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An Analysis of the UK Auto Component Industry: From the perspective of a Tier 2 safety software company

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By

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Executive Summary

The automotive industry is a large critical sector to UK economy as it accounts for close to a million jobs and is the highest exporter for the country. The industry is characterised by the presence of world's major OEMs and Tier 1 suppliers along with a wide chain of other suppliers. The relationship between these players has mostly been studied only to the extent of OEMs and Tier 1 suppliers, leaving a gap in establishing the relationship with Tier 2 suppliers with the other two. This industry has been in the news for quite some time for being less competitive due to low growth and high number of players but there are also positive news about various government initiatives to promote low carbon development and to boost up the existing supply chain.

This report aims to unravel the nature of relationship between OEM/Tier 1 suppliers and Tier 2 suppliers in the UK auto component sector and also to discover opportunities that might be present for Silver Atena, a new Tier 2 safety critical supplier.

In doing so, first the auto component market structure has been studied to ascertain the current opportunities, trends, government initiatives etc. The relationship between OEM/Tier 1 and Tier 2 suppliers has helped in segmenting the clients into three: Tier 1 suppliers, R&D centres and Design Engineering centres. Based on this segmentation, an exhaustive client and competitor analysis has been provided. It is also observed that most current developments are taking place in the fields of electronics/electrical components involving software which makes it a good proposition for Silver Atena. This report has identified four domains for Silver Atena to focus on viz. powertrain, vehicle control, driver assistance and infotainment & telematics.

Even though the future seemed bright, when the current market conditions were analysed it revealed that most participants are making very low profits and even losses making it a very unattractive market to be in.

However, based on the future prospects in hybrid, electric and fuel cell technologies, the report has made recommendations for Silver and has also highlighted the challenges that Silver Atena needs to overcome in order to make a successful entry into the auto component market by leveraging its existing skills.

Acknowledgements

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List of Abbreviations

ASF: Automotive Supplier Finder
ATA: Automotive Technician Accreditation
ATF: Authorised Treatment Facilities
BEV: Battery Powered Electric Vehicles
BIS: Business Innovation and Skills
BKM: Bodie, Kane and Marcus
CAPM: Capital Asset Pricing Model
DWI: Driving while intoxicated
EBIT: Earnings before interest and tax
ECU: Electronic Control Unit
FCEV: Fuel cell electric vehicles
GSD: Global software development
IMI: Institute of the Motor Industry
JIT: Just In Time
MISRA: Motor Industry Software Reliability Association
MRP: Market Risk Premium
NAIGT: New Automotive Innovation and Growth Team
NPD: New Product Development
OEM: Other Equipment Manufacturer
OES: Other Equipment Supplier
OLEV: Office of Low Emission Vehicles
OS: Operating System
PAT: Profit after Tax
PHEV: Plug-in-hybrids
PICG: Plug in car grant
PLD: Programmable logical device
R&D: Research and Development
ROA: Return on Asset
ROE: Return on Equity
ROS: Return on Sales
SDLC: Software Development Life Cycle
SIC: Standard Industrial Classification
SMMT: Society of Motor Manufacturers and Traders
TCE: Transaction Cost Economics
TQC: Total Quality Control
TSB: Technology Strategy Board
UKTI: UK Trade and Investments
WACC: Weighted Average Cost of Capital

Chapter 1: Introduction

The UK automotive industry is a vital part of UK economy as it employs 700,000 people from manufacturing to retail and produces over 1 mn cars and commercial vehicles and 2 mn plus engines annually. The automotive sector accounts for 10% of total exports generating at an average of £ 25 bn in export revenue over the past 5 years. The auto sector constitutes seven volume car manufacturers, eight commercial vehicle manufacturer and has a large number of specialist sports car manufacturer supporting 8 Formula one teams. The UK automotive sector is also characterised by the presence of 19 of the world's top 20 suppliers.

Does this make the UK auto sector an attractive market for new firms? The purpose of this study is to identify the opportunities that the UK automotive sector might present to a new Tier 2 safety software supplier. This study will present one of the first reports on the automotive sector to help the Silver Atena management to get an overview of the auto parts industry forces and its attractiveness.

