement demonstrated the use of an expat which was also used in this case. As mentioned by Collings *et al.* (2007) and Tungli and Peiperl (2009) expats are used for many reasons and in this case they were responsible for the daily running of the organisation, ensuring educating and coaching is offered to employees and to ensure control from the offshore organisation was within their boundaries

The solutions to the poor quality of work were improved through using the expat to educate the graduates from university with the minimum experience, using the improved methods of communication and information transfer. ESP D’s offshore subsidiary also relocated experienced people to teams where they lacked core engineering skills.
ESP L faced other challenges when offshore outsourcing their PDD activities as the organisation lacked the skills and knowledge required to complete these activities. The solution was to recruit

additional employees who had the relevant skills and knowledge but this activity took over three months during which time the offshore organisation was very inefficient. More time was spent by the onshore employees to correct the offshore mistakes making the engagement not adding value. ESP L did not have any expats offshore which could explain the challenges and failures they experienced.

Further, ESP L experienced challenges with the culture offshore as they did not ask questions during the reviewing of PDD activities. This created additional challenges for ESP L because the received data from their offshore organisation was incorrect. ESP L's solution was to educate the offshore employees to continuously ask questions and persuading them to think after several months generated questions around the design phase. Additionally, the use of virtual communication along with clear structured instructions helped support the PDD activities where in previous attempts this was lacking detail and depth.

ESP L went through a long cycle of iterations where there was minimal improvement over six months and the management decided to terminate the offshore contract as the organisation was losing money and time during engagement. The PDD activities were backsourced to their HQ in UK as the management wanted quick cost reduction without spending time and money. However, ESP L management team lacked the necessary competence and experience whereby overnight savings were expected which did not happen.

6.11.3. FTSs

The FTS C employees were reluctant in sharing the data with the offshore counterparts and therefore the solution implemented was to educate the onshore employees to make them aware that offshore has been implemented to reduce costs, keep the competitiveness of the organisation, and secure customer orders. After the onshore employees were educated and informed of the organisation's developments where previously they were not part of the team they began to share data with the offshore employees.

Communication was also a key challenge and this was addressed by having an expat present on conference calls which was not accounted for during the initial starting phase. The benefits of having an expat for this organisation made it easier to communicate during calls and knowledge sharing including knowledge transfer was more diverse and clear.

However, even having an expat the pure PDD activities had already been translated once and then further translated to the offshore teams which was time-consuming (a few months) and no immediate benefit were identified.

FTS J also experienced communication challenges with offshoring; this was addressed through documenting a clear work package ensuring every stage was captured with detailed information on each request. This approach was used to allow an external organisation to take on PDD activities for FTS J and improved the communication challenges experienced.
FTS J engagement with Japan involved language barriers and the management team employed a Japanese manager to ease the communication challenges. The manager was a local resident and

was present in all communications between the two organisations where improvement was made in documenting and illustrating the PDD activities.

There were other cultural issues when FTS C used offshoring which could not be resolved overnight which included the offshore employees not asking questions, no interrogation of the data, no understanding of timescales and in general the managers lacked the ability to deliver and commit on time.

When FTS C used an expat it cost over $300 thousand dollars and the role involved coaching the offshore organisation, ensuring they fully understood the processes and philosophies of the organisation.

It was not possible to change overnight the working procedures and processes at FTS J where tacit knowledge was not completely documented or shared with the external organisation. This was addressed through supplying supplement documentation to the offshore employees to help support through the PDD activity phase. FTS J started to document and capture tacit knowledge and improve the processes which did not support external organisations.

Knowledge transfer within FTS C was also an issue and this was addressed through converting tacit knowledge on tasks, which were repeatedly done internally without any process or systems, to explicit knowledge. The benefits of this allowed the offshore organisation to understand how to complete the PDD activities and ensure full data had been received. FTS C acknowledged they had challenges with internal knowledge, in particular, tacit knowledge which took several months to document. During this period there was minimal improvement in activities as FTS C did not commit to delivering training to their offshore employees and the management did not dedicate time and passion to offshoring.

To further improve the organisations ability when offshoring the PDD activities FTS C had a number of people based onshore in Europe from the offshore organisation which helped improve communications and the quality of PDD activities improved.

However, the onshore management did not commit for a long-term engagement as the cost of having an onshore engineer was twice or three times the salary of an Indian employee. It cost FTS C around $24,000 per offshore employee to be based onshore where they only paid $8,000 for an offshore employee based in India. FTS J moved four key offshore coordinators to the onshore subsidiary where these employees were the interface between the two organisations. This addressed the immediate challenges with communications and the lack of data required for the PDD activities.

The lack of strategy behind the engagement of FTS C developed additional challenges where the organisation failed with offshore outsourcing and therefore the contract was terminated. FTS C developed their OWOS taking the learning from the failures but the organisation still faced similar difficulties.
FTS J could not provide critical mass of PDD activities where the majority of their work streams consisted of low-volume work as the organisation did not have a strategy on which activities could be outsourced or offshore. The volume of PDD activities was only identified after FTS J failed to

meet the financial benefits associated with offshoring as there was too much inefficiency during the journey.

6.12. Decision making on PDD activities across three segments

This section discusses the key findings from Chapter 4 and Chapter 5 which span across the three segments to understand how these organisations based in the automotive industry made key decisions when outsourcing, offshore outsourcing and offshoring their PDD activities.

The findings are discussed and compared with current literature and highlights new insights and developments in the field of outsourcing, offshore outsourcing and offshoring of PDD activities.

A study conducted by Eppinger and Chitakara (2009) discovered that the majority of the academic literature is around outsourcing and offshoring of PDD activities in general and is contained within the boundaries on what it is and why it should be done.

Eppinger and Chitakara (2009) further conclude that this research area has lacked the focus required to develop meaningful frameworks/models that can be applied within organisations in particular to support managers who could develop and implement a more efficient and robust outsourcing decision-making strategy.

This research study within the automotive sector has also identified the lack of outsourcing and offshoring models and the poor decisions taken by the management within the three automotive segments.

The outsourcing, offshore outsourcing and offshoring strategic decision-making model developed in Chapter 7 addresses this gap.

The proposed model developed and discussed in Chapter 7 contributes to the body of knowledge in developing new theory in automotive PDD. In fact, Eppinger and Chitakara (2009) also point out that many executives are making key decisions which may have a significant impact on their organisations and therefore the decision-making model presented in Chapter 7 is developed to help organisations make these decisions.

Further, the literature highlights the importance of a strategic approach which is often overlooked but a critical stage during the decision making process (Prahalad and Hamel 1990a, Quinn and Hilmer 1994, Venkatesan 1992a) and Chapter 7 (and the preceding Chapters) contribute to the literature by addressing this gap.

6.12.1. Decision making on outsourcing of PDD activities across three segments

The decision-making process across all three segments that outsourced their PDD activities to onshore organisations consisted of the following:

OEM A outsourcing decisions were conducted at top level and there was no clear decision-making model or process involved when they outsourced their PDD activities to onshore organisations. The lack of strategy involved the projects losing time to market and suffering financially, however these were discovered at a later stage of the project. The decision-making process was conducted by a single person within the organisation and this added complexities as the full phenomenon was not fully understood.

The PDD activities outsourced to external onshore organisations had not been correctly identified or analysed because these external organisations were unable to carry out these activities as there was a lack of knowledge to conduct these activities. Therefore, in this case, the project was backsourced to HQ which impacted the time to market and caused additional expenditure in the project.

OEM C also outsourced activities to their onshore ESPs that were based within close proximity of their organisation. The decision-making process when working with onshore ESPs was more difficult than their offshore outsourcing proposition. However, there were still challenges as the management teams did not have the expertise on how to manage an onshore ESP being responsible for a key development phase during the project development.

ESP D also had an unclear outsourcing decision-making procedure but the decisions had been based on an ad hoc strategy. As the number of projects were increasing, ESP D outsourced PDD activities to external organisations. The outsourced PDD activities involved non core and core and only after going through the outsourcing journey these organisations experienced difficulties and challenges. These activities were backsourced to the HQs. The backshoring of PDD activities highlights these organisations had unclear strategies behind their motives to outsource and the decision making procedures were also unclear.

ESP L was not outsourcing to any onshore ESPs as there was sufficient engineering resources internally to conduct these activities. However, there were plans within the organisation to engage with an onshore ESP within 12 months.

FTS C did not outsource to onshore ESPs as the project activities involved within the organisation were carried out with their OWOS based in China, India, and Philippines. However, these offshored activities consisted of simple administrative and engineering drawing tasks involving a lower skill level compared to their Western subsidiaries.

FTS J did not use any decision-making processes or methodologies when outsourcing their PDD activities. In this case the management teams just outsourced any PDD activity which enabled the internal resources to become free. In this instance, outsourcing was more driven by engineering resources then reducing costs with their offshore outsourcing and OWOS. Employees from the organisations were not trained on outsourcing of PDD activities and used literature from simpler outsourcing industries when applied to complex engineering situations gaps appeared and difficult challenges arose.

6.12.2. Decision making on offshore outsourcing of PDD activities

OEM C offshore outsourcing proposition was based on reducing cost from the organisation and in particular the PDD cost was of interest. The ESPs management made decisions to offshore a complete engineering program to an offshore third party organisation located in India. The decision-making process in this case study was underpinned by reducing costs during the PDD phase. The short term thinking developed challenges for this these organisation that become difficult to fix

ESP L's future offshore outsourcing strategy was being developed and was also underpinned on reducing PDD costs within the organisation.

OEM C developed an offshore outsourcing business model that did not include what data was required when offshoring the activities, the level of interaction for each activity, the capability of the offshore ESP and the overall robustness regarding the transfer was insufficient. The challenges involved with offshoring the PDD activities had not been identified as OEM C's management team had a perception that outsourcing to local ESPs was similar to offshoring. Outsourcing and offshoring was distinguished when the organisation experience challenges during the offshoring journey. The challenges are outlined in section case 6.6 and 6.10.

It was also apparent that ESP D's offshore outsourcing decisions were constrained at top level and a single executive within the organisation had decided to use an offshore ESP. These decisions had been based on cost reductions and the employees in the wider organisation had not been consulted or made aware on the offshore developments. The decision-making process was unclear and it was more of an ad hoc strategy to offshoring outsourcing.

OEM C’s offshore business model was revised such that the offshore employees based in the external organisations were transferred to OEM C's HQ based in Germany to improve the communications. However, even after revising the model, challenges were still evident with quality innovation and creativity within the organisation. The challenges still remained as these organisations took short cuts when developing their solutions and can be explained using the garbage bin approach (Cohen *et al.* 1972).

OEM C's management lacked the experience and knowledge required when offshoring which could explain the reasons why the organisation failed with offshore outsourcing. The PDD activities sent offshore consisted of non core, near core and core which suggests there was no strategy in defining the PDD activities. This was also evident in ESP D’s organisation as there was no consistency in the offshored PDD activities as they required a full spectrum of skills and capabilities which the offshore organisation lacked. The high level of interaction and communication required for the near core and core activities were backshored to the HQ location. A corporate decision was made that consisted of backshoring the entire body engineering function from the offshore organisation as the project was steering towards a significant financial impact and a further delay in launching a vehicle.

The learning from this outcome identified that OEM C's offshore organisation was only capable of conducting simple routine engineering support tasks and development of high value innovative PDD activities was not possible.

ESP D's poor decision-making, lack of strategy, lack of management involvement with offshore outsourcing routed ESP D towards developing their OWOS.

ESP L also conducted offshore outsourcing of PDD activities whereby there was no strategy behind the type of activities that will offshore to an external organisation that was based in India. The PDD activities included non core, near core and core where it was only identified after they were offshored to the external organisation and could not be completed due to the skills and knowledge required. This indicates that ESP L, although having a strong management team that had previously outsourced and offshored, failed to develop a robust offshore outsourcing strategy. The organisation failed to work as a team, there was a lack of commitment and dedication

FTS J did not use any decision-making processes or methodologies when offshore outsourcing their PDD activities. Further, during an interview the executive VP stated;

> I would love to have something like a model for outsourcing and more importantly offshoring and in many cases no methodology had been used, which is a pity as we have learnt the hard way by spending additional money and failing on activities.

FTS C decision-making on offshore outsourcing of PDD activities was based on 'me too' strategy through imitating other competitors within their field. The team was inexperienced and they were new two outsourcing and offshoring, and key decisions had already been made which meant these PDD activities could not be easily reversed. The decision made by this organisation to engage with an offshore outsourcing organisation had not fully been understood and the mechanisms on which PDD activities could be offshored was not apparent to the management team.

The negative experience with their offshore ESP steered FTS to develop an OWOS in the Philippines based on costs where the labour rate per hour for PDD CAD activities was $12 per hour compared to India where it was $21.00, China was $34.50 and UK was $52.50. Therefore FTS C calculated theoretical savings of $40.5 per hour. The OWOS based in the Philippines was only providing simple administrative support tasks and the core competency was within the European subsidiaries.

In 2008, the management, also based on cost reduction and increasing the internal engineering resources, developed an OWOS based in India where they already had engaged with an offshore outsourcing organisation.
As FTS C had already terminated previous engagements with an offshore outsourcing organisation and developed their OWOS no learning was documented. During the development of their OWOS poor practices were repeated and the journey started again. There was no strategy going forward and the organisational challenges had been experienced again, but an OWOS enabled FTS C to gain a better control and management commitment than offshore outsourcing.

The engineering director mentioned:

> I will never use another third-party organisation based in India, now there is no need and I have an extended headcount which these countries are dedicated to our organisation and our reporting to our UK organisation. It is much easier to manage our internal subsidiary having all the billing structures are in a single place and the key enablers are present such as cost, resources and infrastructure.
>
> One big lesson that we have learned as an organisation is to bring over the offshore colleagues as early as possible during the PDD phase so they can learn and understand our systems and processes, which is a key item from a hindsight perspective.

In 2010 FTS C developed another OWOS based in China for cost reduction and local presence to their customers. However, there was a lack of decision-making during the initial phases of developing the OWOS and the organisation is not aware if they are receiving a cost benefit. Further, during the data collection the management teams were completely unaware if the OWOS provided a cost benefit but the OWOSs were been used solely for overflow of engineering capacity and they lack the capability in terms of attention to detail and ability to design from clean sheet.

6.12.3. Decision making on PDD activities to OWOS

This section analyses the decision-making amongst all three sectors and across the six in-depth case studies from Chapter 5 using further data from Chapter 4 to discuss the key findings. As shown in Chapter 4 in Figure 4.7, the 20 OEMs interviewed a total of15 developed OWOS and four had future plans in developing OWOS within 36 months. The decisions to develop an OWOS were underpinned by cost reduction and only after offshoring the PDD activities challenges and management difficulties arose.

The six in-depth case studies analysed in Chapter 5, five of the organisations developed OWOS whereas one engaged with an offshore outsourcing organisation. However, the one organisation that had no OWOS, analysed as part of the in-depth analysis, had plans to develop their subsidiary within 36 months.

OEM A had developed an OWOS based in USA as indicated in Figure 4.6 in Chapter 4. This research is focused on outsourcing, offshore outsourcing and offshoring of PDD within the automotive industry whereas OEM A's OWOS concentrated on electrical design and therefore it has not included in this analysis. However, OEM A had business plans on developing an OWOS based offshore to conduct PDD activities for the parent firm.

From the six in-depth case studies, four organisations (OEM C, ESP D, FTS C and J) all failed with offshore outsourcing as there was no clear strategic decision-making model or processes associated when they offshore outsourced to external organisations. FTS C’s approach was based on a ‘me too’ decision. The management teams lacked the knowledge and experience required on how to manage these organisations when they offshored their PDD activities and more focus at the start was on reducing costs and understanding how offshoring could be done efficiently.

The learning experiences (positive and negative) with offshore outsourcing steered the three organisations (ESP D, FTS C and J) to develop their OWOS. In fact these organisations took a laid-back approach where challenges could not be contained in a short period of time and started to impact the organisations financially.

OEM C lost financially and discovered offshore outsourcing did not fit into their business model and therefore backsourced activities that were highly sensitive requiring specialist knowledge and retained the simplest PDD activities offshore. This decision was made as the organisation was premature when offshoring the PDD activities. ESP D developed a new OWOS which cost around $2.19 million and this development did not provide products to be produced any quicker as suggested by the literature. However, as costs were underpinned by the decisions to offshore outsource and develop their OWOS, FTS C was unaware if any costs savings occurred.

Chapter 7 . Model Development

7.1. Introduction

This chapter provides an in-depth analysis to the development of the strategic decision-making model. The research has identified that automotive organisations within the three segments had no clear strategic decision-making models and associated processes when outsourcing, offshore outsourcing and offshoring their PDD activities. This impacted the organisations financially, created an unpleasant working culture and delayed the launch of products into the market. The impact also created uncertainty within the automotive organisations with reference to outsourcing and offshoring PDD activities.

To understand this phenomenon in further detail, a current state model has been developed to identify how current PDD activities were outsourced, offshore outsourced and offshored within the three segments in the automotive industry.

The current state model highlights how the organisations based in the three segments outsourced, offshore outsourced and offshored their PDD activities. The current model also shows actions had only been taken after failure occurred and the management reacted this way. The stages in the current state model are discussed to allow a more comprehensive understanding into how these organisations conducted outsourcing, offshore outsourcing, and offshoring of their PDD activities.

The proposed model was developed through the data collection, interviewing, best practices, coding and further developed and enhanced through ten focus group activities. The proposed model has used the practical framework developed by McIvor (2000) as a guide throughout the development stage.

This study has developed a proposed model consisting of a five stage approach and is titled "*A strategic decision-making model for outsourcing/offshoring outsourcing and offshoring PDD within the automotive industry (OEMs, ESPs and FTSs)".* Each stage of the model is discussed in-depth. Additional data is provided how an organisation is required to carry out each stage. This is supported through supplement data and real-life examples from the automotive industry.

The proposed model has been validated/tested through 10 focus group workshops where academics and practitioners scrutinised the model. This enabled further developments and improvements. The proposed model was further validated using (Kirkpatrick 1975) model which has been proven to validate industry and academic learning which is applied in management studies.

7.2. Model Development

There are two models developed from this research study. A current state model is discussed in section 7.3 and the proposed model is discussed in section 7.4.

7.3. Current State Model

This study has developed a current state model that identifies how the three segments (OEMs, ESPs, and FTSs) outsourced, offshore outsourced and offshored their PDD within the automotive industry. This model is developed from the findings of this study. The current state model was used to understand and draw a picture to highlight deficiencies and where organisations were failing. The current state model is shown in Figure 7.1. The following sections will discuss each step of the current state model.

7.3.1. Any internal PDD activity selected for outsourcing or offshoring

Outsourcing and offshoring within all three segments enabled a common model to be drawn as these organisations had similarities when defining which PDD activities were outsourced, offshore outsourced or offshored. There was no classification of the PDD activities and were selected without any underpinning decisions or strategy. The PDD activities ranged from highly complex to simple activities. The PDD activities selected were sensitive and confidential for these organisations but there was no appreciation within the business on what value these activities generated. Key decisions were based on tactical accounts or cost reduction purposes as identified in Chapter 6.

There PDD activities were allocated as below:

1. Wholly owned subsidiaries located in offshore locations predominantly China and India were the two main countries used. A whole range of PDD activities had been offshored to the organisation's wholly-owned subsidiary.
2. Strategic alliances based offshore consisting of third-party organisations. Sensitive and highly critical activities had been offshored to third-party ESPs.
3. Strategic alliances based onshore which were local to the outsourcing organisations. A range of activities from highly critical and sensitive to simple modelling had been outsourced locally to ESPs.

7.3.2. PDD activities cannot be completed as inappropriately defined and challenges arose

A range of PDD activities had been outsourced and offshored to external organisations which required a high level of skills, capability and competencies from these organisations to execute these activities. In particular the offshore organisations, whether a wholly owned subsidiary or an offshore ESP, had inherited the same challenges as they were not able to complete these activities. During the processing of these activities, additional challenges arose as these activities were sensitive and critical for an organisation's success which became apparent to the external and internal organisations. A high range of skill sets was required for these activities and knowledge which was kept internally had not been cascaded or discussed outside the organisation boundaries and therefore these organisations could not complete these activities. A study conducted by Ciravegna and Maielli (2011) highlighted that, when internal knowledge is not cascaded to external resources it can result in negative effects on the outcome. The challenges have been identified in outsourcing, offshore outsourcing and offshoring.

7.3.3. Challenges addressed with additional resources and expenditure

The top five challenges experienced by the three segments are outlined in Figure 7.9. These challenges experienced by the three segments had been identified only after commencing outsourcing or offshoring of the PDD activities. The organisations employed minimal effort upfront to ensure the challenges had been identified and addressed to allow an efficient and cost effective journey. However, the challenges experienced later on during commencing of the PDD activities resulted in the organisations sending expats to offshore locations, moving and shuffling PDD activities that required a high level of skills and experience, additional hidden costs with training and coaching to external organisations, and additional reworking of engineering content incorrectly completed. These additional activities implemented to action the challenges had not been thought of during the outsourcing or offshoring of PDD to external and offshore wholly owned organisations.

The three segments analysed had similar occurrences where the overall cost of outsourcing, offshore outsourcing and offshoring had not fully been understood. These organisations stated the challenges addressed caused the business to lose money and time to market of the products suffered.

7.3.4. Outsourcing of PDD activities

Outsourcing included a whole range of PDD activities which were critical and rather sensitive to the organisation's competitive advantage.

A range of PDD activities were outsourced to local ESPs who lacked the core competencies and skill sets to complete these activities. These activities were backsourced to any of the three segments depending on which organisation outsourced the activities. For instance OEM A outsourced a vehicle program to an ESP that was located within a short distance from their engineering centre. As this program was core development work for OEM A after several months it was realised and backsourced. The PDD activities were redefined to understand which could be carried out by the ESP. The outsourcing of this program was linked to the first stage within the current state model as OEM A outsourced without taking into account other inputs required within the PDD phase. This was the case in many other organisations where the decision making and robustness of defining tasks did not exist.

The external organisations that were capable of delivering PDD activities were provided additional support from the customers such as training, coaching and guidance through the development phase. There were hidden costs from the customer's perspective as additional mentoring and training of systems and processes were implemented to ensure the external organisations understood how to deliver the activities.

7.3.5. Offshoring outsourcing and offshoring of PDD activities

The PDD activities that were offshore consisted of two elements:

1. Offshore outsourcing to low-cost developing countries.
2. Offshoring also based in low-cost developing countries.

As there was no structure or methodology applied to which PDD activity was offshoreable, the offshore outsourcing and offshoring organisations were incapable of delivering these activities. These activities did not undergo any strategic analysis when transferred, and during the journey the organisations identified these activities were critical and sensitive to the organisation's success and competitive advantage. The PDD activities recognised as critical for the success of the organisation were backsourced and caused delays and confusion amongst employees.

There was no clear decision-making process on the critical and sensitive PDD activities. The organisations that failed with the PDD activities realised that only simple activities requiring a minimum interaction and interfacing within the wider organisation was suitable for offshore organisations.
Majority of the PDD activities during the backsourcing stage had been redefined to understand which activities were capable of being offshored.

OWOS were developed after automotive organisations based in the three segments failed with offshore outsourcing. The challenges were taking a long period to resolve and the two organisations had different strategies, for instance one being focused on profit whereas the other focused on growth.

7.3.6. Redevelopment of the outsourcing/offshoring proposition

All three segments had similar occurrences on outsourcing and offshoring of their PDD activities which involved not having a clear or concise methodology on all decision-making processes to ensure the organisations have correctly identified and documented each outsourceable activity. A non-automotive study conducted by (Bounfour 1999, Lonsdale 1999) highlight the lack of methodology has resulted in organisations to fail when outsourcing and in particular this is not an outsourcing failure but an inherent problem with the lack of guidance and decision supporting material required for managers to effectively make these decisions.

The decision-making process was based on tactical accounts with very little strategic thinking or evaluating the drivers and challenges that these organisations could experience during their journey.

Any PDD activity was outsourced to either an OWOS, outsourcing or offshore outsourcing organisation. The organisations did not identify any drivers or challenges and learnt the hard way by terminating 13 offshore outsourcing contracts amongst the three segments and 43 organisations developed short term cost strategies. The challenges had been addressed using additional resources and expenditure from the outsourcing organisations to ensure project timings were not negatively affected. The additional coordination required with onshore outsourcing, offshore outsourcing and offshoring resulted in the costs to spiral where no cost benefit was achieved.

Once the activities were backshored and redefined, the organisations reviewed their outsourcing and offshoring journey to understand what changes were necessary to ensure lessons learnt can be applied to future decisions. Thus, the activities were reviewed internally to understand which were outsourceable, offshoreable and the ones to be retained with the HQ.

7.3.7. Current state model of outsourcing/offshore outsourcing and offshoring PDD within the automotive industry (OEMs, ESPs & FTSs)

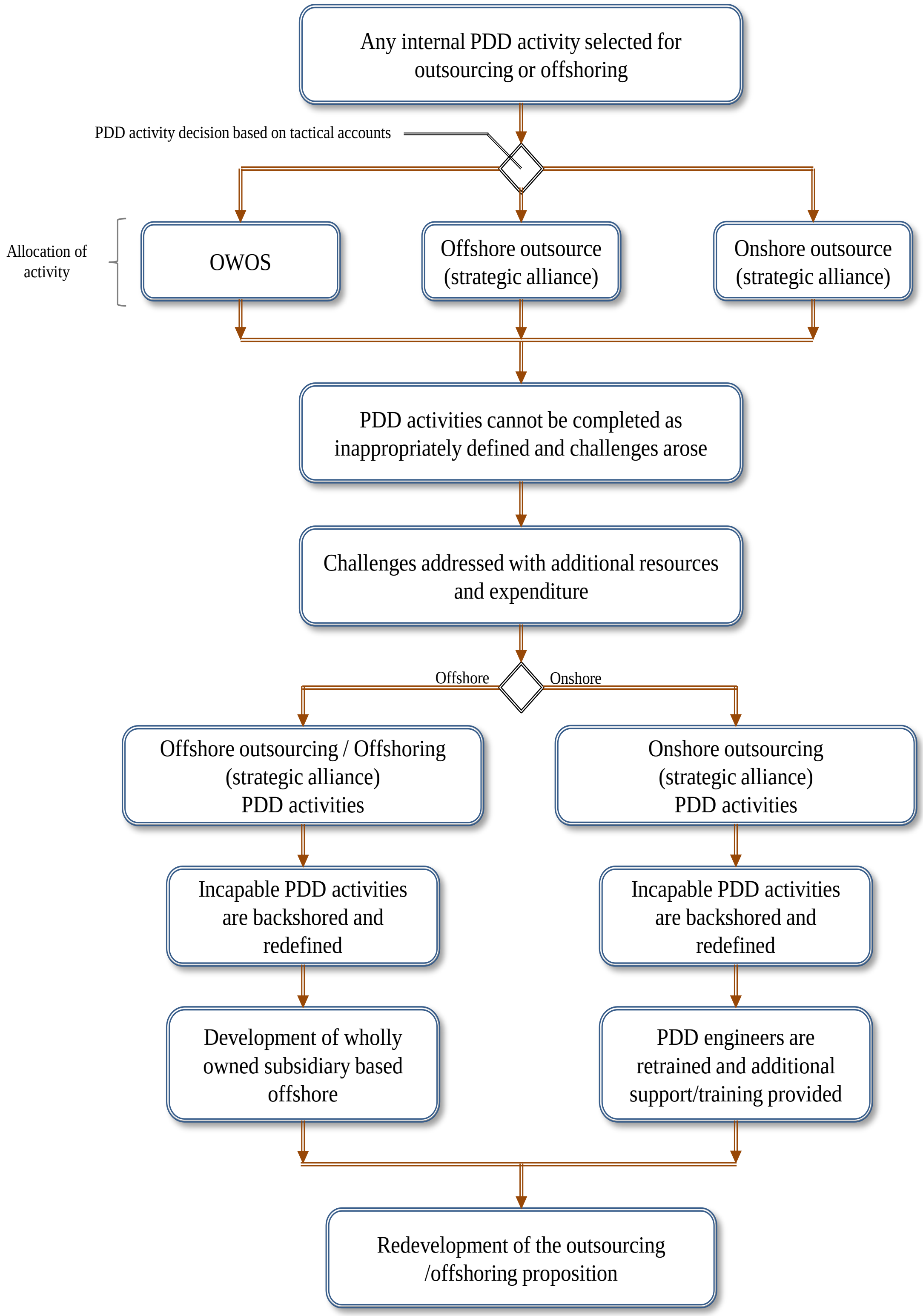


Figure 7.1. Current state model of outsourcing, offshore outsourcing and offshoring of PDD.

7.4. Proposed Model

This section delivers the research aim to develop a strategic decision-making process and associated model to strategically support management in outsourcing/offshore outsourcing and offshoring of PDD within the automotive industry.

The proposed model was underpinned by the data collection, interviewing, best practices, coding development, collection of secondary data and activities from the focus groups that further enhanced, and developed the model through testing and validation.

Additionally the model is further reinforced by the practical framework for evaluating the outsourcing decision created by McIvor (2000) which was used as a guide throughout the development stages. The proposed model has been titled "*A strategic decision-making model for Outsourcing/Offshoring Outsourcing and Offshoring of PDD within the automotive industry (OEMs, ESPs & FTSs)*" and consists of five stages leading to outsourcing, offshore outsourcing or offshoring strategy. The model addresses the gap in the literature to add a practical model that can be used by organisations (including managers, practitioners, researchers) to implement and follow a strategic approach when deciding to outsource or offshore the PDD activities. The proposed model is shown in Figure 7.2.

Each stage of the model is described briefly.

The first stage of the model fine slices the internal PDD activities of an organisation into commodities and smaller modules.
Due to the complexity of PDD, automotive organisations are required to break down the PDD activities through the use of fine slicing each activity which is discussed further in section 7.4.2. The fine slicing is carried out through multi-disciplinary teams supported by additional process activities to evaluate the decisions. A decision point is added to understand the type of activity; categorised into three separate activities:

1. Non core activities.
2. Near core activities.
3. Core activities.

The second stage of the model consists of detailed mapping of the PDD requirements of each activity to understand its impact on the organisation if outsourced or offshored. For instance, interaction and communication are mapped for each activity to evaluate how they affect the PDD activities, mapping of tacit knowledge for each PDD activity allowing an organisation to identify how tacit knowledge is converted into explicit knowledge which is extremely important when outsourcing or offshoring. The second stage is an iterative process and could take organisations a few rounds to clearly map their PDD requirements.

The third stage of the model reviews the drivers and challenges in detail associated with PDD activities for onshore and offshore. Before stage four is reviewed a decision box is added to ensure the organisations' requirements/drivers and challenges have been understood and addressed.

The fourth stage of the model involves allocating PDD activities after following the strategic decision-making stages for outsourcing/offshoring. These activities are allocated to any of the following;

1. Outsourcing activities to a strategic alliance onshore where an organisation buys the engineering resources.
2. Offshoring activities to a strategic alliance where an organisation buys the engineering resources.
3. Offshoring activities to a wholly owned subsidiary where an organisation develops engineering resources.
4. No outsourcing or offshoring of activities an organisation continues performing activities internally and develops engineering resource.

The fifth stage of the model develops the detailed PDD outsourcing/offshoring strategy for OEMs, ESPs, or FTSs and is shown in Figure 7.2.

7.4.1. A proposed strategic decision-making model for outsourcing/offshoring outsourcing and offshoring PDD within the automotive industry (OEMs, ESPs & FTSs)

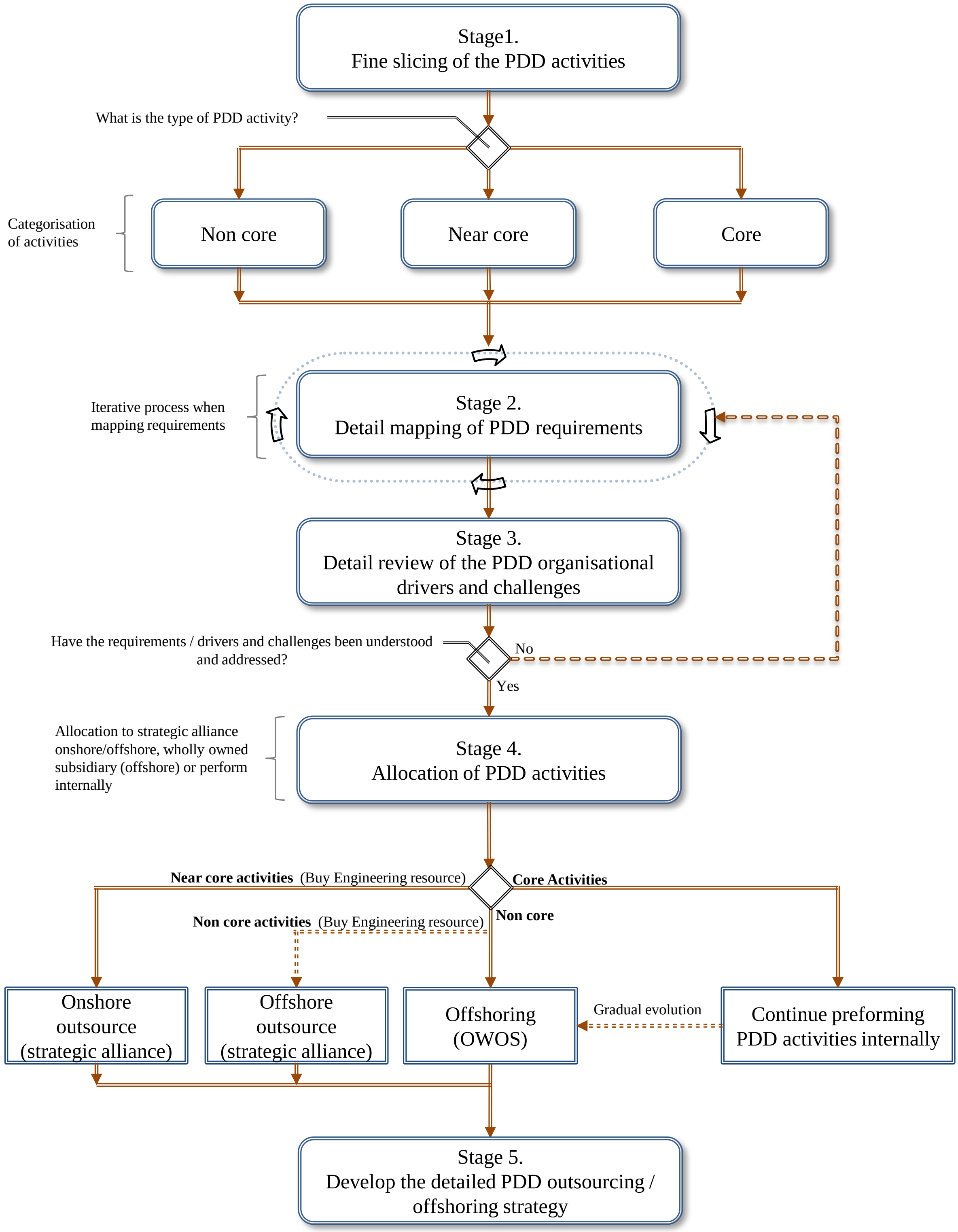


Figure 7.2. Proposed strategic decision-making model for outsourcing/offshoring outsourcing and offshoring of PDD within the automotive industry.

Each stage of the model and additional activities required to support an organisations decision are discussed below in further detail.

7.4.2. Stage 1: Fine slicing of the PDD activities

Stage one of the decision-making model concentrates on fine slicing the organisation's PDD value chain activities through a fine lens perspective. It involves breaking down activities into smaller modules which are easier to analyse and understand. The term 'fine slicing' is used as described by Mudambi (2008), Contractor *et al*. (2011) and Buckley (2009) which allows an organisation to break up their activities.

As PDD contains a high level of complexity, a finer analysis is required on the organisational activities. Fine slicing of activities is classified into three areas; non-core activities, near core activities and core activities which are not comparable to simpler activities other than product development or engineering (Bunyaratavej *et al.* 2011, Jensen and Pedersen 2011).

The research discovered that organisations which did not involve key stakeholders when fine slicing their PDD activities never meet their objectives outlined when outsourcing or offshoring the PDD activities. However, the organisations that developed multi-disciplinary teams when accessing these activities gave the best results. Thus, stage one activities must consider multi-disciplinary teams from different areas of the organisation consisting of people from product development, operations, research and development and managers who are responsible for delivering. Organisations interviewed as part of this research lacked the ability to develop multi-disciplinary teams that resulted in PDD activities not sliced correctly.

Fine slicing PDD activities enabled these organisations to identify their value chain and which activities contributed to high value adding, competitiveness and uniqueness. An organisation that outsources without understanding non-core, near core and core activities over time may inevitably outsource or offshore core functions to an external service provider which could grow into a competitor (Eppinger and Chitkara 2009). Therefore, fine slicing of non core, near core, and core activities is further discussed below in detail.

7.4.2.1. Non-core activities

Fine slicing non core activities enables organisations to identify the less unique value chain activities which are non-critical and impact the least on competitive advantage. These activities are necessary for an organisation to perform and have minimum contribution to value adding.

Stage one of the strategic decision-making model requires organisations to fine slice their non core activities using the approach outlined in Figure 7.3 which is further explained in detail.

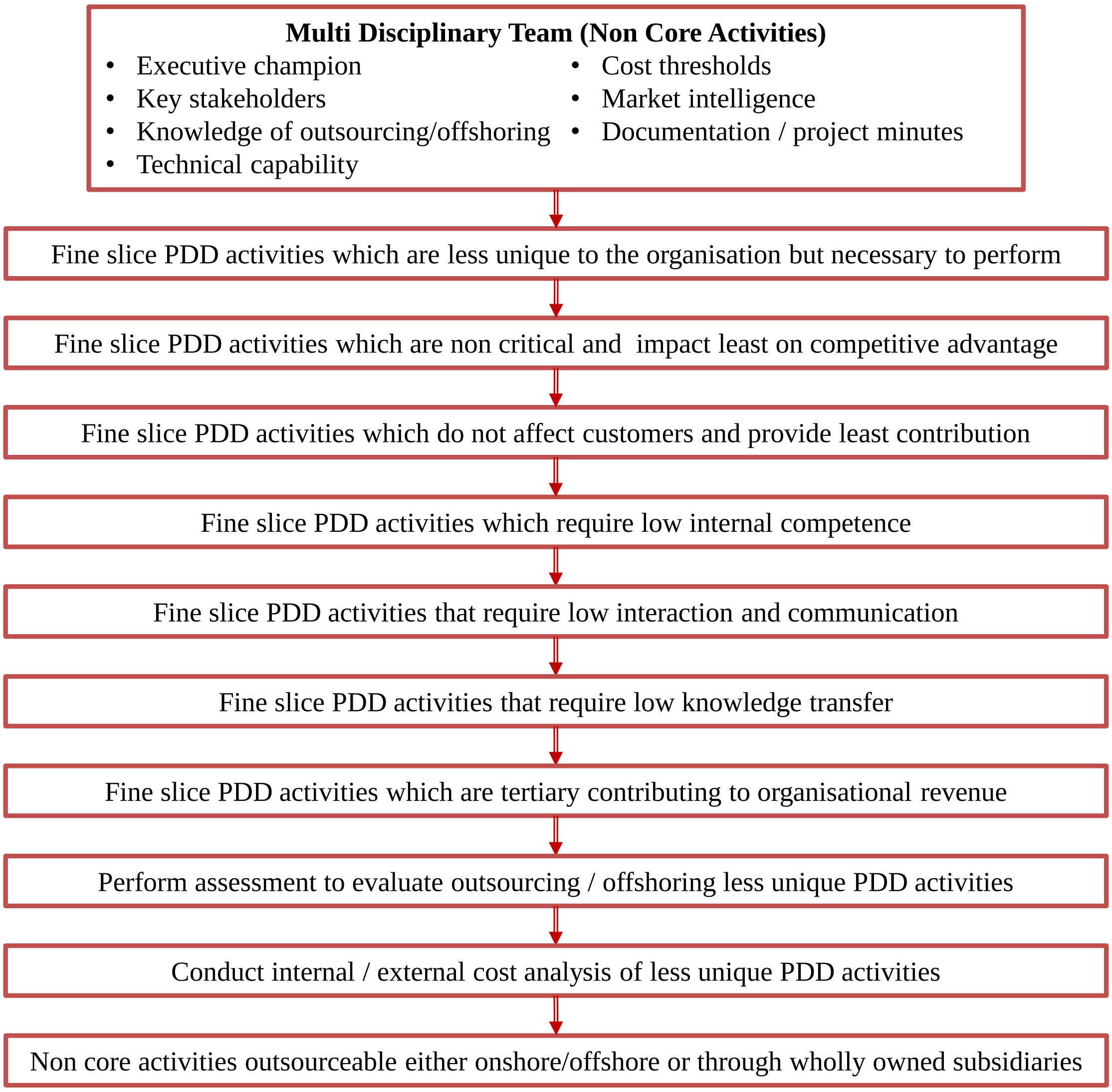


Figure 7.3. Fine slicing of non-core activities.

Fine slicing of non-core activities begins with the organisation setting up a multi-disciplinary team that works in collaboration with other stakeholders to identify the non-core activities and consists of the following;

1. Appointment of executive champion – Appoint a senior person within an organisation who chairs/manages the multi-disciplinary team and ensures the objectives during fine slicing of non-core activities are correctly met. The executive champion is also responsible for making tough decisions during the fine slicing process and accountable for presenting the propositions to the executive board of directors.
2. Key stakeholders – These are people within the organisation and responsible for PDD activities on a delivery and managerial level. The stakeholders must understand relevant engineering activities and the organisational commitments to fine slice the non-core activities.