1.1 Purpose of the study

This study will provide a picture of the broad macro-economic conditions prevailing in the UK economy and then will narrow down to the UK automotive sector and finally focus on to the auto parts sector. The UK auto supply chain is characterised by companies from all over the world with different buyer-supplier relationship models. This makes it a complex playing field with all the players having different business approaches. The complexity increases further as the sector has seen almost negligible growth and an increased number of players operating within it over the past few years.

In spite of these challenges, we can see new developments taking place in areas such as low carbon technology, enhanced safety systems in today's cars. A survey by Auto Analysis (2011) covering major OEMs and Tier 1 suppliers, have indicated that vehicle companies have shown interest to source electronic control units, satellite navigation systems, advanced air conditioning and safety systems in the UK. This will

help reduce exchange rate fluctuation, minimise cost of an extended supply chain, take advantage of the labour market flexibility and positive industrial relations environment and finally to exploit the growing UK expertise in low carbon technologies. And for the electric vehicle market, an entirely new supply chain will have to be established for sourcing specialist wiring harness, electric power units, electric drive train and gearing.

With strong signalling from the government to support the automotive sector by improving access to finance for growing companies, reduce red tape, trade missions to emerging economies and a commitment shown to decarbonise the economy through initiatives like NAIGT (New Automotive Innovation Growth Team), Automotive Council, TSB (Technology Strategy Board), OLEV (Office of Low Emission Vehicles), Plug in car grant (PICG) and tax incentives for electric vehicles will sow the seeds for an improved automotive and supply chain network within the UK. These new developments are bound to make the UK a viable place for auto development and the component supply market will see new energy in terms of increased internal sourcing of high tech components and new electric vehicle components which will provide opportunity for new players like Silver Atena to exploit the new product development market.

In such a competitive environment, Silver Atena wants to explore these new opportunities by correctly positioning itself to cater for the needs of the sector. Silver Atena was formed from the merger of Silver Software and Atena Technologies in 2008. Silver Atena is an expert provider of safety critical software and hardware and operates in Aerospace & Defence, Automotive, Rail and Gas Turbine & Energy sector across various parts of the world. In the UK, Silver Atena only operates in the Aerospace & Defence sector and now wants to explore the UK automotive component market as it believes it can leverage its skills and competencies learnt from other sectors especially its German counterpart, to enter the UK parts market.

1.2 Research Question

To assist Silver Atena in exploring the UK component market, the following research questions will be answered:

1. What is the **current structure** of the UK auto component market?
2. Who are the **clients and competitors** of Silver Atena?
3. Is the UK auto component market **attractive** for Silver Atena?
4. How can Silver Atena increase its **brand awareness** in the UK auto component market?

The reason for selecting the above questions is to produce a realistic business case for successful engagement in the UK parts market. In order to get into this competitive industry, Silver Atena has to know the opportunities and threats that the current market throws. So in the first question, it becomes important to look at the market structure in terms of macro-economic factors, industry forces and buyer-supplier relationships.

Along with this, Silver Atena also has to know who can be its potential clients as that will decide the revenue stream. But in order to earn a share it has to compete with the existing players. And in some cases, even a client can be its competitor. So the second question will provide a detailed client-competitor analysis to help Silver Atena position itself.

In order to exploit these opportunities and minimize the threats, Silver Atena has to first identify and then use its strengths; that will come from doing an internal analysis. Also knowing the current profitability of the industry and risk involved in operating in this industry will provide a basis for Silver Atena to decide on the attractiveness, which will be answered in the third question.

And finally, as a new entrant, along with leveraging its existing skill set, for Silver Atena to increase its branding in the industry, it has to actively promote itself. The fourth and the final question will provide promotion channels and customer value proposition for Silver Atena.

Having looked at these, the research will also be extended to make a few recommendations and to highlight a few challenges for the future.

1.3 Research Format

This research begins with a literature review that will identify the tools needed to conduct an external analysis of the UK component market, internal analysis of Silver Atena and also describes the methods to measure profitability and risk involved in the industry.

Among various research methodologies available, the third chapter will select and discuss the appropriate methodology that will best suit the research and will also highlight the challenges involved.

In the fourth chapter, analysis of the data collected from various primary and secondary sources will be discussed that will provide a base for discussing all the research questions in the fifth chapter. The external analysis will use frameworks like PESTLE and Porter's 5 Forces to represent the industry structure. The fourth chapter will then include the analysis of the potential clients and competitors of Silver Atena. And finally, the attractiveness will be analysed in two parts. The first part will discuss the internal analysis of Silver Atena in terms of core competency and competitive advantage and finally SWOT framework will be used to consolidate the analysis to identify its position. The second part will then analyse the profitability of the industry and provide measure of investment risk. The reader should note that the data analysis in this chapter will correspond to the research done for Silver Atena by Prithviraj and Mrinal (Silver Atena Report, 2011[1]).

The fifth chapter will discuss the research questions based on the analysis done in the previous chapter and will also draw inferences from academic literature to fill all the

[1] Note: M. Sharma and P.P. Choudhury, 2011, 'Silver Atena Report: the UK Automotive Component Market Review', MBA Management Project, University of Nottingham, September, 2011

gaps. The chapter will also highlight the challenges that Silver Atena might face going forward.

And finally the sixth chapter will conclude the research by stating the findings in brief and will highlight any scope of further research.

Chapter 2: Literature Review

The literature review has been structured in the similar sequence as the research questions. So it starts with an over view of automotive market and safety software market. In order to understand the market structure and opportunities present in auto component market, along with broad environment scanning, it is also important to demystify the forces present in the Tier 2 supplier industry. So the selection of proper tools (PESTLE, 5 Forces) that will be useful to evaluate the industry has also been included as a part of literature review. It was observed that the relationship between buyers and Tier 1 suppliers have been studied extensively in many researches but there has been hardly any case when these studies were extended to understand the relationship between the OEMs and Tier 2 suppliers or Tier 1 and Tier 2 suppliers. These kinds of studies are particularly important for this research which will help in identifying the clients and competitors for Silver Atena. Thus existing literature will be explored to establish the relationships. The literature review has then been extended to identify and analyse a few tools for internal analysis of the firm like Core competency analysis and VRIO framework. These will help to explore the opportunities and mitigate the threats using the strengths and eradicating the weaknesses of the firm. And since financial analysis will form the final part of the research, tools like financial ratio analysis and measurement of risk have also been discussed here.

2.1 Overview of Auto parts industry

The auto industry has been a local industry for most part of the last century. Apart from Ford and GM, the auto globalization took hold only in 80s and 90s. Honda and Nissan were the first Japanese auto makers to have plants in Europe and North America soon followed by Toyota. The much smaller Suzuki became active in small car and truck market and made an early entry in India and Hungary. The operation of Mercedes and BMW also expanded from German soil to the United States, Brazil and Mexico. The large suppliers like TRW, Allied signal, Dana etc followed the Big Three overseas but thousands of mid and small sized suppliers stayed away. The Japanese auto makers and part suppliers formed a different relationship and following

OEMs like Toyota, many Japanese suppliers built manufacturing facilities overseas. Ford on the other hand tried to force its suppliers to follow it to its assembly locations else will be left out. So only large suppliers were able to enter new markets and a series of Mergers and Acquisitions, JVs and Licensing followed.

But with the increase in competition and decrease in margin, there is reduced scope of economies of scale. Also to remain competitive and to differentiate, automakers are seeking more flexibility in terms of product engineering and purchasing overhead. This is made possible by using the platform concept where automakers are using same parts on different car models or brands. As in this case, the product engineering cost will not decrease but there can be reduction in purchasing area by working with fewer purchasing people. This has led to a decrease in number of suppliers the automakers do business with. According to Santucci (1997), these JVs have different characteristics. Instead of just collaborating in a particular operation, in order to meet the requirement of the automakers, the suppliers try to present a common face. So we see more sharing of manufacturing processes, administrative functions, marketing actives are complimentary and also jointly owning a facility. And this makes more economic sense to work with same supplier as automakers are building similar vehicles in variety of regions.