3. Knowledge on outsourcing/offshoring – The multi-disciplinary team members must understand the organisational commitments and have knowledge on outsourcing and offshoring in general. However, if the key stakeholders are lacking this input then additional training and coaching must be provided to ensure the fine slicing stage is conducted correctly.
4. Technical Capability – The multi-disciplinary team must have technical capability when fine slicing the non-core activities to fully understand the activities. If the technical capability is missing from the team members it could result in the activities being sliced incorrectly.
5. Cost/performance thresholds – The multi-disciplinary team members must understand internal costs of activities and how to conduct cost analysis with outsourcing and offshoring.
6. Market intelligence – The multi-disciplinary teams must have up to date market intelligence to understand the efficiencies of outsourcing and offshoring. This also includes an understanding on competitors and the different activities being outsourced or offshored.
7. Documentation/project minutes – Nominate a person who will be dedicated to document each stage of the fine slicing process and ensure minutes have been captured.

After careful consideration and selection of the multi-disciplinary teams the organisation can start fine slicing the PDD activities which is based on Figure 7.3 and is explained below.

Fine slice PDD activities which are less unique to the organisation but necessary to perform – The organisation needs to fine slice activities which are less unique in terms of competitiveness. These activities are necessary for organisations to perform as they contain work elements that contribute to near core and core. These activities are broken into smaller manageable modules which can be identified easily.

Fine slice PDD activities which are non-critical and impact least on competitive advantage – The organisation needs to fine slice the non-critical PDD activities which can be outsourced/offshored or even offshored to a wholly owned subsidiary. These activities are less unique and if outsourced or offshored there is no impact to the organisational competitive advantage and are not necessary to be performed by the organisation.

Fine slice PDD activities which do not affect customers and provide least contribution – Fine slice activities which can be conducted externally and have no impact on customers if they are outsourced or offshored but are necessary for an organisation to perform. These activities contribute less to an organisation's value chain than activities which are at the higher end of the chain.

Fine slice PDD activities which require low internal competence – These are activities that require low competence from internal employees and are the most time consuming. However, it must be noted that some activities may have different levels of tacit knowledge which need to be clearly identified and documented for an external organisation to successfully deliver these activities.

Fine slice PDD activities that require low interaction and communication – The organisation fine slices activities which need a low level of interaction between people when conducting PDD. In addition activities that involve the least communication between people can be identified as outsourceable. Usually the non-core activities require less interaction than near core or core activities.

Fine slice PDD activities that require low knowledge transfer – The organisation identifies PDD activities that require minimum knowledge transfer between work packets. For instance product a and product b may have a rather complex design but the knowledge transfer between the two products can be rather low, meaning there is more chance for these activities to be outsourced.

Fine slice PDD activities which are tertiary contributing to organisational revenue – The organisation fine slices the activities which contribute a tertiary level to the organisation's revenue and segregates these into three categories: primary, secondary, tertiary.

Perform assessment to evaluate outsourcing/offshoring less unique PDD activities – Once PDD activities have been fine sliced the organisation needs to evaluate whether these activities qualify for outsourcing or offshoring. This is done by going through the various stages as outlined in Figure 7.3.

Conduct internal/external cost analysis of less unique PDD activities – It is rather important for the organisation to conduct a cost analysis to understand if the activities will remain competitive if conducted internally or outsourcing to an external service provider or a wholly owned subsidiary may provide further cost benefits.

Non-core activities that are outsourceable either onshore/offshore or through wholly owned subsidiaries – The outcome of fine slicing PDD activities will enable an organisation to clearly identify the non-core activities. If required, the organisation can revisit any stage of model to ensure the correct decisions are made.

The focus group sessions along with empirical data collection highlighted a number of non-core activities the automotive industry used while identifying their activities for OEMs, ESPs and FTSs. These activities are highlighted in Table 7.1 and differentiated for the three segments.

	OEMs	**ESPs**	**FTSs**
Non-core activities	2D CAD 3D CAD CAE meshing analysis Advanced calculation/simulation Packaging studies (simple) GD&T Drawing updates Software Development Engineering Administrative Project engineering work BOM creating Jigs and tooling development Prototyping of parts	2D CAD 3D CAD CAE meshing analysis Advanced calculation/simulation Drawing updates Software Development Engineering Administrative	2D CAD 3D CAD CAE meshing analysis Advanced calculation/simulation Drawing updates Software Development Engineering Administrative Jigs and tooling development Prototyping of parts

Table 7.1. Example of non-core automotive activities of OEMs, ESP, FTS.

7.4.2.2. Near core activities

Fine slicing near core activities enables an organisation to identify activities which are moderately unique and are essential to perform. Near core activities have typically been retained internally within an organisation but due to competitiveness, product expansion, capacity constraints and other factors, automotive organisations are outsourcing these activities. For example OEMs outsource their near core activities to ESPs either consisting of complete body engineering solutions or complete turnkey solutions. As these organisations need to retain their competitive position, meet their time to market aspirations, activities which were conducted internally are carried out externally. Near core activities are positioned between non-core and core, thus relatively biased towards core activities of an organisation. Stage one of the decision-making model requires an organisation to fine slice their near core activities which is achieved following the approach outlined in Figure 7.4 and explained in detail below.

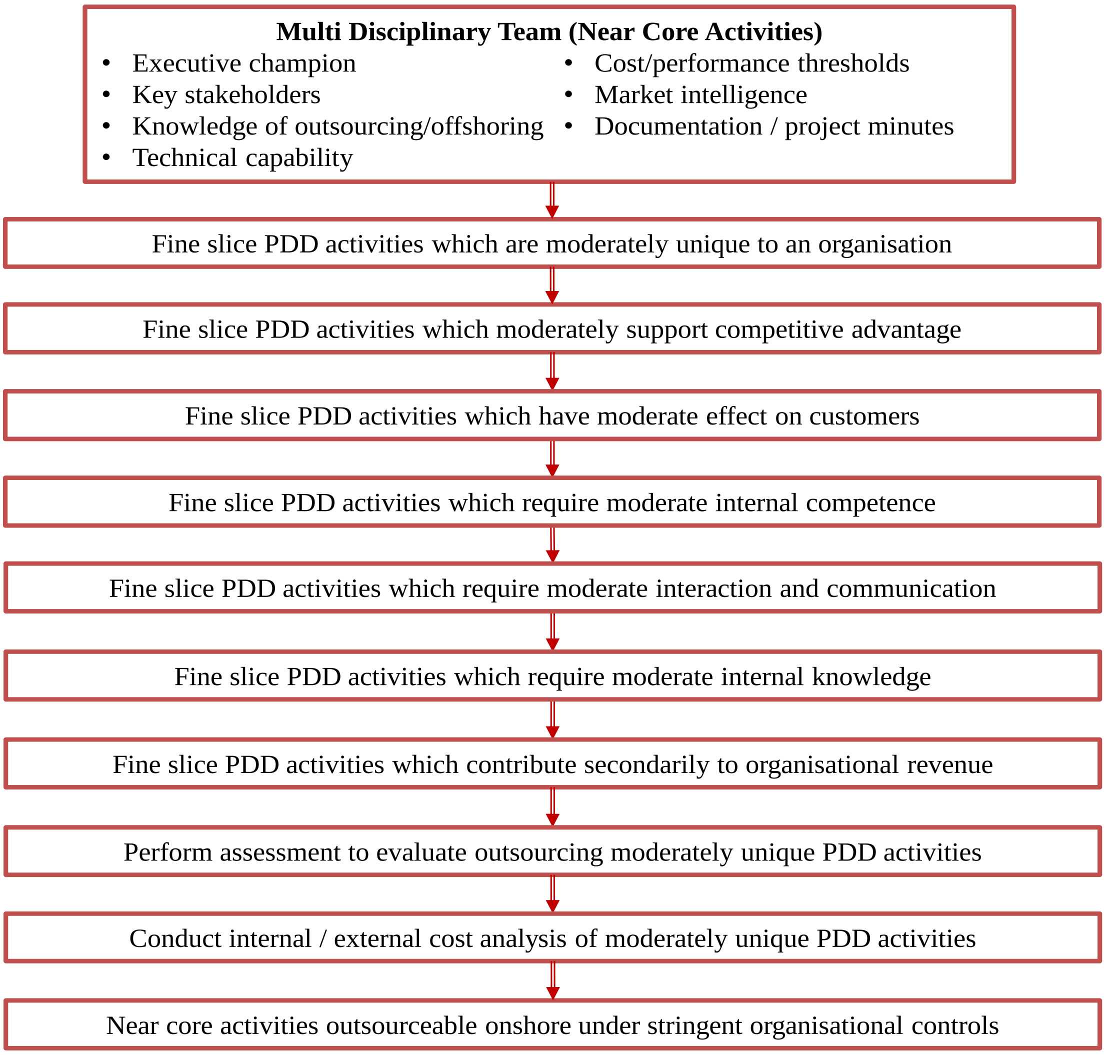


Figure 7.4. Fine slicing of near core activities.

Fine slicing of near core activities begins with the organisation setting up a multidisciplinary team using the method outlined in section 7.4.2.1.

Once the multi-disciplinary teams have been identified and the relevant data collected the next stage involves fine slicing and identifying the PDD near core activities detailed below.

Fine slice PDD activities which are moderately unique to an organisation – The organisation fine slices moderately unique activities which are positioned one step away from the core. The near core activities requires an organisation to carefully consider how they are defined during the fine slicing procedure as these activities are close to the organisations core competitiveness.

Fine slice PDD activities which moderately support competitive advantage – The organisation fine slices PDD activities that contribute moderately to the competitive advantage. These activities are necessary for an organisation to perform which contribute to the overall competitive advantage within the field.

Fine slice PDD activities which have moderate effect on customers – When fine slicing, the organisation must identify which PDD activities have moderate effect on the customer and do not directly change the customer's opinion. Activities which are not identifiable will require segregation and are revisited before a decision is made.

Fine slice PDD activities which require moderate internal competence – The organisation when fine slicing must utilise their internal competence methodology to further understand which PDD activities require moderate internal competence. To perform these activities it relies on a combination of moderate competence and high competence capability of an organisation.

Fine slice PDD activities which require moderate interaction and communication – Fine slicing requires an organisation to understand which PDD activities require moderate interaction between people and the different type of interaction used, an example is where a product requires moderate internal interaction amongst people and such activities are necessary to be performed onshore. In addition to the interaction, an organisation is required to understand which PDD activities require moderate level of communication and map out how interaction and communication can be handled if these activities are outsourced.

Fine slice PDD activities which require moderate internal knowledge – Fine slicing requires the organisation to identify activities which require a moderate internal knowledge to successfully execute these tasks. During the identification stage, the organisation is required to map out how internal knowledge which in most cases is tacit knowledge can be converted to explicit knowledge allowing a smoother knowledge flow. Additionally external organisations will benefit from explicit knowledge which enables them to grasp the PDD in a shorter time and improve the knowledge efficiency within an organisation.

Fine slice PDD activities which contribute secondarily to organisational revenue – Fine slicing these activities will allow organisations to identify the near core activities which have secondary contribution to the organisational revenue.

Perform assessment to evaluate outsourcing/offshoring moderately unique PDD activities – Once the PDD activities have been fine sliced and categorised into near core the organisation is required to evaluate whether these activities are eligible for outsourcing. The assessment is conducted through a third disciplinary team and chairperson who will decide which activities are near core.

Conduct internal/external cost analysis of the PDD activities – The organisation is required to perform a detailed cost analysis of the activities it requires to outsource. When conducting the cost analysis the organisation is required to understand if these activities can be required from the market using a third party service provider at effective prices or whether the internal costs are more competitive than buying from the market.

Near core activities outsourceable onshore under stringent organisational controls – At this stage the fine slicing of PDD activities is complete and the outcome of this stage enables the organisation to clearly identify their near core activities. However, if the organisation feels the fine slicing processes requires refinement then any stage can be revisited to ensure the correct decisions are made.

The focus group sessions along with empirical data collection highlighted a number of near core activities that were outsourced in the automotive industry by OEMs, ESPs and FTSs. Near core activities are highlighted in Table 7.2 and differentiated for the three segments.

	OEMs	**ESPs**	**FTSs**
Near core activities	Powertrain Electrical/Hybrid Managerial roles Engineering PDD roles Body engineering functions - Semi/full commodities - Complete engineering - Mid cycle activities - Subsystem engineering - Top hat derivative development Complete vehicle contracting (manufacturing) Packaging studies (complex) Testing (engineering) Benchmarking	Engineering PDD roles CAD advanced Packaging studies (complex) Manufacturing development Design/styling Testing (development) Engineering PDD roles	Engineering PDD roles Concept design Design Verification Plan sign off Manufacturing development Testing (development) Engineering roles

Table 7.2. Example of near core automotive activities of OEMs, ESP, FTS.

7.4.2.3. Core activities

Fine slicing core activities enables an organisation to identify PDD activities which are highly unique, distinctive and innovative. A core activity of an organisation could be exemplified as maintaining the competiveness within the market place and serving the customer (Quinn 2000). Core activities add the most value to an organisation's capability value chain and must be identified cautiously for long-term strategic reasons. PDD activities that impact the most on competitive advantage can be separated from near core and non-core activities. For example, OEMs brand positioning and brand defining is core to their business and these activities are not outsourced or offshored but retained closely within the boundaries of the organisation having full control.

Stage one of the decision-making model requires the organisation to fine slice and identify its core activities which is achieved by following the approach as outlined in Figure 7.5.

Multi Disciplinary Team (Core Activities)

- Executive champion
- Key stakeholders
- Knowledge of outsourcing/offshoring
- Technical capability
- Cost/performance thresholds
- Market intelligence
- Documentation / project minutes

↓

Fine slice PDD activities which are highly unique to the organisation and difficult for competitors to reproduce

↓

Fine slice PDD activities which are highly critical and impact greatest on competitive advantage

↓

Fine slice PDD activities which highly affect customers and provides significant contribution

↓

Fine slice PDD activities which require highly competence resources

↓

Fine slice PDD activities that require high levels of interaction and communication

↓

Fine slice PDD activities that require high level expert knowledge

↓

Fine slice PDD activities which are primary contributors to organisational revenue

↓

Perform assessment to evaluate offshoring of highly unique PDD activities

↓

Core activities to be retained internally and competence developed

Figure 7.5. Fine slicing of core activities.

Fine slicing of core PDD activities begins with the organisation setting up a multidisciplinary team using the method outlined in section 7.4.2.1.

Once the multi-disciplinary teams have been identified and the relevant data collected, the next stage involves fine slicing and identifying the PDD core activities as explained in Figure 7.5.

Fine slice PDD activities which are highly unique to the organisation and difficult for competitors to reproduce – The organisation is required to fine slice their PDD activities to identify which are highly unique and positions the organisation in a different segment compared to its competitors. The highly unique activities are difficult for competitors to reproduce and are a key USP for the organisation.

Fine slice PDD activities which are highly critical and impact most on competitive advantage – When fine slicing highly critical PDD activities which have the greatest impact on competitive advantage, the organisation is required to ensure the multi-disciplinary teams all agree on these activities and if required spend a considerable amount of time to ensure these activities are clearly identified.

Fine slice PDD activities which highly affect customers and provide a significant contribution – The organisation is required to fine slice PDD activities that highly affect customers and if these activities are carried out inaccurately it may contribute to a negative effect and potentially the organisation to lose key customers and market share. These activities also provide a significant contribution to the PDD process and if outsourced or offshored could lead to negative consequences so care must be taken during the fine slicing stage.

Fine slice PDD activities which require highly competence resources – The organisation is required to fine slice PDD activities which require and rely on highly competent resources. These activities are critical to the organisation they require a high level of internal competence and capability for them to be performed. However, an external organisation would struggle to successfully execute these activities and would require extensive support from the outsourcing organisation.

Fine slice PDD activities that require high levels of interaction and communication – The organisation is required to fine slice and identify the PDD activities that require a high level of interaction amongst people within the organisation. If these activities are dispersed away from the organisation it could lead to inefficiencies during the interaction process and create a higher margin of error. Additionally, these activities also require a high level of communication amongst people and are necessary to be performed onshore due to the complexities involved and to avoid further inefficiencies.

Fine slice PDD activities that require high level expert knowledge – The organisation is required to fine slice the PDD activities and identify which require a high level of internal expert knowledge. These activities are quite constrained within the organisation and would be difficult to do externally without the know-how or expert knowledge.

Fine slice PDD activities which are primary contributors to organisational revenue – The organisation is required to fine slice and identify the PDD activities which primarily contribute to the organisation's revenue or in other terms the 'cash cow' products. The outcome of these activities predominantly generates the primary revenue for the organisation and is easily distinguished from near core and non-core activities. There is a need to clearly define which are the most premium products or services that the business relies on. In terms of products this could be either single commodities or premium vehicles or even services which are key to the customer.

Perform assessment to evaluate offshoring of highly unique PDD activities – Once the PDD activities have been fine sliced for stage one of the PDD model the organisation is required to evaluate whether these activities are capable of being offshored to a wholly owned subsidiary taking into account the gradual evolution of such activities.

Core activities to be retained internally and competence developed – at this stage the fine slicing of PDD activities is complete and the organisation can clearly identify their core activities and the fundamental explanations to why they cannot be outsourced. However, if the organisation feels the fine slicing process requires further refinement any stage can be revisited to ensure the activities are defined correctly.

A number of core activities are listed in Table 7.3 from the data collection and focus group sessions. The core activities are segregated in OEMs, ESPs and FTSs based in the automotive sector.

	OEMs	**ESPs**	**FTSs**
Core activities	IP Design/styling - Styling phase class A styling Core chassis/platform development New technology (critical technology) R&D Sales & Marketing Attribute setting - system weight - quality targets, - component costs - ride and comfort - perceived quality Technical requirements/standards Prototype builds Vehicle sign off integration	Powertrain Electrical/Hybrid Complete vehicle contracting (manufacturing) Benchmarking Managerial roles Design Verification Plan sign off R&D	Design/Styling Benchmarking Managerial roles Component manufacturing Technical standards

Table 7.3. Example of core automotive activities of OEMs, ESP, FTS.

7.4.2.4. Other tools to use when fine slicing activities

During the focus group workshops, the participants stated that organisations may require additional tools to support activities during the fine slicing process. Therefore, to ensure no oversights when fine slicing an organisation's internal activities, these additional tools are included in this research and applied to stage one of the model. They are discussed below.

Firstly, applying the SWOT analysis on critical activities enabled the organisations to view stage one of the model through a different lens when fine slicing the internal activities. This analysis will highlight the weaknesses and threats within each fine sliced category and force the organisation to use additional countermeasures to address them.

Secondly, the V model originally created for software development was transformed and re-applied to engineering PDD that allowed a deeper understanding of the internal activities. The V model is constructed such that the left-hand side is where the complete requirements are defined and takes a high level of integration. The opposite side of the V model is concentrating on integration and validation where the validation and acceptance phase as shown in Figure 7.6.

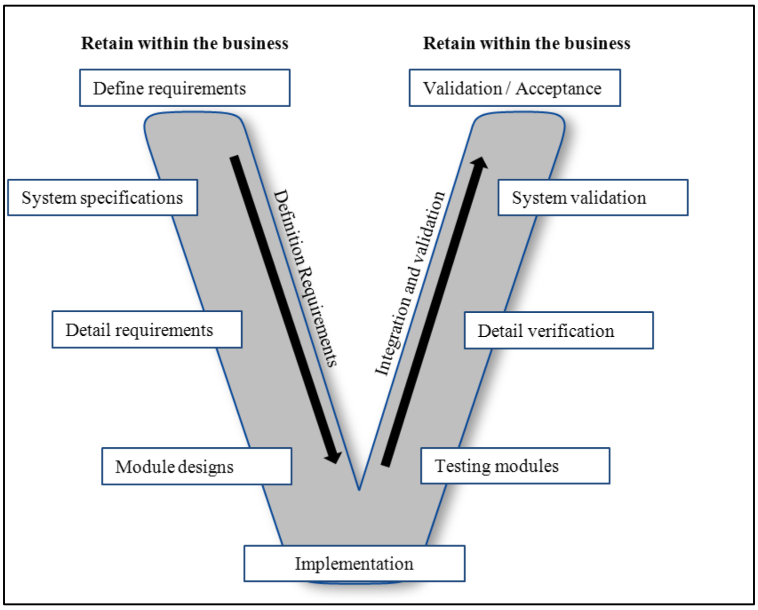


Figure 7.6. V model for engineering (Source: adapted internal documentation).

The top left and right of the V model are treated as an organisations core competency and are retained within the organisations boundaries not being outsourced or offshored.

7.4.3. Stage 2: Detail mapping of PDD requirements

Stage two of the model requires stage one, fine slicing of PDD activities to be complete in order to start the detail mapping process. This stage concentrates on mapping the PDD requirements of each activity outlined from stage one which are categorised into non-core, near core and core activities. PDD is a complex field of study in particular when thousands of interfaces and hundreds of people are involved. The research discovered automotive organisations that contributed a minimum amount of time or were rather impatient when carrying out the detail mapping stage of their internal PDD activities failed to correctly identify these activities which resulted in backshoring, additional costs occurred to the business and a delayed time to market launch.

Thus, stage two will follow the approach outlined in Figure 7.7 which is explained further in detail.

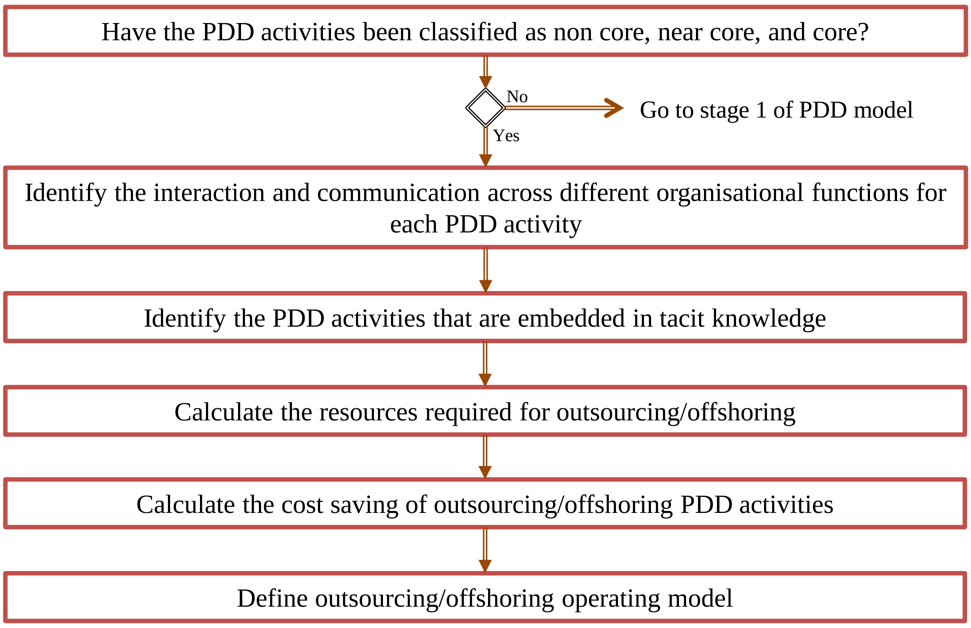


Figure 7.7. Detail mapping activity.

Have the PDD activities been classified as non-core, near core, and core? – Stage two of the strategic decision-making model for outsourcing/offshoring PDD requires an organisation to complete stage one of classifying the PDD activities into non-core, near core and core. It is advised that stage one is completed before continuing, otherwise the decision-making process could lead to an adverse outcome.

Identify the interaction and communication across different organisational functions for each PDD activity – This stage involves the organisation to map out the interaction and communication required across different organisational functions for each PDD activity. For instance if product A and product B are two separate products but both are necessary for integration the interaction and communication amongst two functions requires analysing to understand how complexity can be minimised.

Identify the PDD activities that are embedded in tacit knowledge – This stage involves the organisation identifying which PDD activities from stage one of the PDD model are embedded in tacit knowledge belonging to people and retained by certain employees for various reasons. These reasons include job security, reluctance to share data and fear of data being shared or made available internally. When external organisations are carrying out PDD activities tacit knowledge becomes rather important.

Firstly, for an external organisation to succeed and deliver a project tacit knowledge must be converted into explicit knowledge. This is achieved by updating the current organisation's process with this type of knowledge. Secondly, tacit knowledge must be clearly cascaded and well documented for an external organisation to use and understand. The research discovered that organisations who retained tacit knowledge within their boundaries and disbursed elements did not received the benefits or meet their objectives when working with external organisations

Calculate the people required for outsourcing/offshoring – Before calculating the number of employees required, the organisation must develop a resource plan if not available already to calculate the engineering employee shortfall. The shortfall is calculated once internal contractors and FTEs have been suitably added to the organisation. This creates an understanding on the number of additional employees required for the PDD activities. If an organisation has a motive to reduce costs then the amount of additional onshore employees would be kept to a minimum with a greater emphasis on offshoring.

In addition to the resource plan an organisation must also review current activities (non core, near core and core) to calculate the total additional people required for outsourcing/offshoring.

Table 7.4 illustrates the number of employees required for a strategic alliance based either onshore or offshore and a wholly owned subsidiary offshore.

Strategic alliance (onshore)	**Strategic alliance (offshore)**	**Wholly owned subsidiary (offshore)**
>15 people	>5 people	>100 people

Table 7.4. People required for operating model.

For strategic alliances based onshore more than 15 people are required for an engagement to provide the organisation with tangible value. For strategic alliance offshore more than 5 people are required mainly as offshoring is perceived at the start of any journey a risk to an organisation. For a wholly owned subsidiary, more than 100 people are required to successfully achieve the financial benefits and provide a critical mass of work activities.
The research identified that organisations which employed less than 100 people offshore struggled with their wholly owned subsidiaries which were underutilised and became expensive to operate.

It must be noted that these figures quoted in Table 7.4 are not absolutes and in actual practice will vary. The figures are provided to enable an organisation gauge the number of people required for the three operating models.

Calculate the cost saving of outsourcing/offshoring PDD activities – This stage involves calculating the cost saving if an organisation decides to outsource/offshore their PDD activities. The organisation is required to use their internal costing structure for employees and comparing whether outsourcing onshore/offshore or a wholly owned subsidiary offshore provides cost advantages.

Define outsourcing/offshoring operating model – This stage is dependent on the cost saving stage and requires an organisation to define its outsourcing/offshoring operating model. There are two operating models usable based on the cost analysis and several activities that take place in stage two the PDD model.

1. Fixed price deliverable (deliverable based) – Consists of project work deliverable based contracts consists of larger work activities, turnkey solutions and are financially larger.
2. Fixed term contract (transactional based) – Consists of transactional work mainly consisting of smaller work packets and involves buying hours/people for fixed terms.

See Figure 4.1 for further details on the operating models and responsibilities.

7.4.4. Stage 3: Detail review of PDD organisational drivers and challenges

Stage three of the model requires activities from stage one and two to be completed. Stage two of the model is an iterative process and may involve two or three rounds when detail mapping the requirements.

PDD activities when reviewed from an onshore and offshore perspective add complexity by changing the drivers and challenges if an organisation decides to offshore the same activity as communication breakdowns, the level of competence in developing countries is lower than developed countries and understanding the activity, if not clearly defined, produces a different outcome. Therefore stage three is important for an organisation to review all their PDD activities from an onshore and offshore approach.

The drivers and challenges for a strategic alliance whether onshore or offshore and wholly owned subsidiary offshore are also different because a wholly owned organisation will have direct control of activities, ensure management is committed and knowledge is shared without thinking that an external service provider will capture sensitive internal information.

Figure 7.8 identifies the different drivers discovered from the data collection and field interviews showing how they are different for each approach (onshore/offshore) and each segment (OEMs, ESPs and FTSs).

	OEMs Drivers	**Weighting Resp (%)**	**ESPs Drivers**	**Weighting Resp (%)**	**FTSs Drivers**	**Weighting Resp (%)**
Strategic alliance (onshore outsourcing)	1. Engineering capacity 2. Cost reduction 3. Flexibility 4. Time to market 5. Capability	*100* *40* *80* *100* *30*	1. Engineering capacity 2. Cost reduction 3. Local presence 4. Engineering capability 5. Failed with strategic alliance	*100* *40* *80* *67* *60*	1. Engineering capacity 2. Cost reduction 3. Local presence 4. Engineering capability 5. Failed with strategic alliance	*100* *50* *70* *75* *65*
Strategic alliance (offshore outsourcing)	1. Cost reduction (Direct) 2. Cost (Indirect) 3. Engineering capacity 4. Flexibility 5. Capability	*75* *45* *80* *100* *30*	1. Cost reduction 2. Customer driven 3. No upfront investment 4. Engineering capacity 5. Retain competiveness	*80* *50* *40* *70* *65*	1. Cost reduction 2. Customer driven 3. No upfront investments 4. Engineering capacity 5. Retain competiveness	*75* *60* *55* *65* *40*
Wholly owned subsidiary (offshore)	1. Cost reduction 2. Engineering capacity 3. Local market presence 4. Access to educated people 5. Capability	*90* *100* *85* *75* *20*	1. Cost reduction 2. Engineering capacity 3. Protect IP 4. Control 5. Failed with offshore alliances	*90* *80* *75* *80* *35*	1. Cost reduction 2. Engineering capacity 3. Proximity to customers 4. Control – Develop existing facility 5. Failed with offshore alliance	*100* *100* *70* *100* *45*

Figure 7.8. Top five key drivers for OEMs, ESPs and FTSs.

Figure 7.8 shows a 3 x 3 matrix demonstrating the top five drivers for each sector namely OEMs, ESPs, and FTSs mapped against strategic alliance onshore/offshore and wholly owned subsidiary (offshore). The drivers have been ranked in the most cited during the interviews and give an indication to an organisation of the different drivers to be considered when going through stage three of the PDD model.

For strategic alliance onshore all three sectors identified engineering capacity (engineers) as the main driver for outsourcing as internal engineering capacity was fully utilised. For strategic alliance offshore all three sectors identified that cost reduction was the primary driver as the business objectives were to reduce the PDD costs utilising low cost countries. However, when all three sectors developed wholly owned subsidiaries offshore cost was also a primary driver again through utilisation of low cost countries.

As shown the drivers amongst the three sectors are different in scope and depth and an important stage within the PDD model. An organisation can use the drivers highlighted in Figure 7.8 as a starting point to support their decision when identifying the drivers.

Figure 7.9 identifies the top five challenges when OEMs, ESPs and FTSs outsourced or offshore their PDD activities to either strategic alliances or wholly owned subsidiaries based offshore. As shown, the challenges As shown the challenges for each sector namely OEMs, ESPs and FTSs are different and will impact the PDD activities whether they are outsourced or offshore or if additional mechanisms are required to ensure these activities can be delivered.

	OEMs Challenges	**ESPs Challenges**	**FTSs Challenges**
Strategic alliance (onshore)	1. Communication 2. Quality of work 3. Reluctant to engage with outsourcing partner 4. Not cascading internal processes 5. Additional coaching and control required for external organisations	1. Communication 2. Resistance from customer 3. Lack of knowledge transfer from customer 4. Outsourcing any PDD activities 5. Not understanding customers systems and processes	1. Communication 2. Resistance to work with ESP 3. Additional resource required to manage external organisation 4. Outsourcing of any PDD activity 5. Knowledge transfer
Strategic alliance (offshore outsourcing)	1. Communication 2. Additional checking of data 3. Unclear PDD Specifications 4. Lack of employee experience 5. Employee Attrition	1. Communication 2. Controlling offshore 3. Management commitment 4. Lack of skills 5. Rework of data	1. Communication 2. Additional time in managing people 3. Cascading of information 4. Rework of data 5. Developing Capability
Wholly owned subsidiary (offshore)	1. Communication 2. Rework of data 3. Lack of experience 4. Employee attrition 5. Unclear Specifications	1. Communication 2. Rework of data 3. Management Trust 4. Control 5. Employee attrition	1. Communication 2. Rework of data 3. Lack of capability 4. Control 5. Management buy-in

Figure 7.9. Top five challenges for OEMs, ESPs and FTSs.

Figure 7.9 shows a 3 x 3 matrix for the top five challenges for OEMs, ESP, and FTSs which are mapped against strategic alliance onshore/offshore and wholly owned subsidiary (offshore). The drivers illustrated are ranked in the most cited during data collection and provides indication to an organisation when identifying its challenges and what to consider during the process of stage three PDD model.

The research discovered that organisations were visionless to the challenges they would experience when outsourcing and offshoring, this stage not considered resulting in a poor strategy and overspend to the organisation. These organisations assumed the same work activities were offshoreable and they would run smoothly without new challenges.

The first onshore challenges for OEMs were communication issues when outsourcing the PDD activities to ESPs because the internal processes and systems lacked outsourcing depth for external organisation to work with. For an ESP, the first challenge was incomplete work information received from the customers as they were unsure themselves how to work with an external organisation and incapable of documenting or describing what type of activity was required. The first challenge for FTSs was communication barriers onshore, employees resistant to work with external organisations, see section 4.6 where the challenges are discussed further.

OEMs, ESP and FTSs all experienced communication issues as a primary challenge when offshoring the PDD activities whether it was a strategic alliance offshore or a wholly owned subsidiary offshore. However it must be noted that OEMs also experienced communication issues when outsourcing to a strategic alliance based onshore.

A number of factors influence the communication issues that these organisations experienced such as lack of offshore experience, not cascading data correctly and specifications unclear and ambiguous. Other challenges can be found in section 4.6.

Once the organisation has identified the drivers and challenges for the PDD activities, the challenges need addressing as the outsourcing or offshoring activities will be impacted.

For example, the most cited challenge was communication and a number of solutions were implemented by these organisations; for instance to improve the communication between the onshore and offshore employees the organisations had a coordinator based onshore who would liaise with the offshore teams. This coordinator was from the offshore organisation but based onshore. However, for an organisation this leads to additional costs which were not originally in the offshoring proposition.

All challenges need addressing by the organisation and to fully understand how the decision making process at this stage is influenced whether outsourcing or offshoring is conducted through a strategic alliance based onshore/offshore or development of a wholly owned subsidiary offshore.

A decision box is necessary after stage three of the PDD model before the PDD activities are allocated, as this will give the organisation an opportunity to review stage two where the detail mapping is conducted and stage three where the drivers and challenges are outlined and addressed. In addition, a feedback loop is added to the decision box after stage three which ensures any PDD activities not mapped or reviewed in detail are revisited and understood.

7.4.5. Stage 4: Allocation of PDD activities

Stage four of the PDD model requires completion of stages one, two and three before allocation of PDD activities. This stage involves the organisation to make a decision and allocate the PDD activities to either a strategic alliance onshore, a strategic alliance offshore, an offshore wholly owned subsidiary or continue performing these activities internally. There are the four key areas for allocation as shown in Figure 7.10.

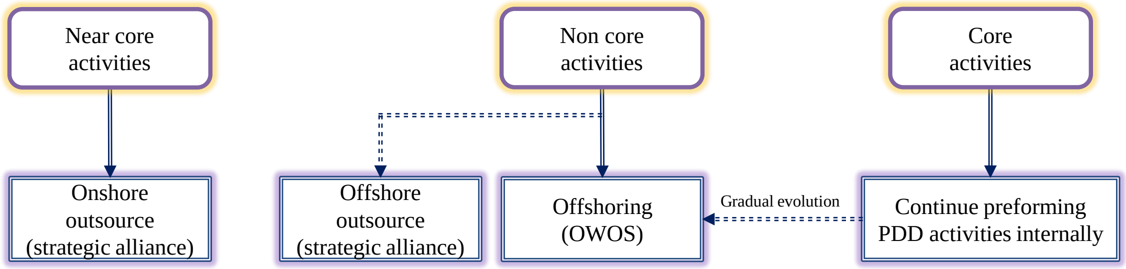


Figure 7.10. Allocation of PDD activities.

The allocation of PDD activities based on Figure 7.10 are categorised as following:

1. *Near core activities* – Onshore outsourcing with a strategic alliance organisation based within a short proximity from the customers HQ. The engineering resources are acquired from the market to fulfil the demand.
2. *Non-core activities* – Offshore outsourcing and offshoring based in low cost/emerging countries. Engineering resources are acquired from the market.
3. *Core activities* – Retained internally and continued to be performed within the organisation where the competence is further built and strengthened. Over a period of time there is a gradual evolution where the core activities are offshored to the organisation's wholly owned subsidiary in order to reduce cost and potential localisation within the local market.

7.4.6. Stage 5: Develop the detailed PDD outsourcing/offshoring strategy

Stage five of the PDD model is the last stage involving the organisation deciding whether outsourcing/offshoring or both models are used. This stage involves the organisation developing a strategy for the selected outsourcing/offshoring model and provides a competitive advantage because organisations interviewed as part of the research lacked the ability to develop a strategy. The strategy will also enable the organisation to become unique in the way it conduct outsourcing/offshoring of PDD and benefit from tighter controls and process robustness along with being different.

The strategy should be divided into various steps that are required to achieve the overall objective, for instance development of a wholly owned subsidiary offshore. An example of the organisation's steps and considerations to take into account are the following;

Management commitment – Nominate the management team responsible for developing a wholly owned subsidiary offshore and include key stakeholders from the offshore location. The management team are required to involve a number of stakeholders from different departments within the organisation.

Addressing the challenges – Stage three of the PDD model requires an organisation to identify the challenges when deciding to outsource or offshore its activities. All challenges outlined by the organisation need addressing, documenting and enrolling a member from the management team who is accountable and responsible for implementation. The organisation is required to focus on these challenges associated with offshoring because many of the failures identified during the data election stage had been ignored.

Transition phase – The start of relocating activities offshore cannot be done overnight and is a slow process and patience is required. Before the PDD activities are relocated offshore the organisation is required to document what type of knowledge is associated with these activities and the impacts if his knowledge is not cascaded with during the transition phase. These activities will require an element of coaching and training to ensure the offshore employees understand the activities. In addition the organisation is required to identify how many expats will be required offshore until the wholly-owned subsidiary is competent to operate independently and without support from the parent organisation.

Offshore project success – This is required to identify how the success of the offshore project will be measured. Some questions can be used; would there be a monthly or quarterly review to understand costs? How would the parent organisation understand if the offshore subsidiary is competitive? One method would involve the organisation to measure actual time; offer an activity versus the planned time to give an indication whether offshoring is providing the benefits. Another method involves calculating 'first time right' on the number of activities sent offshore and how many were reworked or involved additional time.

Decision Making – The organisation is required to develop an organisational chart to illustrate clearly the level of decision making that occurs in an offshore organisation. If necessary a RASIC chart can be developed to identify roles and responsibilities within the organisation.

7.4.7. Validation of the strategic decision making model for outsourcing/offshoring PDD within the automotive industry (OEMs, ESPs & FTSs)

This section focuses on validating the model developed/discussed and also tests the model. The research is underpinned by empirical data collected within the automotive industry across the three organisation segments. It was further underpinned by using Kirkpatrick's (1975) model developed and proven to validate testing from industry and academic areas to generate effective outcomes (Boyle and Crosby 1997, Kirkpatrick 1975, Phillips 1997). Kirkpatrick's model used for validation and testing has history of been applied successfully in product design and engineering research studies (Ahmed 2001).

Kirkpatrick (1975) model consists of four levels and has been applied through each step of the model development as described below:-

Level One – Reaction, Reviews how the participants reacted and responded to the model proposed.
Level Two – Learning, Identifies what has been learnt from the model development and it's applicability of learning its implementation.
Level Three – Behaviour, Evaluation of behaviour changes once the model has been implemented within an organisation.
Level Four – Results, Effect on the organisation upon employing the model and how organisational behaviour changes with such an approach.

Levels three and four require implementation of the decision making model within an organisation and a considerable amount of time is required to evaluate their behaviour and the outcome of implementation. These two levels are out of the research scope and six organisations have been approached and agreed to review the model with current outsourcing/offshoring activities and those organisations developing outsourcing/offshoring from start have also approved to use the model. However, this activity is due post submission of the thesis.

Thus, levels one and two are used to validate the model through focus group workshops consisting of professional practitioners and academic scholars in the area of outsourcing and offshoring.

Further, Ahmed (2001) added another element to Kirkpatrick (1975) model termed validation which uses levels one, two, three, four (only one and two used in this research) to track back changes in previous levels on how improvements are named to the model.

7.4.8. Model Validation Process

The strategic decision making model for outsourcing/offshoring PDD within the automotive industry was validated through 10 focus group workshops allowing organisations and academic scholars to critique and scrutinise the model and advise on areas where improvements are required to robustly engineer a fruitful model for an organisation to implement when outsourcing/offshoring PDD activities. The 10 workshops consisted of five conducted with practitioners and the remaining with academic scholars in a rotating order.

Krueger and Casey (2000) identified that conducting focus group workshops enables effectiveness during analysing activities and a forum for different disciplines within each group to share insights, experience, clarification and common understandings when presenting and critiquing the outsourcing and/or offshoring decision-making model with experiences of the participants to share and improve the overall effectiveness of the model. Further, the focus group workshops enabled real-life situations to be applied and discussed on outsourcing and offshoring of PDD.

All 10 focus group workshops enabled the different participants to comment and add their experiences in this area to build and relate the model if it were applied in a working environment. FGW3 was rather new to outsourcing and offshoring unlike other organisations already implemented or halfway through the process of implementation allowing the model to benefit from breadth and depth for is usability within an organisation and absorbing current learning and challenges into the model.

The focus group workshops were recorded with additional comments and notes taken using flipcharts, whiteboards and follow up meetings were also carried out. The additional comments and feedback from the participants was further implemented into the model to improve its overall activists.

The number of focus group workshops, participating industries, participant positions and number of participants in each workshop is illustrated in Table 7.5.

A total of 25 iterations were carried out to each stage of the model and consisted of regular reviews with the focus group participants before saturation had been achieved.

Focus Group Workshops (FGW)	Industry	Participant Positions	Number of Participants	Duration (hrs.)
FGW 1	Automotive and Consultancy (ESP)	Senior Practitioner Senior Manager & Engineer	3 Participants	3
FGW 2	Outsourcing and offshoring (Academic)	Professor	1 Participant	2.5
FGW 3	Automotive (OEM)	Senior Manager & Line Manager	2 Participants	2.5
FGW 4	Supply Chain and product development (Academic)	Professor	1 Participant	3.5
FGW 5	Automotive (OEM)	Director, Senior Manager & Vice President	3 Participants	3
FGW 6	Engineering Strategy (Academic)	Senior Lecturer	1 Participant	3
FGW 7	Automotive (FTS)	Director, Chief Engineer	2 Participants	2
FGW 8	Supply Chain management (Academic)	Principal Lecturer	1 Participant	3
FGW 9	Automotive/Electronic (ESP)	Vice President & Senior Manager	2 Participants	2
FGW 10	Strategy and decision making (Academic)	Senior Lecturer	1 Participant	6

Table 7.5. Outline of focus group workshops

FGW1 was an automotive and consultancy organisation who had been practising outsourcing and offshoring for over 20 years. Three participants took part in the focus group activity to review the model and each participant had around 10 years of outsourcing and offshoring experience.