2.1.1 Automobile Safety and Software Industry

Since the introduction of electronics systems into vehicles in 60s, the main sources of current innovation in automotive is in the field of electronics especially software which is about 80% of the automotive industry's functional innovation (Mossinger, 2010). Software is used to improve performance or increase safety both active and passive and also enhances the comfort through infotainment and telematics products. Vehicle software has to be highly reliable with failure rate of about one part per million in a year (Mossinger, 2010). Nowadays vehicles contain several electronic control units (ECUs) that are interconnected by standardized bus systems which increase the complexity of the automobile functioning. Mid-sized cars have around 50 ECUs and a high end luxury models have more than 80 ECUs (Mossinger, 2009). The below table shows the revenue generated by electronics components in automobile indicating the fact that electronics are a part of most major brands:

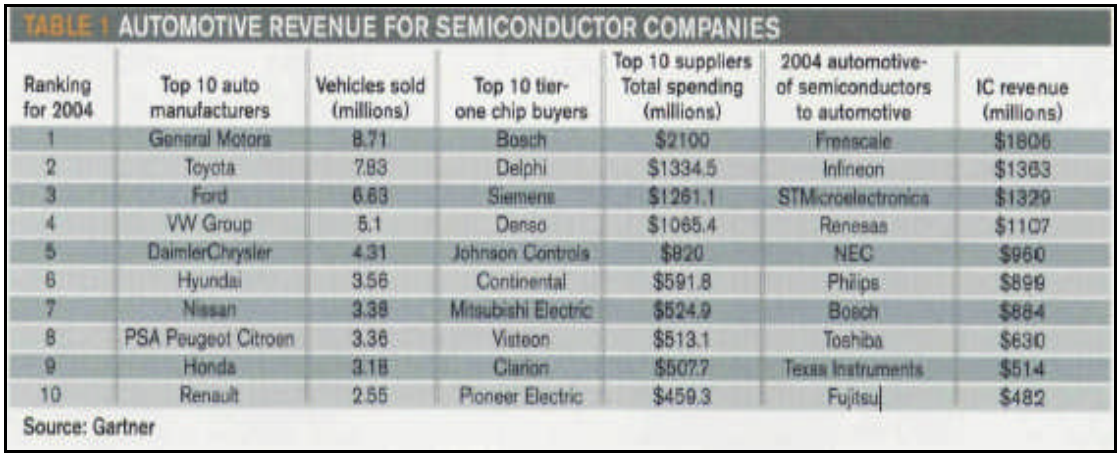

TABLE 1 AUTOMOTIVE REVENUE FOR SEMICONDUCTOR COMPANIES

Ranking for 2004	Top 10 auto manufacturers	Vehicles sold (millions)	Top 10 tier-one chip buyers	Top 10 suppliers Total spending (millions)	2004 automotive-of semiconductors to automotive	IC revenue (millions)
1	General Motors	8.71	Bosch	$2100	Freescale	$1806
2	Toyota	7.93	Delphi	$1334.5	Infineon	$1383
3	Ford	6.63	Siemens	$1261.1	STMicroelectronics	$1329
4	VW Group	5.1	Denso	$1065.4	Renesas	$1107
5	DaimlerChrysler	4.31	Johnson Controls	$820	NEC	$960
6	Hyundai	3.56	Continental	$591.8	Philips	$899
7	Nissan	3.38	Mitsubishi Electric	$524.9	Bosch	$884
8	PSA Peugeot Citroen	3.36	Visteon	$513.1	Toshiba	$630
9	Honda	3.18	Clarion	$507.7	Texas Instruments	$514
10	Renault	2.55	Pioneer Electric	$459.3	Fujitsu	$482

Source: Gartner

Fig 1: Automotive Revenue for Semi-conductor Companies

According to Davis (2010), there is a trend to replace automotive mechanical and hydraulic systems with by-wire configuration of sensors, actuators and microprocessors. Today's automobile can be regarded as embedded computer environment on wheels with 100 million lines of software codes running on dozens of microprocessors that controls engine, maps its transmission shift points and interacts with the component of power train, climate control, infotainment systems, anti-lock braking, engine control, active suspensions and vehicle dynamics. According to Davis (2010), the various electronic/electrical systems that are loaded in a vehicle are:

- Anti Lock Braking systems
- Electronic stability program (ESP), traction control
- Adaptive cruise control, Automated distance regulation
- Automatic rain sensor
- Headlamp levelling and automatic headlamp control
- Parking aids
- Remote Keyless Entry
- Navigation system
- Automatic speed control system
- Night vision systems
- Electric park brake and
- Automatic roll braking systems.