FGW2 was an academic scholar and subject matter expert in the field of outsourcing and offshoring. The academic scholar had 30 years of experience in this field and took part in this activity.

FGW3 was an automotive OEM based in Germany and one of the largest organisations. The two participants took part in the focus group activity each having around 12 years of experience with outsourcing and offshoring of PDD relatively new to offshoring and still facing challenges with outsourcing.

FGW4 was an academic scholar in supply chain and product development with extensive knowledge in the area of outsourcing and offshoring. The academic scholar had over 25 years' experience and took part in this activity.

FGW5 was an automotive OEM based in UK with an aggressive approach to increasing their product portfolio. The organisation had experience of outsourcing and offshoring their PDD. Each participant had around 15 years of experience but was relatively new to outsourcing and offshoring taking part in the focus group workshop.

FGW6 was a senior lecturer on engineering strategy. The lecturer's expertise was leveraged to incorporate the strategic element of the decision making model and had over 20 years of experience and took part in this activity.

FGW7 was an automotive FTS based in Sweden where two participants engaged with the focus group workshop. Both participants had over five years of experience and were relatively new to offshoring but were outsourcing PDD on a regular basis.

FGW8 was a principal lecturer on supply chain management in particular within the automotive industry. The lecturer had over 25 years' experience in supply chain management and took part in this activity.

FGW9 was a leading automotive ESP based in Germany with offices based globally and the organisation had experience of outsourcing and offshoring. The two participants taking part in the focus group activity had 7 years of experience in PDD.

FGW10 was a senior lecturer on strategy and decision making with over 25 years' experience in the field. The lecturers expertise on strategy and decision making was leveraged to add depth to the decision making model and took part in the focus group activity.

Each focus group workshop was opened using a mirrored approach with an introduction into the research, objectives, the aim of the research and the initial findings along with an introduction to the strategic decision making model for outsourcing/offshoring PDD within the automotive industry. The five stages of the model were reviewed in detail and participants requested to express their feelings, their concerns and the challenges they encountered during or at the start of their journey. In particular the participants were requested to demonstrate how each challenge was overcome and how they ensured this was implemented followed by their comments on the practicality of the model.

Additionally, the decision-making model was reviewed with academic scholars practising the area of outsourcing and offshoring, supply chain product development and engineering strategy/decision to build academic rigour into the model.

7.4.9. Level 1 Reactions

All 10 workshops followed consistency, continuity and were constructed to ensure maximum benefits were retrieved during the time spent with the interviewees.

The immediate reactions from all participants stated the proposed model to be a very useful tool but it depends on the maturity of the organisation in terms of how far into their journey they are with outsourcing and offshoring. For instance FGW3 was rather new to offshoring so the model was applicable imminently than FGW1 who were already engaged in the journey but stated the model still provides great value because it allows our or any organisation to review the offshoring business even though our maturity in this field was rather advanced.

Below are the following suggestions recommended for each stage of the model and where improvements were necessary to enhance the models robustness and ensuring rigour was achieved. Additionally the suggestions also helped the negative reactions from management and other people within an organisation during executing each stage of the model.

7.4.9.1. Stage 1 of the model

The first stage of the model was changed extensively over a period of time because all the participants stated the first few iterations of the model was not capable of categorising the PDD activities into three key areas non core, near core and core as suggested by the data collection. As the research involves PDD a complex area of study fine slicing would benefit an organisation to categorise activities clearly and accurately, this stage for evaluation is critical.

The industry participants commented that the fine slicing stage is usually overseen by organisations. The participant's then stated this stage is incomplete because multi-disciplinary teams are not allocated when developing outsourcing, offshore outsourcing, and offshoring where this process breaks down.

During the first workshop and subsequent reviews all participants outlined the model is definitely useable and they would attempt to apply within their organisations. In summary the following comments were made by participants on stage one of the model and its usability and usefulness to an organisation.

1. The fine slicing process of the PDD activities is a key area which organisations overlook and contribute marginally resulting in activities not correctly been identified.
2. The fine slicing process categorises the PDD activities in three key areas none core, near core, and core, making the model easy to follow and providing a structured approach.
3. When an organisation decides to categorise their activities into three areas as mentioned above the use of supplement process steps enables the model to become more user friendly and simple to use.
4. Use of additional tools when fine slicing the PDD activities is also useful to provide additional support during this process. However, the supplement process steps are in depth and critically underpinned this stage.

In contrast to the use ability and usefulness of the model, participants also commented on factors to take into account when going through stage one of the model.

1. A multidisciplinary team is necessary throughout all stages of the model in particular stage one where the organisation is identifying and evaluating near core, non core and

core activities. During this stage an organisation can easily become less focused and therefore an executive champion is required with a senior role in the organisation.

2. When fine slicing activities it is critical to use the supplement information developed to support the decisions at stage one.

7.4.9.2. Stage 2 of the model

The second stage of the model followed the journey of stage one because detail mapping of PDD requirements only takes place once fine slicing of PDD activities is complete and a number of iterations of the model took place before stages one and two were sequentially aligned.

During the focus group workshops and the participants identified that when a detailed mapping of PDD requirements was necessary and iterative process would enable an organisation to revisit activities which could not be classified at the time of assessment or there was unsureness about these activities. The iterative process enables an organisation to go through a number of rounds before this stage is completed. The iterative process was derived from the academic scholars experience in the area of outsourcing and offshoring and the practitioners agreed with their comments.

In summary the following comments were made by participants on stage two of the model and its usability and usefulness to an organisation.

1. Stage two provides a structured approach by using an additional supplement information to help support the decision making process
2. Identifying the interaction and communication of each PDD activity can take a long duration so the teams are required to be patient with this process but a required step to ensure the activities involving a high level of interaction and communication are captured and documented.
3. When organisations decide to offshore their PDD activities to a wholly owned subsidiary under estimate the critical mass required to benefit the organisation. This is also captured in stage two and care must be taken that organisations do not oversee this.

In contrast to the usability and usefulness of the model, participants also commented on factors to take into account when going through stage two of the model.

1. The multi-disciplinary team can become rather disconnected so an executive champion is necessary to be accountable for this activity. A common mistake organisations make that leads to turbulent conditions is where the knowledge internally is retained within the employees and external organisations are identified as a threat. Stage two of the model has captured converting tacit knowledge into explicit knowledge for the activities, this is a good step but there will be a degree of uncertainty within the organisation on which activities involve tacit knowledge.

7.4.9.3. Stage 3 of the model

The third stage of the model involved a number of iterations before stages one, two and three were processable. The iterations consisted of removing the data collected drivers and challenges from the model as organisation will not have access to the research data and over a period of time the drivers and challenges today will change in five years' time. Thus, the organisation is required to identify their drivers and challenges unique to their business without being influenced by other organisations. The participants identified this stage is extremely important because the PDD drivers and challenges impacts the outsourcing or offshoring decision.

In summary the following comments were made by participants on stage three of the model and its usability and usefulness to an organisation.

1. The model reviews the organisation's drivers and challenges which are very important through the decision-making process especially when considering outsourcing or offshoring the PDD activities.
2. The use of supplement information to support an organisation when conducting a detailed review of the PDD drivers and challenges is definitely required and provides good support to the organisation to make this decision.
3. After stage two and stage three are completed a decision box is required to ensure the drivers and challenges have been understood and addressed. The use of a decision box enables an organisation to review both stages before allocating the PDD activities. The participants commented the decision box was a good idea and was derived from a number of workshops after the model was reviewed intensively.

In contrary to the use ability and usefulness of the model participants also commented on factors to take into account when going through stage three of the model.

1. Ensure at this stage the multi-disciplinary team is still engaged and the executive champion fully understands the challenges involved at stage three.
2. Communication has always been an issue when outsourcing and offshoring and organisations must appreciate and acknowledge that this cannot be ignored. The use of clear specifications, having offshore people on-site and ensuring knowledge is clear for a given activity must be underpinned otherwise these organisations will experience the same challenges.
3. The challenges must be addressed otherwise an organisation looking at implementing their outsourcing/offshoring strategy will fail to deliver and the task for the executive champion is to ensure these challenges are addressed completely.

7.4.9.4. Stage 4 of the model

The fourth stage of the model was removed from stage one as the allocation of activities could only be done once stages one, two, and three were completed.
The participants and research went through a number of iterations and real examples using organisational data to develop this stage.
The allocation of PDD activities involves an organisation to allocate the activities into four areas are shown in Figure 7.2.

All the participants from various focus group workshops agreed with the allocation of these activities to various operational models.

In summary the following comments were made by participants on stage four of the model and its usability and usefulness to an organisation.

1. Stage four is relatively easy to follow and activities have been clearly identified for their allocation.
2. The model highlights when strategic alliances onshore/offshore are used the engineering resources are acquired from the market which indicates to an organisation an external service provider is used. In contrast to buying the engineering resources, core activities are retained internally which over a period of time are sent to the organisation's offshore wholly owned subsidiary. Non core activities are offshored to a wholly owned subsidiary or to an offshore strategic alliance if a wholly owned subsidiary is not used.

In contrast to the usability and usefulness of the model, participants also commented on factors to take into account when going through stage four of the model.

1. It is important that the team at this stage are fully engaged and they understand the allocation of these activities. The executive champion is required to ensure all stakeholders agree with this allocation.
2. There might be some management debates between a wholly owned subsidiary offshore and a strategic alliance offshore so the team is required to clearly justify their reasons based on the different stages of the model.

7.4.9.5. Stage 5 of the model

The final stage of the model is required for the organisation to develop the PDD outsourcing/offshoring decision-making strategy. During the focus group workshops the participants agreed for this stage to be added to formulate a strategy and actions with responsibilities that could be documented and identified.

In summary the following comments were made by participants on stage five of the model and its usability and usefulness to an organisation.

1. The model provides a comprehensive staged approach for an organisation to develop the outsourcing, offshore outsourcing and offshoring strategy.
2. The model takes into account different options available to an organisation based on the various stages in the model.
3. All participants agreed the strategy is necessary for an organisation and the model addresses the need to do so.

In contrast to the use ability and usefulness of the model participants also commented on factors to take into account when going through stage five of the model.

1. The steps towards achieving strategy must include the relevant stakeholders who will deliver all actions required.
2. Ensure the responsibilities are clearly identified for each person otherwise the results may become diffused.

The focus group workshops reviewed each stage of the model in detail with the participant's recommendations and improvements which have been incorporated into the model. Thus, the participants from industry and academia agreed not all organisations will start at stage one and follow the model through sequentially as each organisation will be at a different place in the journey and therefore one or two stages may be excluded. However, the model has the advantage of identifying how organisations have conducted outsourcing/offshoring and revisiting their original proposition could add a different dimension when applying this model.

However, the participants advise organisations to understand the basics such as which activities are near core, non core and core by going through stage one of the model. Thus, if organisations exclude one or two stages it was still give an advantage to review their current outsourcing/offshoring activities to highlight the shortfalls.

7.4.10. Level 2 learning

All participants participating in the focus group workshops highlighted that once the amendments to the decision-making model were implemented it was easy to learn and demonstrate a best practice approach. The model in particular used key wording from the industry making it easy to follow and flow through each step. The following suggestions during the focus group workshops identified some areas of improvements to further enable easy use of the model.

1. Additional supplement information regarding each stage of the model to support the decision-making process adding value to organisations implementing the model.
2. Detail the different operating models used by automotive organisations when they outsourced or offshored their PDD activities, show for instance how many ESPs were engaged with an OEM and if they had an offshore wholly owned subsidiary.

The two in-depth suggestions were addressed in this research and additional supplement information has been added to the model and Chapter 6. All participants agreed once the additional improvements are applied to the model it would be deemed robust and complete, ready for implementation.

Further, a comment was made by the director during FGW3 stating, *"Often businesses are normally and could be rightfully accused of sleepwalking into outsourcing or offshoring, for example we have always done it this way or have done it ourselves but the question why does this not get addressed?. The proposed model is definitely well structured and our business can benefit from not making mistakes".*

7.4.11. Level 5 validation

Each focus group workshop built upon the previous one and once all workshops had been completed, the model developed maturity in breadth and depth. During the workshop reviews more data was presented and the model was explained in further detail to participants. The final model was further validated with all participants to ensure the workshop detail was captured.

The workshop activities generated additional improvements and suggestions to the model which were implemented and tested through various workshops. This stage was an iterative process and consisted of many hours of activity to finalise the model. The iterative process meant the model was continuously revised and adjusted from the workshop activities and additional participants who were academics in this field.

The outsourcing and offshoring decision-making model is in the process of being implemented by the researcher's organisation.

Chapter 8 . Conclusions

8.1. Introduction

The aim of this research was to develop a strategic decision-making process and associated model to strategically support management in outsourcing, offshore outsourcing and offshoring PDD within the automotive industry. The aim of this research has been completed.

This chapter presents the research conclusions to the overall study and is structured into 8 key sections. Section 8.2 presents the studies' research objectives and the research question; section 8.3 walks through the systematic approach used for the research; section 8.4 presents the key empirical findings including decision-making across all segments; section 8.5 presents the challenges of communication, culture and the implications when offshoring PDD activities; section 8.6 contrasts the outsourcing/offshoring of PDD with the extensive ITO literature; section 8.7 presents the contributions to theory and practice from this study; section 8.8 reviews the limitations of the study and section 8.9 presents the reflections of the study.

8.2. Research objectives and research question

The overall aim of this research is to develop a strategic decision-making process and associated model to strategically support management in outsourcing, offshore outsourcing and offshoring of PDD within the automotive industry across three segments (OEMs, ESPs, and FTSs).

There are seven objectives of this research:

Objective 1: To review current literature in the academic field of outsourcing and offshoring using either wholly owned subsidiaries or third parties organisations. The review will map existing trends, and identify different theoretical models used to understand outsourcing/offshoring strategies.

Objective 2: To establish current research methodologies used throughout the literature understand how these have evolved over time, and to use these as one input for developing the methodology for this research.

Objective 3: To map out how three different organisational segments (OEMs, ESPs, and FTSs) are outsourcing, offshore outsourcing and offshoring their PDD and which delivery models are used i.e. outsourcing, offshore outsourcing and offshoring (to their wholly owned subsidiaries).

Objective 4: To compare the drivers and challenges in outsourcing, offshore outsourcing and offshoring when automotive organisations disperse their PDD activities across the three organisational segments.

Objective 5: To establish routes taken by the three organisational segments when deciding their outsourcing, offshore outsourcing and offshoring strategies and the implications of dispersing their PDD activities.

Objective 6: To analyse the gathered data to determine if outsourcing, offshore outsourcing and offshoring on a global basis can be managed more effectively, and if so, development of a strategic decision making process.

Objective 7: To develop an outsourcing, offshore outsourcing and offshoring strategic decision making model from the empirical data having general applicability but be specifically focused on use within TATA.

This study addresses the following research question which has been fulfilled, through the development of a strategic decision making model to supporting management when outsourcing, offshore outsourcing or offshoring PDD within the automotive industry:

How can the management of outsourcing, offshore outsourcing and offshoring of product design and development be enhanced within the automotive industry.

8.3. Research approach

This study on outsourcing, offshore outsourcing and offshoring within the automotive industry across all three segments (OEMs, ESPs and FTS) is the first to be conducted, whereas previous studies in other sectors are comprehensive but lack focus on the automotive sector. The study also provides the in-depth analysis required for automotive organisations to make key strategic decisions when fragmenting their PDD activities.

This study has used a qualitative approach where 99 semi-structured interviews were carried out in 50 automotive organisations and the distribution of interviews across these organisations is detailed in section 3.5.3.4. The qualitative approach ensured the researcher could provide a more in-depth analysis when automotive organisations outsourced, offshore outsourced and offshored their PDD activities.

The 50 automotive organisations consisted of 20 OEMs; 17 ESPs and 13 FTSs where a total of 151.5 hours of interview data was collected. In total, there were 43 interviews conducted in OEMs; 36 interviews conducted in ESPs and 20 interviews conducted in FTSs. All interviews averaged between 1.5 hours and 2 hours.

The study provides an in-depth analysis to the drivers and challenges experienced by the automotive organisations within the three segments. The solutions these organisations implemented for the challenges and the impact on the PDD activities; the people and the organisations are also discussed in this study.

The six in-depth case studies focused on two automotive organisations in each segment where further analysis was conducted to understand how outsourcing, offshore outsourcing and offshoring of the PDD activities were carried out. The case studies also identified the challenges these organisations experienced; the solutions implemented for the challenges; the implications to the PDD activities and the decision-making strategies/methodologies used.

The in-depth case studies were further analysed using a cross-case analysis approach to understand the common findings amongst these six organisations and where possible data from Chapter 4 was also used to strengthen the findings.

The findings were then discussed in Chapter 6 around the drivers of onshore outsourcing, offshore outsourcing and offshoring amongst all three segments. The same method was applied to the challenges. Each segment was also analysed to understand how outsourcing, offshore outsourcing and offshoring of the PDD activities is conducted. Solutions have also been discussed on how each segment implemented different strategies to overcome the challenges that were experienced. An in-depth review was undertaken across all three segments to understand how decision-making within the automotive industry is conducted.

A current state decision model was developed from this study, indicating the poor management strategies and lack of decision-making models/methodologies used. The current state model also identified that decisions were based ad hoc and the cost driver when offshore outsourcing or offshoring became questionable due to additional resources and control required for the PDD activities.

A proposed strategic decision-making model was developed from the study which involves a five-stage approach to assist automotive organisations considering outsourcing, offshore outsourcing and offshoring of PDD activities. Further, to assist organisations making key decisions, each stage of the decision-making model has an in-depth associated process.

8.4. Key empirical findings

This study has investigated a total of 50 automotive organisations consisting of 20 OEMs; 17 ESPs and 13 FTSs. The findings identified all three segments were outsourcing, offshore outsourcing and offshoring extensively. The failures are explained due to the lack of knowledge/experience in this area, poor methodologies and decision-making strategies used.

A summary of the top five challenges and drivers are identified in Figure 4.24 and Figure 4.25 and were experienced by the automotive organisations based in all three segments. Although, some findings within the drivers and challenges are applicable in non-automotive organisations, this research study is the first to investigate all three automotive segments across the three different sectors (outsourcing, offshore outsourcing and offshoring) whereby the findings demonstrate novelty of this research.

8.4.1. Decision making across OEMs, ESPs, FTSs

The six in-depth case studies discovered that decisions were conducted at top management level and overall clarity was lacking with decision-making across all three automotive segments when outsourcing, offshoring outsourcing, or offshoring their PDD activities.

The lack of decision making and strategy involved with the PDD impacted products and delayed the launch into the market. These organisations also suffered financially and disruption was caused to the PDD activities. For instance, decisions in OEM A involved no clear decision-making model; in OEM C decisions were ad hoc; in ESP D there were unclear outsourcing decisions/procedures with an ad hoc strategy; in ESP L there was no requirement to outsource but the organisation had a 12 month plan to start outsourcing and there was no clarity on which PDD activities could be outsourced; in FTS C decision-making was based on a 'me too' strategy (copying other organisations without knowing their challenges and drivers) and FTS J generally had no decision-making processes or methodologies. See Table 5.4 showing an in-depth analysis.

Due to the complexities involved with the PDD activities across all three organisations in particular when offshore outsourcing or offshoring, the perceived cost saving of fifty per cent was ambiguous and factually these organisations only received around twenty to twenty five per cent saving. However, when backsourcing PDD activities there was no cost saving.

Eppinger and Chitakara (2009) discovered from their research that decision-making models were lacking from the literature and request more research to develop decision-making models to aid management with key organisational decisions. The novelty of this study is the development of a strategic decision making model when automotive organisations are considering outsourcing, offshore outsourcing and offshoring. It further addresses this gap highlighted by Eppinger and Chitakara (2009) and others where the current literature is absent in this area.

Further, the literature also highlights the importance of a strategic approach which is often overlooked, but a critical stage during the decision making process (Prahalad and Hamel 1990b, Quinn and Hilmer 1994, Venkatesan 1992a). The strategic decision making model is shown in Figure 8.1.

8.5. Discussion of communication and culture when offshoring of PDD activities

The research study has discovered automotive organisations based in all three segments experienced, amongst others, communication challenges when offshore outsourcing and offshoring their PDD activities. Communication was the most cited and frequent challenge when offshoring organisations carried out PDD activities.

Together with the challenges outlined in sections 6.5.1, 6.6.1 and 6.7.1 communication can be explained by the different cultures which exist in each country. The automotive organisations offshored their PDD activities and the impact of culture on international business activities is imperative when organisations are offshoring (Gibson *et al.* 1999, Ralston *et al.* 2008). Culture is an underexplored area in offshoring of services, in particular from an empirical perspective (Hahn and Bunyaratavej 2010) and there are implications when organisations move operations outside their home country (Carter *et al.* 2010, Jones and Davis 2000).

Culture can be explained by being a dynamic phenomenon which constantly evolves and is created by interactions with others; shaped by leadership behaviour, and a set of structures, routines, rules and norms that guide and constrain behaviour (Schein 2010). Additionally, organisations are faced with other cultural aspects such as survival, growth and internal integration to allow daily functioning and ability to adapt and learn (Schein 2010).

Hall (1989) defines two types of communication cultures that exist: low context and high context communication. The findings of this research, when automotive organisations are offshore outsourcing or offshoring their PDD activities, can be classified as high context communication as the information is either in the physical context or internalised within the person, adding to the complexity when automotive organisations disperse their PDD activities offshore.

The implications of culture and communications have adverse effects when the three segments carried out offshore outsourcing or offshoring of their PDD activities to an OWOS. From the cross-cultural literature, culture and language barriers impact the quality of interactions (Stringfellow *et al.* 2008) and this leads to further implications when automotive organisations are offshore outsourcing or offshoring their PDD activities. However, these practices within offshore outsourcing and offshoring of automotive PDD are not followed sufficiently enough to understand the synergies amongst the wider pool of research literature on international business culture and communications. This research study has identified culture and communication as an important success factor for automotive organisations.

8.5.1. Cultural implications when offshoring PDD

Offshoring/offshore outsourcing involves international boundaries and therefore this research study has identified that culture and communications are a significant contributor to the success when organisations offshore PDD activities. The research study has identified a number of cultural implications as highlighted.

1. Additional checking of data resulted from the onshore organisations not fully explaining the requirements from the work activities. This included poor communication and the differences in culture between the two organisations based onshore and offshore and the lack of supportive documentation to ease the communication between the organisations. One example of this emerged when FTS J experience consecutive communication challenges when offshoring their PDD activities. An expatriate was used within the organisation who acted as an intermediary between both organisations at additional costs which had not been planned. However, there was a gradual improvement in communication and knowledge transfer between two organisations but there was still cultural misalignments.

2. Additional time was spent in controlling the offshore organisations at each stage of the development process and throughout the PDD activities. This can be avoided if clear and concise communication was used during the crafting stage of writing the PDD specifications which were sent offshore. The employees based onshore are required to change their mind-sets when working with people in different countries as meanings and explanations require further clarity to ensure ambiguity is minimised.

3. The onshore organisations had not developed clear PDD specifications to allow offshore outsourcing or offshoring organisations to understand in basic terms what was required from an activity. These organisations that lacked the ability to develop a clear PDD specification also discovered their tacit knowledge and key information for certain PDD activities was unknown within the organisation and critical information was amongst the employees. This added additional complexities as tacit knowledge over a period of several months/years was converted into explicit knowledge and clearly documented.

4. There was minimum knowledge transfer during the early stages of the project implementation phase which then had consequences on the upstream activities. The organisations in all three segments identifying that transferring and communicating tacit knowledge is the most difficult process when outsourcing and such activities cannot be done overnight. A number of different strategies were used to help these organisations as illustrated in section 6.7.8.

5. The automotive organisations in particular the FTSs did not cascade the relevant information required to perform the PDD activities and this resulted in additional time lost in communicating between onshore/offshore organisations. The PDD work activities completed by the offshore organisations were sent onshore for approval and integration into other areas of the vehicle design. However, it was discovered that the poor information transfer which resulted in communications and culture misalignment affected

the outcome of the PDD activities with the additional complexity of employees' experience and skills lacking the Western engineering talent. The PDD activities required further iterations and reworking which added on-costs to the project and this was a hidden cost not accounted for in the project scope. The automotive organisations based in all three segments, only after learning and experiencing the negative outcomes, appreciated that design offshoring was more complicated and challenging than outsourcing (Zirpoli and Becker 2011). These organisations changed their strategy as they relocated a number of CAD coordinators from the offshore organisations into their HQ based onshore to further improve the quality and communication challenges that arose during the journey. The strategy used resulted in additional costs to the organisations and disruption to the PDD activities.

The automotive organisations based in all three segments when offshore outsourcing or offshoring their PDD activities reported it became harder to interact and transfer high-end information which became unclear during the communication process. Similar findings are also identified in ITO and BPO research studies; Carmel and Tjia (2005), Dibbern *et al.* (2008), Stringfellow *et al.* (2008).

The research has also identified that cultural and communication challenges faced by automotive organisations in all segments had a financial impact to the offshored PDD activities. As identified by Brown and Eisenhardt (1995) communication is an essential ingredient for a successful product development outcome where these organisations suffered with the implications when offshoring these activities.

Further, a total of 13 offshore outsourcing contracts were terminated within the three segments and the organisations that developed OWOS faced further challenges with aligning the cultural and communication aspects to their global business activities.

Similar findings have been identified by other researchers in non-automotive organisations; King and Torkzadeh (2008), Metters (2008), Nicholson and Sahay (2004) and Stringfellow *et al*. (2008)

8.6. Contrasting outsourcing/offshoring PDD with ITO

This section analyses how the experience of outsourcing and offshoring PDD contrasts with the existing literature in particular the extensive ITO. The findings from this research study identified that automotive organisations based in the three segments outsourced or offshored their PDD activities sporadically involving all core, near core and non core tasks without fully understanding the implications when carried out by an external organisation.

The automotive industry has experienced a significant transformation in how PDD activities have been outsourced and offshored as typically two decades ago only a handful of PDD activities had been considered for outsourcing but it is now becoming an important part of an organisation's strategy in order to meet their product portfolio demands and retain their competitiveness within the industry. The research has identified that a lack of engineering capacity within the three segments was a key driver for these organisations to outsource/offshore their PDD activities enabling these organisations to obtain the necessary engineering resources required to meet their product portfolio demand. There is a gap in the literature on PDD within the automotive industry and this finding when contrasted with ITO provides a different perspective.

Outsourcing and offshoring in the automotive industry in particular the body engineering element of the PDD has a longer development cycle plan (average time to design a vehicle is 24-30 months) compared to IT (average time for software development 6-12 months) and the two activities require a different level of skill set and capability. PDD is classified as a complex engineering activity and a black art (Brown and Eisenhardt 1995, Elfring and Baven 1994, Tripathy and Eppinger 2011) whereas IT activities require a lower level of sophistication and skill level (Quinn 1999) and both are unique to their industries'.

8.6.1. Differences within PDD and ITO

Outsourcing of PDD is relatively new in particular within the automotive industry across the three segments and is an area which is under-researched (Burdon and Bhalla 2005). These organisations are increasing the level of sophistication and are advancing their outsourcing activities but the literature is slow in researching and providing practitioners cutting edge solutions (Contractor *et al.* 2011). This research draws additional comparisons on how the experience between PDD and ITO are expressed between the two literature streams and therefore contrasts are outlined in this research study.

The role of an engineer within the PDD sector requires a significant amount of technical knowledge/capability and a unique skill set as compared to an engineer based in the IT sector.

PDD is the activity of finding robust solutions to technical problems through the application of learnt knowledge, engineering experience and simultaneously ensuring that current conditions and constraints are taken into account (Pahl and Beitz 1996). Outsourcing of engineering design services still causes concerns with quality of work and sending these services offshore creates another of complexity for organisations to manage (Zirpoli and Becker 2011). If these activities are outsourced or offshored in the automotive industry they still require a team effort to work jointly on outsourcing solutions where for instance an OEM outsourcing PDD activities will contribute and share knowledge with their partners and the integration of components and modules are different between OEMs and product models (Fujimoto and Clark 1991, Veloso and Fixson 2001).

This disconnect is down to the absence of standardisation within the automotive industry and still remains an area of opportunity. In the ITO industry, the work packets outsourced or offshored can predominately be isolated from the mainstream activities and are completed in isolation.

These activities require repetitive iterations and constant changes during the development cycle but are heavily reliant on people and are isolated until other process are completed (Kaganer *et al.* 2013). This way of working excludes simulations engineering, regular communication on updates, and knowledge of design changes. If this approach is used within PDD it will impact the organisation significantly and delay time to market, increase the risk of losing competiveness and require further costs (Fujimoto and Clark 1991).

The automotive organisations based in all three segments outsourced their PDD activities due to the limited engineering capacity available internally. The drivers when the automotive organisations outsourced or offshored is identified in Figure 4.25. In automotive PDD people are an important ingredient used to carry out product development/engineering activities and these activities are extremely resource dependent. The outsourcing goal from the automotive organisations interviewed across the three segments was to obtain further resources to ensure the project demand or product portfolio was fulfilled. The automotive organisations, in particular the OEMs and FTSs, did not base their decisions on the number of engineering resources required for a certain activity/project but decisions to develop next generation models had been based on market opportunities identified.

The IT industry's main driver when outsourcing or offshoring is predominantly cost reduction (Lacity *et al.* 1994, Lacity *et al.* 2009) also see section 2.9.1 and 2.9.2. The larger IT outsourcing contracts awarded were organisations in financial trouble or either facing difficulties in maintaining cost structures, poor performance, reduced profits or lower earnings (Loh and Venkatraman 1992, Mojsilović *et al.* 2007, Strassmann 2004). This research study in the automotive industry identified different drivers to the IT industry and can be explained by the type of products, activities and services involved within the two industries. The PDD cost drivers when outsourcing or offshoring are distinctive as the research has identified costs become an overriding factor than engineering capacity but were used simultaneously as a driver factor.

The automotive industry has experienced a significant change historically when outsourcing and offshoring the PDD activities within the three automotive segments. Over two decades ago automotive vehicles had been developed on minimum platform sharing and carryover of components across different models was rarely implemented. However, due to economies of scale, efforts to maximise resources, enriching PDD activities and reducing development costs, automotive organisations are migrating to common vehicle platforms with the integration of a modular approach which in actual practice is more difficult to execute and implement than present literature suggests (Persson and Åhlström 2006).

This creates an advantage for OEM organisations that outsource their PDD activities as a modular approach allows tasks to be distributed to external organisations (Ethiraj and Levinthal 2004) and design strategies along with lessons learnt are transitioned into new PDD activities. The IT industries' product development differs to the automotive sector as product design cycles are significantly shorter. The PDD cycle time is a competitive advantage for organisations (Cooper and Kleinschmidt, 1994) and this research has identified when automotive organisations outsourced, offshore outsourced or offshored there was no tangible benefit with cycle time improvements other than to meet their goal with delivering new products and retaining their competitive positions.

The core activities of automotive organisations are still retained within the fixed boundaries and this research has identified that organisations are outsourcing their PDD near core activities which are extremely close to the organisation's core activities. The near-core activities contain a high level of technical knowledge, complexity and know-how and ultimately contribute to the corporate revenue; see section 2.13.1.2. The organisations that outsourced near core activities required ESPs to have an engineering technical centre within a short proximity from their customers otherwise securing contracts was extremely difficult.

The IT industry is heavily involved with offshoring their activities to lower cost countries and therefore having a front office located within a short proximity from the customers has not been a mandatory request. The IT industry has changed their approach in the way outsourcing and offshoring is conducted (Kedia and Mukherjee 2009). Organisations in the IT sector are maturing with their work streams and the level of responsibility required when outsourcing and offshoring is increasing.
IT organisations are becoming more aware and are developing a mirrored model similar to the automotive PDD where local offices are situated near their customer's in-order to secure high responsibility work.

The research discovered that automotive organisations experienced additional challenges with culture, management, retaining staff, when offshoring or offshore outsourcing and similar findings were also identified in a study conducted by Rottman and Lacity (2012) in the IT sector. These authors noted that outsourcing was better aligned than offshore outsourcing and using an OWOS. The complexity involved with either offshore outsourcing or offshoring through the use of a wholly owned subsidiary can be explained by the different cultures and languages that are used across international countries. This has also been identified in IT outsourcing and these elements are also applicable to PDD in the automotive industry.

However, conversations become problematic when discussing technical component design and complex problem solving engineering tasks. Further, in a Harvard Business Review article by Amaral and Parker (2008) and work of Mokhoff and Wallace (2005) who highlighted that design outsourcing projects are frequently late, over budget and the requirements initially set out are not fully met.

The complexity of PDD within the automotive industry can explain why organisations failed to meet their objectives before executing outsourcing or offshoring or development of their OWOS. The literature on ITO does not drill in depth to understand the key determinants required when outsourcing/offshore in the automotive industry. This can also explain when automotive organisations adopt an ITO approach the journey becomes complex and the management are not completely equipped to resolve these complexities. The complexities also result in additional time and disruption within the organisation.

Further, the research has identified the ITO literature must be used with cautious within the automotive industry and across the three automotive segments.

8.7. Contributions from this thesis

This section provides an in-depth conclusion and identifies the contributions from the research study. There are two key contributions from this thesis: contribution to theory and contribution to practice both discussed in-depth.

8.7.1. Contribution to theory

This research has studied in-depth the phenomenon of outsourcing, offshore outsourcing and offshoring of PDD activities within the automotive industry spanning across the three segments OEMs, ESPs, and FTSs.

The research area has become increasingly popular as automotive organisations are under more pressure than before to reduce costs with simultaneous growth in expanding the product variety and creating different ways in making decisions; the most common "make vs buy". To survive with the increase demand the automotive organisations are outsourcing/offshoring the PDD activities.

The management practices within the research area are still evolving with ad hoc decisions causing these organisations to experience new and unusual challenges and the management teams struggled to provide the right solutions including decision-making.

This study has used an inductive exploratory approach to develop theory from an empirical perspective where data was collected through 99 independent semi-structured interviews and six in-depth case studies that were developed to further understand outsourcing, offshore outsourcing and offshoring PDD phenomenon.

Research in outsourcing and offshoring of high-value activities involving PDD within the automotive industry is still at an embryonic stage. At present there is little research coordinated within outsourcing, offshore outsourcing and offshoring of PDD within the automotive industry and therefore this study advances our knowledge in this field through the development of a strategic decision-making model and associated process. This model can be used as a tool for organisations when making key decisions regarding PDD.

Research scholars within the management discipline for instance Eisenhardt (1989), Easterby-Smith *et al*. (2012) define when building theory the research subject should provide novel insights to the specific phenomena under investigation. This study has provided novel insights to the specific phenomenon on outsourcing, offshore outsourcing and offshoring within the automotive industry. The findings provide new insights on a series of topics such as the drivers and challenges when automotive organisations based in the three segments conducted; outsourcing, offshore outsourcing and offshoring. Additionally, six in-depth case studies were used to further understand and explore the phenomenon in detail along with solutions these organisations implemented.

This study makes the following significant theoretical contributions: The proposed strategic decision-making model for the automotive industry across all three segments is one aspect of novelty for this study. The decision making model is shown in Figure 8.1 and further discussed in Chapter 7.

The proposed strategic decision-making model has been titled *"A strategic decision-making model for outsourcing / offshoring outsourcing or offshoring of PDD within the automotive industry (OEMs, ESPs & FTSs)"*.

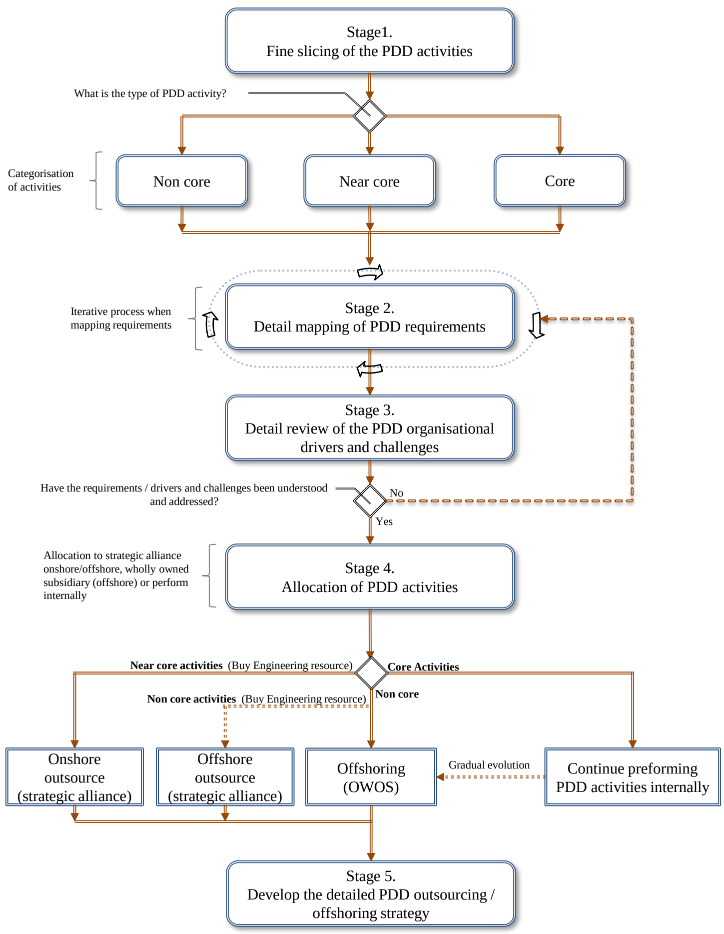


Figure 8.1. Proposed strategic, decision-making model for outsourcing, offshore outsourcing and offshoring of PDD within the automotive industry.

The model addresses the challenges automotive organisations experience on an operational and strategic level to ensure both short-term and long-term perspectives are accounted for. The proposed model is applicable to organisations considering outsourcing, offshore outsourcing or offshoring their PDD activities and can be used at any stage. The model has been developed to incorporate flexibility, allowing adjustment to an organisation's maturity in this area.

The question that many organisations are still asking is: *"Do we outsource, offshore outsource or offshore the PDD activities?"* The research has identified cost reduction and increasing internal engineering capacity/resources as the two key drivers across all three segments and these decisions cannot be made using an ad hoc strategy. The organisations that made ad hoc decisions and ignored key stakeholders failed to achieve their cost reduction and objectives, whereas other organisations developing a long-term strategy also did not meet their objectives. This was down to these organisations not having sufficient depth surrounding which activities are non core, near core and core. The organisations had unclear decision-making processes to justify their decisions and management were unaware on the outcome of these decisions.

Therefore, when an organisation is considering to outsource, offshore outsource or offshore their PDD activities, a strategic decision-making model is required to ensure the full cost benefit is achieved and a clear classification of the PDD activities is conducted. This enables these organisations to either continue performing core activities internally within their headquarters; develop a wholly owned subsidiary where none core activities are offshored; engage with a strategic alliance based offshore also for core activities or engagement with strategic alliances based on shore where near core activities are outsourced.

This study has addressed the research aim of developing a strategic decision-making model to support management decisions, research objectives and the research question which are outlined in Chapter 8 and addressed the gap which was identified in Chapter 2 (literature review).

8.7.2. Contribution to practice

Outsourcing, offshore outsourcing and offshoring has become one of the most discussed strategies within many organisations for several reasons, such as cost reduction; increasing engineering resources; developing flexibility and developing competitiveness.

This study has contributed to practice through the development of a decision-making model to support management in making key decisions when outsourcing, offshore outsourcing and offshoring of PDD within the automotive industry.

Firstly, the current state model was developed from the findings that highlighted a clear lack of strategy and strategic thinking when organisations were outsourcing, offshore outsourcing and offshoring their PDD activities. This can explain the reason why OEMs, ESPs and FTSs experienced difficult challenges and failed to meet their objectives. Therefore, management are required to focus not only on the cost element but also the wider organisation regarding the PDD activities.

Secondly, the proposed model provides a five-stage strategic, decision-making process to ensure activities at stage one are fine sliced and classified correctly before the strategy in stage five is developed. The advantage of the strategic decision model is that each stage has supplementary data which provides additional support when organisations are working through each stage. Examples of activities, such as core, near core and non core are also provided as a guideline to support the decision-making process at each stage.

Thirdly, the strategic decision-making model is of high relevance to managers and executives as the study provides key insights for organisations; in particular people who are decision-makers in the area of outsourcing, offshore outsourcing and offshoring of PDD within the automotive industry which in an area of aggressive growth and information is difficult to obtain.

Fourthly, the research provides current or new organisations with practical guidance which has been explained in-depth in Chapter 7 when making key decisions to outsource, offshore outsource or offshore their PDD activities.

8.7.2.1. Managerial implications

This study on outsourcing, offshore outsourcing and offshoring of PDD activities is a new phenomenon and unexplored within the automotive industry across the three segments. The study identified that strategic decisions were made once the organisations failed to meet their objectives. This created a gap between the decision-making process and how outsourcing, offshore outsourcing and offshoring of the PDD activities was conducted within OEMs, ESPs and FTSs.

The study has significant managerial implications which are discussed below:

8.7.2.2. Drivers and challenges

The drivers analysed over the three organisational segments were different across outsourcing, offshore outsourcing and offshoring which cannot be used interchangeably. For instance OEMs had different drivers compared to ESPs and FTSs and were not applicable across outsourcing or offshoring both having different complexities. As noted in the Chapter 4 and Chapter 5 across the three organisation segments when outsourcing engineering capacity/resources was the key driver followed by reducing costs from the organisation when offshore outsourcing or offshoring the PDD activities. The management teams within the organisations assumed that benefiting from a lower employee cost (in region of 20 per cent to 30 per cent) and offshoring or offshoring outsourcing the PDD activities would enable instant cost savings. However, this was not the case and caused additional challenges and had significant impactions with loss of time to market and extra costs being associated with the projects.