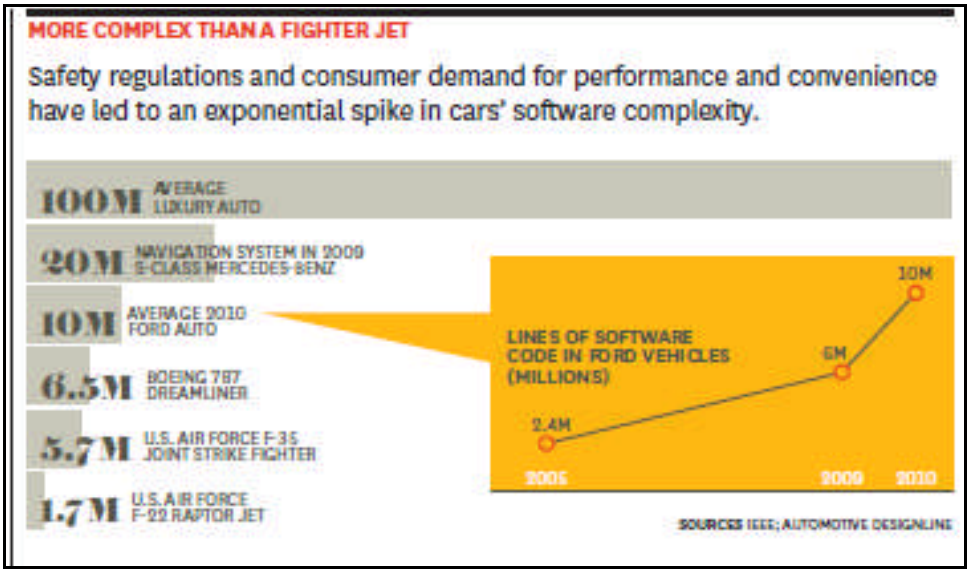

Fig 2: Lines of Code in Automobile (Source: MacDuffie and Fujimoto, 2010)

In order to master these complexities, vehicles are partitioned into domains like power train, chassis, body/interior and infotainment, each with different requirements. If power train domain requires extremely precise timing, closed loop control and real time behaviour, infotainment will demand optimal presentation of information. So there are many differences between automotive software and other type of software in personal and telecommunication in terms of reliability, functional safety, real time behaviour, minimized resource consumption, robust design and mechatronics closed loop control (Mossinger, 2010).

The automotive innovations have been fast paced also due to the need to reduce CO2 emissions leading to the development of propulsion technologies. Along with conventional combustion engines, hybrid systems and electric vehicles are gaining market shares and software form a key to implementing these technologies. And it has been observed that automotive system suppliers often sell higher volumes of product than single OEMs selling entire range of vehicles.

All these innovation has an impact on the vehicle cost. According to a research by VDC (2004), during 1999-2002, software development costs will contribute to one-third of automobile production costs which are mainly due to:

a. Increasing electronic content to satisfy safety and fuel economy standards, environment requirements, comfort and convenience and multimedia and entertainment services.
b. Due to the complexity involved in designing ECUs, labour cost will be higher.
c. With increase in software content, there are software licensing costs involved used in modelling, simulation, and test automation tools.

2.2 Environment Analysis

The environment scanning process can be traced back to 1960s when scanning was used to make economic forecasts. But now it has much wider appeal from short term conditions to broad political, economic, social and technological elements of the environment. According to Brownlie (1999), environment of the firm can be defined as:

"..those factors which are outside its control but which determine, in part, how the firm performs."