The challenges experienced by these organisations had not been identified or thought off and during their outsourcing and offshoring journey the organisations were unable to provide sufficient solutions to completely resolve the challenges.

8.7.2.3. Cost reduction

Offshore outsourcing was underpinned by cost reduction within the organisations and predominantly used as an experiment by all three segments. For instance these organisations were reluctant to build their OWOS due to the risks of entering a country without understanding how it operates. The management teams were unclear on how to classify PDD activities into non core, near core and core. The core PDD activities were backsourced from outsourcing organisations, external service providers (offshore outsourcing) and offshoring organisations that were wholly owned. These organisations could not perform such high level activities due to the level of skill and competence required.

The implications of this resulted in 13 offshore outsourcing contracts being terminated with core activities being offshored to external organisations which developed a risk to these organisations as internal knowledge was known externally and was unique to the organisation in particular the brand definition and competiveness.

8.7.2.4. Tacit knowledge

Tacit knowledge was an issue in almost all of the organisations and was admitted by the management teams as they did not declare all information to the external organisations when using OWOS. This knowledge was mostly embedded within the employees who were located in these organisations and the drivers behind outsourcing, offshore outsourcing and offshoring had become ingresses within the organisations. The management failed to understand how and what type of knowledge was required for an external organisation.

8.7.2.5. Management knowledge

In general across the three automotive segments the management within these organisations lacked the knowledge on working with external organisations. For instance onshore service providers had a key stake of organisations near core activities than the FTSs which required management to develop different strategies which was lacking in all organisations.

Automotive organisations considering outsourcing, offshore outsourcing or offshoring their PDD activities to external organisations or developing their OWOS are required to rethink their current strategies and organisational models.
The management team are required to understand the differences between outsourcing, offshore outsourcing and offshoring as there was confusion within these organisations. The management within the automotive organisations were unaware on the type of interaction required for each PDD activity and the implications of not understanding fully created additional challenges for these organisations.

8.7.2.6. Strategic decision making

The outsourcing or offshoring drivers based on cost reduction are only applicable when strategic decisions are made within the organisation. The study has clearly shown the failures were with the management unable to identify a strategic plan and sufficiently coordinate themselves with external organisations that were responsible for their PDD activities. However, organisations are required to understand that a strategy is necessary to achieve the maximum cost benefit when applying the strategic decision making model.

8.7.2.7. Short term strategies

Short-term strategies on achieving cost reductions did not provide the expected cost savings. To ensure short term solutions provide cost and resource value, the strategic decision-making model has been develop to ensure these organisations achieve their objectives when outsourcing, offshore outsourcing or offshoring the PDD activities in this complex area.

8.7.2.8. Involvement of key stakeholders

It is advised that key stakeholders (purchasing, manufacturing, engineering, logistics, program teams and departments who have contact with external organisations) are educated on why the organisation is required to outsource or offshore their PDD activities.

8.7.2.9. Implementation of model

As the researcher is working in the field of outsourcing and offshoring of PDD within the automotive industry, the model within the next few months is going to be implemented.

The researcher is starting from stage one to understand the current state of the organisations PDD activities. This stage will highlight the strengths and weakness on how the organisation has classified their current PDD activities and what fine slicing methods were used for the PDD activities.

Early indications have highlighted that the model is providing a different thinking strategy within the organisation as dispersing PDD activities requires a new way of working.

The model will also be piloted in two other organisations where it will be used at various stages due to their outsourcing and offshoring maturity.

8.8. Limitations

Despite the novel contributions this study makes to the body of knowledge within outsourcing, offshore outsourcing and offshoring in the automotive industry, the researcher is also aware of the limitations. There are three limitations as outlined:

1. The study is limited to the automotive sector across all three segments and further generalisability of the results in other fields and low-cost countries should be done with caution.
2. The study is based on an inductive approach with the use of in-depth case studies, which provides a sound basis for further development of qualitative studies as it allows the variables to be related to a specific phenomenon (Miles and Huberman 1994) or making use of quantitative methods in different ways (Eisenhardt 1989, Yin 1994a).
3. The coding of data was based on the analysis from the interviews which was conducted at a particular point in time. After the interviewing process participants learned more on outsourcing, offshore outsourcing and offshoring.

Given these limitations which are outlined for this study, the aim of the study also increases our knowledge on this significant, yet inadequately researched area on outsourcing, offshore outsourcing and offshoring of PDD activities within the automotive industry.

8.8.1. Suggestions for future research

The theoretical aim of this study was theory building and development (Eisenhadrt 1989; Yin 1991) so propositions for further research are identified in this section.

Research into outsourcing, offshore outsourcing and offshoring of PDD is still in the primary stage and influenced by theories brought from other academic disciplines such as; International Business Studies; Supply Chain Management and Strategic Management. This study has provided an in-depth analysis on outsourcing, offshore outsourcing and offshoring of PDD within the automotive industry across three sectors (OEMs, ESPs and FTSs).

The researcher has the opportunity to take this study further and recruit additional research scholars who could look at the future research suggestions and these suggestions can be incorporated within the organisation and into the strategic decision-making model.

During the research journey interesting future suggestions have been documented which would further enhance the study findings.

Firstly, this study is grounded to the automotive industry in particular OEMs, ESPs and FTSs and is a known limitation as explained in section 1.6.3.

To further the study it would add value to investigate other non-automotive sectors such as heavy goods, commercial vehicles and the aerospace sector. It would be a worthwhile endeavour to apply the strategic, decision-making model which includes the five-stage approach to various industries as stated to discover the behaviour of the model and if necessary what additional adaptations would be required to make this work. In particular, stage one of the model which fine slices the PDD activities into three areas non core, near core and core would be applicable for all industries but this would need further investigation.

Secondly, the model is grounded to outsourcing, offshore outsourcing and offshoring of PDD activities and would benefit from researching nearshoring to understand how the different organisations will use the model and the methods they would employ at each stage.

Thirdly, the research used an inductive exploratory approach to develop theory building with the use of case studies. The research could be complemented by using a deductive approach with independent and dependent variables leading to statistical generalisation where the two data sets can be compared and then generalised (Yin 2009).

Fourthly, the research discovered within the automotive industry that outsourcing was primarily conducted due to engineering capacity constraints, offshoring outsourcing was used as an experiment and to reduce costs, and offshoring was used as an extended workbench also at reduced costs. One suggestion would be to research the drivers in other industry sectors when outsourcing, offshore outsourcing or offshoring the PDD to correlate the findings and understand the behaviour of the strategic, decision-making model and whether it would require adaptation for other industry sectors.

Finally, the research identified backsourcing of PDD activities which occurred within the industry and was down to the activities being classified incorrectly which were either outsourced or offshored. However, the outsourcing process was kept within the organisation's boundaries and not disclosed to third parties or the wider public. The research was fortunate to access the data where backsourcing existed and future research would provide fruitful results to understand and develop a backsourcing process which could be incorporated into a stand-alone model when automotive organisations backsource.

8.9. Reflections

This section will present the research reflections regarding the research findings and the strategic, decision-making model for outsourcing, offshore outsourcing and offshoring of PDD within the automotive industry across three segments.

8.9.1. Researchers role

In qualitative research the role of the researcher is important in order to keep neutrality to the research topic which was a continuous learning cycle and can be described using the knowledge management life-cycle.

The continuous process of learning knowledge through this research can be explained using Dalkir (2013) knowledge cycle consisting of three stages:

1. Knowledge creation and capturing.
2. Knowledge sharing and dissemination.
3. Knowledge acquisition and knowledge application.

I would like to take the opportunity to mention the researcher's involvement with outsourcing and offshoring. Firstly, the researcher was involved with outsourcing and offshoring with a large OEM and ESP involving outsourcing and offshoring the PDD activities. Communication with the offshore design centre was on a daily basis to discuss PDD where learning from live experiences helped the researcher to engineer the model and during the focus group workshops the challenges that were experienced by the researcher had been identified in other organisations. During the journey on the large outsourcing and offshoring project the researcher also managed FTSs who had OWOS which was visited during the PDD phase. The learning and experience captured through the journey enabled the researcher to gain first-hand experience which enabled a clear understanding of outsourcing and offshoring from the three industrial perspectives.

Secondly, the researcher's understanding was further improved through reading seminal work in this field such as Willcocks *et al.*(2011), Brown and Eisenhardt (1995), Contractor *et al.* (2011), Eppinger and Chitkara (2009) and many others.

Thirdly, academic conference papers were written and presented at conferences relating to the research topic with feedback sessions to further enhance the study. During these conferences the researcher had the opportunity to engage with recognised scholars in the area of outsourcing and offshoring.

Finally, the informal and formal interactions underpinned and built my mental paradigms on outsourcing and offshoring of PDD and supported the researcher through the journey.

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Appendix 1

Interview Guide OEMs

Company: Time: Date: Present:

Interview guide (OEMs)

Generic approach (background into company, deal size, employees)

1. What are your business verticals?

2. What vertical has been identified for outsourcing/offshoring?

3. How are the engineering functions outsourced? Have they been outsourced or offshored, was there any particular reason for taking such approach?
   a. Was the engineering functions first outsourced or offshored? How did you go on about deciding this?

4. Does the business have a wholly owned subsidiary or uses a third party supplier?
   a. Where in the world is this subsidiary or third party located? Why was this destination chosen?
   b. How many people are working at this centre (approx. +/-.)?
   c. What has been the investment for your subsidiary?
   d. How many years will it take to recover your investments from the subsidiary? (e.g. 2, 3, 4?)
   e. What are different types of jobs performed from the subsidiary (Engineering only or IT support also)?
   f. Does the centre cover full business hours to provide support?
   g. How long has this subsidiary/third party been developed?
   h. What has driven you down a subsidiary route, costs, resources, etc.?
      i. What has driven you down a third party route?
   i. Who manages the OWOS? e.g. parent organisation or local management?
      i. Who manages the third party? Local expats position within the outsourcing organisation?
5. What are the sizes of outsourced/offshore projects?

6. In a typical year how many new products do you launch and how many do you refresh/facelift?

Strategic approach (cost, capacity, emerging markets, and local design support)

1. What stage/function of your product development process are outsourced? (are these complete body engineering product development designs or low responsibility support activities).
2. Has the business ever executed outsourcing/offshoring with a subsidiary or third party?
    a. What was outsourced? Complete body engineering? Low responsibility design, etc.?
    b. Was it successful?
    c. What criteria was success measured against? Do you see this measuring criteria changing in the near future say around 3-5 years' time? If not why?
    d. Explain what were the success factors (capacity, increased flexibility, etc.)?
    e. Were all the milestones met if not what was lacking?
        i. What went wrong? How was this changed? How did you ensure this was not repeated on future projects?
    f. How would you do it better if given the opportunity to redo?

3. Why did you offshore or outsource?
    a. What were the drivers involved (e.g. could be cost, capacity, core competencies, in-house knowledge, downsizing of business, etc.)?
    b. When developing the business proposition did you take into account any environmental variables?
    c. If you are not already outsourcing or offshoring, are you looking to outsource/offshore in the future? If so has the decision changed?
    d. What percentage of your total engineering work is outsourced/offshore?
    e. What is the work ratio of onshore vs offshore? (For example in a typical project that has been outsourced/offshore)?
        i. How do you think this ratio will move going forward? (Will there be more work offshore or onshore)?
    f. At what stage will you stop offshoring or outsourcing the product development and design?
        i. How would you decide this?
        ii. What would be the drivers involved?

4. Is there any methodology that you use when deciding to outsource or offshore engineering projects?
    a. Have you always used this, if not what has happened overtime for you to change? (Competition direction, etc.).
    b. When deciding on outsourcing or offshoring does the business involve other stakeholders. If so how and who are these people? (In-house, brought services, auditors, consultants, university)?

5. How are decisions made in terms of new work to be sent offshore to the subsidiary or third party?
    a. Who decides this? Parent or corporate organisation?

   b. Does the subsidiary/third party do work for other customers? How is data protected?

6. Are your business plans aligned with outsourcing/offshoring as a corporate strategy or are they operational?
   a. Who makes the outsourcing/offshoring decisions? For a subsidiary does each parent have its own entity or are decisions made from headquarters?
   b. Are these strategic or cost driven?
   c. Who within the business finally decides if outsourcing is to go ahead once all decisions have been made?

7. Do you see a short or long term future plan in offshoring or outsourcing of product development and design?
   a. What are the business plans for the future (3-5 years) on outsourcing and offshoring of product development and design (more work, reduce work, maintain the level, etc.)?
   b. Are there any plans to outsource or offshore high value work than product development and design? This could include more of an engineer's role?
      i. Have these plans changed overtime and why?

8. What has been the cost saving (approx. figure +/- level)?
   a. If this project was not outsourced or offshored how much extra would this cost the business? (approx.)
      i. Or related to capacity, capability, etc.?

9. Do you have an understanding on what your competitors are doing?
   a. Who are your competitors?
   b. What benefits are they gaining from outsourcing/offshoring?
   c. What problems are they experiencing?
   d. Have they changed their approach over time and why?

10. In your opinion has there been a change in pattern of vehicle outsourcing or offshoring?
    a. In the future what do you think the trend will be?
    b. Going forward, do you think the OEM will outsource 100% vehicle program or is more likely to unbundle it and then outsource/offshore at a subsystem, system or component level?

11. How do you know that your outsourcing/offshoring strategy is still competitive?
    a. How often do you revisit the outsourcing/offshoring contract (weekly, monthly, quarterly, or never) to ensure the planed targets are met?

Operational approach (day to day running, problems encountered, experiences)

1. Identify some positive outcomes that have taken place with outsourcing and offshoring?

2. Identify some negative outcomes that have taken place with outsourcing and offshoring?

3. Are you facing any challenges with communications between onshore and offshore teams? Give some examples, has it got better or worse, what were the problems, what are the implications and how have they been resolved?

4. What are the key daily challenges you are facing with outsourcing and offshoring?

5. Have you witnessed any tangible benefits with offshoring or outsourcing?
    a. Product design cycle reduced?
    b. Time zone differences?

6. How do you manage the offshore centre?
    a. How do you control the work load?
    b. What happens to the employees when the work content falls?
    c. How do you submit work to the subsidiary/third party? Is the work submitted via email, work request documentation, etc.?
    d. Does the offshore centre depend on HQ for working capital requirement?
    e. What is your commercial model with the subsidiary centre? Is the cost charged backed?
    f. Do they charge back their cost to you or charge you for the effort with a notional profit?

7. How do you manage the third party?
    a. Are there a local team supporting?
    b. How do you submit work to the subsidiary/third party? Is the work submitted via email, work request documentation, etc.?
    c. Does the third party depend on HQ for working capital requirement?
    d. What is your commercial model with the third centre? Is the cost charged backed or done on a project basis?

8. How are resources in the subsidiary centre/third party acquired (expatriates from parent company, local recruitment, university schemes, reliant on service providers)?

9. How do you measure the success of your outsourcing program?
    a. What measure is used? Has the measuring criteria changed overtime? If so why, etc.?
    b. Has the original RFQ/RASIC changed since outsourcing/offshoring?
        i. What has contributed to the change?
        ii. Has this resulted in additional spend on the project?

10. Is there more control required when outsourcing or offshoring engineering design? If so why? What has changed?

11. Is there anything different you would do in the future? How could you improve? How has it changed over a time?

12. Do you measure the productivity of outsourcing/offshoring? What measures do you use?

Core competence & knowledge (what has been gained from the offshoring process)

1. How did you identify and classify that there was sufficient domain knowledge within the outsourcing / offshoring proposition?

2. How do you ensure knowledge transfer to the subsidiary or third party?

3. How long has it taken for the subsidiary/third party to develop such capabilities to OEM standards?

4. Are there any risks of knowledge learnt by a third party to be used against you? (e.g. if they become the outsourcing partner, the 'inside core' can become dissolved)

5. How is the knowledge retained within the business?
    a. Are there any knowledge management systems in place?
    b. How do employees retain the learnt knowledge?

Appendix 2

Interview Guide ESPs and FTSs

Company:
Time:
Date:
Present:

Interview guide (Engineering Service Provider & First Tier Supplier)

Generic approach (background into company, outsourcing, employees, deal size)

1. Who is your customer, can you give a breakdown on financial spend?

2. How was the contract awarded from the OEM to service provider/first tier supplier? (What convinced the customer to buy services from you?) Was there much competition involved or was this based on previous experience or outsourcing agreements?

3. How many projects are involved with outsourcing & offshoring?
    a. What are the offshore project sizes in terms of resource, finance and time span?
    b. Are you outsourcing the engineering design function?
    c. Was the engineering function first outsourced or offshored and was there any particular reason for doing this? Have the decisions changed overtime?

4. Does the business have a subsidiary? or does it use a third party supplier?
    a. Where is this subsidiary or third party geographically located? Why was this destination chosen?
    b. How many people are working at this centre (approx.)?
    c. What has been the investment for your subsidiary?
    d. How long has this subsidiary/third party been established?
    e. What has driven you down a subsidiary route (e.g., costs, resources, etc.)?
        i. What has driven you down a third party route?
    f. How many years will it take to recover your investments from the subsidiary? (e.g. 2, 3, 4 years? Has this been considered)
    g. What are different types of jobs performed from the subsidiary (Engineering only or IT support also)? Also ask about trend data.
    h. Does the centre cover full business hours to provide support?
    i. Who manages the subsidiary? E.g. parent organisation or local management?

Strategic approach (cost, capacity, emerging markets, and local design support)

1. What stage of the product development process has been outsourced/offshored to subsidiary/third party?
    a. Does the OEM get involved in what can/cannot be outsourced/offshored?
    b. What has been the driver for the OEM to outsource this work to an engineering service provider?

2. Do you have an understanding on what your competitors are doing?
    a. Who are your competitors?
    b. What benefits are they gaining from this process?
    c. What problems are they experiencing?
    d. Have they changed their approach over time and why?

3. Has the business ever executed outsourcing/offshoring?
    a. If so, was it successful, if not what targets were missing?
    b. What criteria was success measured against? Do you see this measuring criteria changing in the near future say around 3-5 years' time?
    c. Explain what were the success factors (capacity, increased flexibility, etc.)?
    d. What went did not go to plan? How was this changed?
    e. How would you do it better if given the opportunity to redo?

4. Why did you offshore or outsource?
    a. What were the drivers involved (e.g. could be cost, capacity, core competencies, in-house knowledge, downsizing of business, etc.)?
    b. Why have you decided to outsource/offshore?
    c. When developing the business proposition did you take into account any environmental variables that could affect the strategy?
    d. If you are not already outsourcing or offshoring, are you looking to outsource/offshore in the future? If so has the decision changed?
    e. What percentage of your total engineering work is outsourced/offshore?
    f. What is the work ratio of onshore vs offshore? (For example in a typical project that has been outsourced/offshore)?
    g. At what stage will you stop offshoring or outsourcing the product development and design?

5. Is there any methodology that you use when deciding to outsource or offshore the product design and development?
    a. Have you always used this, if not what has happened overtime for you to change? (Competition direction, etc.)
    b. When deciding on outsourcing or offshoring does the business involve other stakeholders. If so how and who are these people? (In-house, brought services, auditors, consultants, university)?

6. How are decisions made on new projects if they remain onshore or offshore and if they are sent to either subsidiary or third party?
    a. Who decides this? Parent or corporate organisation?
    b. Does the subsidiary/third party do work for other customers? How is data protected?

7. Are the business plans aligned with outsourcing/offshoring as a corporate strategy or focused operationally (reduce cost)?
    a. For a subsidiary does each parent have its own entity or are decisions made from headquarters?
    b. Are these strategic or cost driven?
    c. Survive or compete?

8. Do you see offshoring or outsourcing as a short or long term future plan in product development and design?
    a. What are the business plans for the future on outsourcing and offshoring this work?
    b. Are there any plans to outsource or offshore high value work such as other than product development and design?
    c. Have these plans changed overtime and why?

9. What has been the cost saving (approx. figure +/- level)?
    a. If this project was not outsourced or offshored how much extra would this cost the business? (approx.)

10. How often do you revisit the outsourcing contract (weekly, monthly, and quarterly)?
    a. How do you know the outsourcing strategy provides the objectives outlined in the business plan?

Operational approach (day to day running, problems encountered, experiences)

1. Identify some positive outcomes that have taken place with outsourcing and offshoring?

2. Identify some negative outcomes that have taken place with outsourcing and offshoring?

3. Are you facing any challenges with communications between onshore and offshore teams? Give some examples, has it got better or worse, what were the problems, what are the implications and how have they been resolved?

4. What are the key daily challenges you are facing with outsourcing and offshoring? Have these improved overtime if not explain further.

5. Have you witnessed any tangible benefits with offshoring or outsourcing?
   a. Product design cycle reduced?
   b. Time zone differences?

6. Do the OEM/subsidiary/first tier supplier communicate directly with the subsidiary /third party? (governance structure)

7. How do you manage the offshore centre?
   a. How do you control the work load?
   b. What happens to the employees when the work content falls?
   c. How do you submit work to the subsidiary/third party? Is the work submitted via email, work request documentation, etc.?
   d. Does the offshore centre depend on HQ for working capital requirement?
   e. What is your commercial model with the subsidiary centre? Is the cost charged backed?
   f. Do they charge back their cost to you or charge you for the effort with a notional profit?

8. What are the feedback mechanisms from parent to subsidiary centre?

9. How are resources in the subsidiary centre acquired (expatriates from parent company, local recruitment, university schemes, reliant on service providers)?

10. How do you measure the success of your outsourcing program?
    a. What measure is used? Has the measuring criteria changed overtime? If so why, etc.?
    b. Has the outsourcing program changed overtime? (Work not fully understood, customer changing milestones, under estimated)? What has been put in place to facilitate these changes?
11. Is there more control required when outsourcing or offshoring engineering design? If so why? What has changed?
12. Is there anything different you would do in the future? How could you improve?
13. Do you measure the productivity of outsourcing/offshoring? What measures do you use?

Appendix 3

Interview guide managers (Operational)

1. How often do you liaise with offshore teams?

2. What are your biggest challenges with offshoring/outsourcing? How are they overcome?

3. Has your work load increased, reduced or still the same with offshoring/outsourcing? If so what are the implications if increased workloads?

4. Have you experienced any communication issues? If yes explain further and how was it resolved?

5. What is the quality of work from offshore locations compared to onshore and has this improved overtime?
    a. Is there any rework required?
        i. How is this error minimised or eliminated to stop reoccurrence?

6. Have you identified any resistance with your clients (OEMS' service providers) on obtaining information?
    a. If so, what happened? How was this resolved?

7. How do you think offshoring/outsourcing can be improved?
    a. What would you do differently?

Interview guide engineers (Operational) (How does outsourcing and offshoring communicate on an operational level).

1. How often do you liaise with offshore teams?

2. How much time does it take to explain what is required from the offshore teams?
    a. What method of communication is used?
    b. Is the work reviewed before it's sent back?
    c. Does this add extra time? If yes has it improved over the last few months?

3. What are your biggest challenges with offshoring/outsourcing? How are they overcome?

4. Have you experienced any communication issues? Give some examples, has it got better or worse, what were the problems, how were they resolved? What are the implications?
5. Do you think having a difference in time zone helps with product development and design?
    a. Does this work successfully? Please explain further?
6. What information is difficult to share with the offshore team?
    a. What are the reasons for this?

7. How do you think offshoring/outsourcing can be improved?
    a. Has it matured overtime or requires a few more years to fully mature?
    b. What would you do differently?

<u>Core competence & knowledge</u> (domain knowledge, what has been gained from the offshoring process, knowledge learnt, used)

1. How did you identify and classify that there was sufficient domain knowledge within the outsourcing/offshoring proposition?

2. Has the OEM, service provider, first tier supplier been capable of cascading the relevant knowledge?

    a. Have you followed there process in design? (Bill of design, dfmea's etc.).

    b. Can the learnt knowledge be used for other clients? Surely reinventing the wheel is not the most efficient method? If so explain this.

3. Would you consider that the learnt knowledge can be used as competitive advantage?

    a. Would this help the company's core competences?

4. How is the knowledge retained within the business?

    a. Are there any knowledge management systems in place?

Appendix 4

Informed Consent Form
Version 1.4 Dated: 09.10.2012

Project Title: Developing a strategic decision making model for outsourcing and offshoring product design and development within the automotive industry
Brief project summary: The research objective is aimed at developing an outsourcing strategic model that can further our knowledge and contribute to the existing body of literature on outsourcing and offshoring of product design and development.

Please initial

1. I confirm that I have read and understood the Information Leaflet For Participant (v2.0) for the above study and have had the opportunity to ask questions.

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving a reason.

3. I understand that all the information I provide will be treated in confidence.

4. I understand that I also have the right to change my mind about participating in the study for a short period after the study has concluded (insert deadline here).

5. I agree to be filmed/recorded (delete as appropriate) and for anonymised quotes to be used as part of the research project.

6. I agree to take part in the research project.

Name of participant: ...…………………………………………………………

Signature of participant: ……………………….……………………………

Date: ………………………. ………………………………………….....…..

Witnessed by (if appropriate): …………………...………………………….

Name of witness: ...………………………………………………………….

Signature of witness: ………………………………………………………..

Name of Researcher: ………………………………………………………..

Signature of researcher: ……………………………………………………..

Date: ………………………………………………………………………...

Signature of witness: ………………………………………………………..

Appendix 5

Information Leaflet for Participants

Project title

Developing a strategic decision making model for outsourcing and offshoring product design and development within the automotive industry

What is the purpose of the study?

The research objective is aimed at developing an outsourcing strategic model that can further our knowledge and contribute to the existing body of literature on outsourcing and offshoring of product design and development. The research will develop new ideas and thinking when organisations consider dispersing their in-house activities to external partners through collecting empirical data from the field and developing a strategic model.

Why have I been approached?

The researcher has selected three key organisations for this study.

1) OEM - Original Equipment Manufacturers.
2) ESP – Engineering Service Providers.
3) FTS – First Tier Suppliers.

You have been selected as the researcher has identified you being affiliated with one of the organisations above and a key part of the organisational strategy on outsourcing and offshoring.

Do I have to take part?

No. It is completely your decision if you want to take part in this study. The study will be outlined in this information leaflet. If you have decided to take part, you will be requested to sign a consent form. Once this form has been signed, you are still free to withdraw at any time and without giving a reason. If there has been any information received during the withdrawal phase, all data will be destroyed and not included in the research study.

What will happen if I take part?

If you agree to take part, you will be given the option to either meet the researcher or communicate in another method, i.e. email, conference call, or an agreed method suitable for the participant. The researcher will discuss the study in more detail and undertake a semi structured interview lasting approximately 60 minutes. A semi structured interview has been selected allowing the researcher to become close to the object of study and have the advantage to probe certain areas of interest. Each participant will be kept strictly confidential and follow all ethical guidelines. Further, the interview process is also confidential and is undertaken at a time or place convenient to you.

What are the possible benefits of taking part?

If you participate in this study, you will have the opportunity to talk about your own experiences with outsourcing or offshoring; how this has affected you or the organisation, what tangible benefits have been experienced, and so forth. You may find that the interview with the researcher provides some unique and useful information that could help you or the business in the near future when deciding or refining the outsourcing/offshoring strategy.

What are the possible disadvantages and risk of taking part?

The disadvantages or risks in taking part are minimal. However, if you feel uncomfortable at any stage please inform the researcher. If there are any further concerns or questions about this research study, the researcher is more than happy to discuss before making any decision prior or during the interview stage.

What if something goes wrong?

This is a research study and involves a semi structured interview approach. Thus, there is little that can go wrong. The researcher is ethically and legally obliged to tell you that there are no special compensation arrangements. If for any reason the researcher has to cancel a pre booked session, then I will ensure that you are notified immediately.

Will my information taking part in this study be kept confidential?

Yes. The researcher is the only person who will have access to the raw data. All the consent forms will be stored in a separate, secure (locked) location from the raw data itself. Data received during the interview stage or any other communication will be anonymised including organisation names.
All raw data will be retained until the final thesis has been submitted and awarded a grade. After this point all data will then be destroyed. If data requires transcribing it will be entered into a secure encrypted database and the file will be password protected. All interviews will be recorded unless stated otherwise.

What will happen to the results of the research study?

The results will be transcribed and presented as part of my doctoral thesis which will not be made public due to the university conditions. As there are limited studies in this area some findings will be presented at academic conferences and/or written up for publication in peer reviewed academic journals with strict confidentiality.

Who is organising the research?

The research is organised by Mr. Steven Simplay, who is a doctoral researcher at Coventry University Department of Engineering and computing.

Who has reviewed the study?

The Engineering and Computing Department's research Ethics Committee has reviewed and approved this study and information leaflet.

Contact for Further Information?

Doctoral Researcher: Mr. Steve Simplay
Contact Number: 02477 657705
Email address: ssimplay@uni.coventry.ac.uk

Appendix 6

OEM analysis

# no	Company OEM	Parent Y/N	HQ Location	Annual Revenue ($ million)	Total Employees in organsiation (2013)	Employees in R&D function	Wholly owned subsidary	Engagement with thrid party ESP	Employees in Engineering ESP Onshore	Employees in Engineering Offshore	OWOS Employees
1	OEM A	Yes	UK	18,587.2	24913	7800	USA (Non Eng) China - (50/50)	UK, India	680	1000	50
2	OEM B	Yes	UK	1,900	1200	300	China Shared with OEM C	UK,Germany	30	0	-
3	OEM C	No	GER	93,748	110,351	8150	China x2 China (50/50) x1	Germany, India	922	35	China - 250
4	OEM D	No	USA	146,917	181,000	10,500	China, India, Brazil, Turkey	Germany, India	400	388	China - 1200 India - 3000 Brazil - 550
5	OEM E	No	GER	156,661	96,895	9,000	China, India	Germany,Czeh Republic	1,170	China - India =	China - 350 India - 1200
6	OEM F	Yes	GER	65,472	71,781	7769	China, Germany & Italy	Germany, India	870	India - 13	China - 300
7	OEM G	Yes	GER	185,898	107,559	11,181	India, Mexico, China	Germay, Italy, India	450	India - 30	China - 3000 Mexico - 200
8	OEM H	Yes	CHN	127.0	1200	750	No	Germany, China	70	150	-
9	OEM I	No	ITL	86,61.6	89025	6,500	China	Italy, Sweden	150	-	350
10	OEM J	Yes	CR	13,709.0	24561	5,500	India	Czech Republic	-	-	-
11	OEM K	Yes	FRN	48,414.52	75,421	7320	China - (50/50)	France, Germany, China, Morocco	250	-	1200 (jv)
12	OEM L	Yes	UK	1,093	3600	1100	No	UK, India, Germany	30	30	-
13	OEM M	n/a	JPN	85,843.20	23,605	5560	China, India	Germany, India, Japan	70	1000	India - 1000 China - 250
14	OEM N	Yes	SWD	18,765.3	23,242	6000	China	Sweden	20	242	China - 242
15	OEM O	Yes	IND	6,996.07	34,612	1500	USA, Italy, China - (50/50)	India, Italy	15	80	-
16	OEM P	Yes	UK	446.48	1480	510	No	India, UK, Romania, Czech Republic	20	68	-
17	OEM Q	Yes	IND	38,600	30,000	3750	UK, India	UK, India	20	-	UK - 250
18	OEM R	Yes	GER	19,022	19,456	4200	China	Germany	80	-	10
19	OEM S	No	JPN	6,800	139,100	6,450	China	Germany, Japan	100	250	China - 340
20	OEM T	Yes	UK	811.9	1422	470	No	UK, India	20	30	-

Appendix 7

Bank of England currency rates year average 2013

Currency	$1	Month Avg	Month End	Quarter Avg	Quarter End	Year Avg	Year End
	22-Dec-14	Nov-14	30-Nov-14	Jul-Sep 14	30-Sep-14	2013	31-Dec-13
Chinese Yuan	6.2213	6.1256	6.1429	6.1644	6.138	6.1475	6.0537
Euro	0.8159	0.8014	0.8022	0.7548	0.7916	0.7531	0.7263
Hong Kong Dollar	7.7559	7.7544	7.7552	7.7512	7.7649	7.7566	7.7539
Indian Rupee	63.23	61.6946	62.21	60.5805	61.93	58.5911	61.795
Japanese Yen	119.93	116.3205	118.69	103.9755	109.7	97.5888	104.96
Singapore Dollar	1.3189	1.2964	1.3035	1.2514	1.2753	1.2512	2.0878
Sterling	0.6398	0.6337	0.6384	0.5991	0.6168	0.6397	0.605
Swedish Krona	7.7772	7.4129	7.4434	6.9474	7.2091	6.5144	6.4085

Currency	£1	Month Avg	Month End	Quarter Avg	Quarter End	Year Avg	Year End
	22-Dec-14	Nov-14	30-Nov-14	Jul-Sep 14	30-Sep-14	2013	31-Dec-13
Chinese Yuan	9.7233	9.6663	9.6216	10.2952	9.9509	9.6161	10.0056
Czech Koruna	35.1853	34.9957	34.7197	34.7926	35.3012	30.5961	32.8976
Euro	1.2751	1.2646	1.2565	1.2599	1.2833	1.1776	1.2004
Indian Rupee	98.8222	97.3548	97.4395	101.156	100.4009	91.7375	102.1348
Japanese Yen	187.4386	183.5435	185.9041	173.5561	177.8456	152.685	173.4779
Swedish Krona	12.155	11.6977	11.6587	11.5975	11.6874	10.1901	10.5919
US Dollar	1.5629	1.578	1.5663	1.67	1.6212	1.5644	1.6528

Accessed on 3rd Jan 2014:
http://www.bankofengland.co.uk/boeapps/iadb/Rates.asp?TD=22&TM=Dec&TY=2014&into=GBP&rateview=A&POINT.x=10&POINT.y=6

Appendix 8

ESP Analysis

# no	Company ESP	Parent Y/N	HQ Location	Annual Revenue 2013 ($ million)	Annual Engineering Revenue (automotive) ($ million)	% of revenue	Employees (2013)	Employees in Engineering Onshore	Employees in Engineering Offshore	Employees in Engineering nearshore	Wholly Owned Subsidiary	Third Party Engagement	Subsidary / Third party Employees	Subsidary / third party drivers
1	ESP A	Yes	SGA	385.0	34.5	9.0	7,000	75	2,500	none	Yes	No engagement with third party engineering service providers.	India – 5600 (2200 PD)	Cost reduction and extended work bench.
2	ESP B	Yes	IND	13,440.1	226.493	1.7	300,464	522	200		Based in a number of locations	Engagement with third party ESPs.	Various locations total - 1770 (400 PD)	Local presence to customer.
3	ESP C	Yes	GER	5,885	2,150	2.7	10,300	2,000	250	80	China and India	Engagement and providing services to third party ESPs.	India – 120 (80 (PD) China – 480 (250 PD)	Cost cutting activity, lack of internal resource capacity.
4	ESP D	Yes	GER	839.2	528.48	63.0	7,268	3500 (inc merger of Rücker AG)	165	90	China, Hungry, India, Malaysia	Engagement with third party ESP	China – 320 (200 FFT, 120 EDAG) - (100 PD) Hungry – 150 (90) India – 150 (40 PD) Malaysia – 30 (25 PD)	Opening engineering centre for close proximity to customer and cost reduction activity.
5	ESP E	No	ITL	106.0	98.26	92.7	831	420	10	220	Germany and China	Engagement with third party ESP	Germany – 333 (200 PD) China - 15 (10 PD)	Nearshore centre opened for close proximity to customer.
6	ESP F (Not body Eng. org)	No	UK	359.3	281.75	78.4	2,100	500	125	335	China, Prague, Germany, USA	Future plans (12 months) to engagement with third party ESP	China – 60 (40 PD) Prague – 200 (160 PD) Germany – 250 (175 PD) USA - 120 (85PD)	Nearshoring developed as cost, cutting activity, other centres developed on back of large engineering projects and close proximity to customers.
7	ESP G	Yes	ITL	146.1	119.51	81.8	743	470	None	215	China, Germany, Spain	Engagement with third party ESP	Germany - 200 (160 PD) Spain - 73 (55 PD) China - 20	Engineering centres opened in nearshore locations for cost reduction. Other offices developed for close proximity to customer.
8	ESP H	Yes	GER	491.3	258.93	52.7	3,300	750	56	0	China, Czech Republic, Hungary, India	Future plans (12 months) to engagement with third party ESP	China - 100 (56 PD)	Local market presence
9	ESP I	No	UK	46.9	40.67	86.7	600	520	40	0	No	Engagement with third party ESP	No captive India - 40 (40 PD)	Offshoring for cost reduction and access to larger workforce.
10	ESP J	No	SWD	289.0	166.30	57.4	3,000	2,050	35	594	India, China, Brazil, Germany	Engagement and providing services to third party ESPs	India – 120 (PD 5) China – 150 (10) Brazil - 158 (20 PD) Germany - 1045 (550 PD) Hungary - 81 (44 PD)	Opening engineering centre for close proximity to customer and cost reduction activity.
11	ESP K	Yes	FIN	464.7	15.93	3.4	2,000	80	25	80	China, Germany	Future plans (12 months) to engagement with third party ESP	China - 35 (25 PD) Finland - 40 (40 PD) Germany - 40 (40 PD)	Opening engineering centre for close proximity to customer.
12	ESP L	No	UK	32.9	26.63	81.0	190	145	None	0	No	Engagement with third party offshore	No captive	-
13	ESP M (Not body Eng. org)	no	UK	13.3	0,782	0.6	40	5	None	0	No	Future plans (12 months) to engagement with third party ESP	No captive	No
14	ESP N	No	GER	119.5	19.92	16.67	1,350	400	190	200	India x2, Chennai, USA, China	Engagement with third party ESP	Bangalore – 70. Chennai – 50. UK – 200 (not captive just for numbers). USA – 70. China - 35	Opening engineering centre for close proximity to customer and from large engineering contracts.
15	ESP O	Yes	GER	1,038.9	529.00	50.92	10,829	2,300	55	1,500	China and various Nearshore locations	Engagement and providing services to third party ESPs	China – 120 (55 PD). Nearshore locations 3000 (1500 PD)	Opening engineering centre for close proximity to customer.
16	ESP P	No	ITL	251.5	172.62	68.64	2,700	650	0	350	Various nearshore locations. China	Engagement and providing services to third party ESPs	Approximately 650 (350 PD) China 25	Opening engineering centre for close proximity to customer and cost reduction activity.
17	ESP Q	Yes	UK	46.9	14.13	30.11	650	30	65	0	Malaysia (closed Dec 2012), America and China	Engagement and providing services to third party ESPs	Malaysia – 0 America – 70 (35 PD) China – 50 (30 PD)	Opening engineering centre for close proximity to customer and cost reduction activity.

Appendix 9

FTS Analysis

# no	Company OEM	Parent Y/N	HQ Location	Annual Revenue ($ million)	Annual Engineering Revenue ($ million)	Employees (2013)	Employees in Engineering Offshore	Wholly Owned Subsidiary	Subsidiary / Third party Employees	Subsidiary / third party drivers
1	FTS A	EU	GER	44,230	26,578.10	103,217	India – 800.	India	OWOS developed No engagement with third party engineering service provider offshore .	Cost reduction and extended work bench.
2	FTS B	India	UK	16,463	11,543	160,000	India - 1200.	India Captives based in a number of locations	Engagement with third party offshore engineering service providers to provide engineering services. OWOS was then developed after	Local presence to customer.
3	FTS C	EU	USA	16,200	12,000	122,300	India – 120 China – 450 Philippines - 175	China Philippines India	Engagement with third party offshore engineering service providers to provide engineering services. OWOS was then developed after	Cost cutting activity, lack of internal resource capacity.
4	FTS D	EU	USA	6,769	2,549	23,000	India - 200 India - 300 (JV) China - 60	India China	Two JV's were acquired two still present. One started as ESP then moved on OWOS was then developed after	Opening engineering centre for close proximity to customer and cost reduction activity.
5	FTS E	EU	GER	61,171	40,401.20	281,381	India - 1000	India, Yes – nearshore centre in Germany	Engagement with third party engineering service providers to provide engineering services. OWOS developed after	Nearshore centre opened for close proximity to customer.
6	FTS F	EU	FRN	23,939	8,695.20	97,419	India (pune) - 500 India (Bangalore) - 200 China - 200	India China	Initial Engagement included Joint Venture Engagement with third party offshore engineering service providers to provide engineering services. Still have two Joint ventures OWOS was developed after JV buy out	Nearshoring developed as cost, cutting activity, other centres developed on back of large engineering projects and close proximity to customers.
7	FTS G	EU	USA	42,700	21,350	170,000	India - 422 China - 320	India Slovakia China	Joint Venture engagement OWOS development after JV's	Engineering centres opened in nearshore locations for cost reduction. Other offices developed for close proximity to customer.
8	FTS H	EU	GER	6,240	5,020	21,989	India - 30 China - 60	India China	OWOS Engagement with engineering service provider	Offshoring for cost reduction and access to larger workforce.
9	FTS I	EU	CND	34,835	23,332	125,000	India - 77 China - 120	India China	Using OWOS	Opening engineering centre for close proximity to customer and cost reduction activity.
10	FTS J	EU	SWD	8,803	8,101	52,000	China - 350 India - 100	India China	Initial Engagement with third party offshore engineering service providers to provide engineering services in India. Then developed OWOS	Opening engineering centre for close proximity to customer.
11	FTS K	EU	FRN	6,805.10	7,478.13	22,000	China - 10 India - 30	Slovakia	Two subsidiaries in nearshore location Contract signed with third party provider in India for engineering services	-
12	FTS L	EU	USA	2,387	2,000	9,000	India - 25	-	Using third party engineering service provider based in India	No
13	FTS M	EU	USA	5,200	4,850	26,000	India - 129 China - 70	India China	OWOS developed straight No engagement with third party engineering service provider offshore	No

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