The information from environment scanning can be used by both small and large firms. A small firm can know about local regulatory and economic trends that might have an impact on their daily business prospect. A large firm will also require this information but additionally might expect data that is broader in scope and with orientation to the future, the environment scanning increases awareness of the management to make effective strategic decisions. It provides insight into the government and legislative policies and that might impact the business. A narrowly defined business mission may focus only on domestic issues relating to trends in product market. But the purpose of environment scanning is to include users, distributors, suppliers, competitors, workforce, government regulation, trade unions, products and process developments that might internally or externally affect the profitability of the firm. Thus a wider environment analysis suggested by Kast and Rosenweig (1974) on nine areas will be able to define a broad business mission that is associated with a diversified, multi product, multi market firm. But a shorter version

popularly known as PESTLE is mostly used by business houses which have the following attributes:

Political: Political climate of society in terms of concentration of power, party system, degrees of decentralization and diversity of function.
Economic: Nature of public versus private ownership, centralization/decentralization of economic planning, banking system, fiscal policies and the level of investment in physical resources and consumption.
Social: Nature of social organisation in terms of class structure and mobility.
Technological: Level of scientific and technological advancement in the society in terms of physical (plant, equipment) and intellectual (knowledge base).
Legal: Nature of legal system, jurisdiction of various government units, taxation and control of organisation.
Environmental: The nature, quantity and availability of natural resources including climate and other conditions.

2.3 Porter's 5 Forces

Porter's 5 Force analyses (2008) have been influential to many businesses making strategic decisions. Though companies might know the average profitability of the industry and how that has been changing over time, but may not have understanding of the reasons for the observed profitability. This framework provides understanding of the forces that shape the industry structure and provide a baseline to analyse company's strengths and weakness with respect to the forces which can help managers to make decisions. According to Porter, the framework helps in first defining the industry, positioning the company to exploit the industry changes and also to reshape the industry structure.

The industry definition scopes the geography of competition and locates the products/services for operation. By identifying the participants and segmenting them in groups of buyers, suppliers, competitors, substitutes and potential entrants, the framework accesses the underlying drivers of each force's level of strength.

By analysing the vertical (buyers and suppliers) and horizontal chains (substitutes and new entrants), the framework can also help in positioning the company where the forces are weakest and Porter has drawn the example of Paccar (Porter, 2008) to illustrate this.

A careful analysis of the industry can also reveal shift in the industry and in case of automotive, we have seen the shift from gas guzzling heavy vehicles to fuel efficient low weight hybrids that offer better comfort, safety and luxury. These developments reveal the changes in auto industry which have made a dramatic shift from mechanical components to electrical/electronic components.

Porter's 5 forces can also be used to restructure the industry which can be either by re-dividing the profitability in favour of the incumbent or by expanding the overall profit pool. Redistribution of the profit requires the incumbent to neutralize buyer and supplier power. And to expand the profit pool, overall demand needs to grow which can be achieved if industry's quality level rises, intrinsic costs are reduced or waste is eliminated.

The purpose of industry analysis is not to declare the industry attractive or unattractive but to understand the competition and the reason of observed profitability. The industry analysis becomes more useful if the elements of industry structure can be quantified. And since the strengths of the competitive forces affects cost, price and capital investment, it can be directly tied to the financial statements.

However, it should be noted that many of the Porter's themes can be challenged. As these competitive forces are a snap shot of time, one need to be aware of the fact that industry structure is constantly undergoing changes. Changes in any of the barrier elements over time will reduce or increase the potential threat of new entrant. Retailers like Wal-Mart, Kmart have designed new supply chain that has increased the economies of scale making it difficult for small retailers to compete. Similarly bargaining power of buyers and suppliers also change over time which can be observed in the global appliance industry. The margins of Electrolux, General Electric, Whirlpool etc. have been marginalized by the consolidation of retail channels. Even threat of substitutes varies over time mainly due to advancement of in

technologies and in auto component market we can observe electronic components replacing many of the mechanical components due to advancement in technology and comparable cost. And finally the rivalry among competitors intensifies over time as the maturity of the industry increases and growth stops.

2.4 Buyer Supplier Relationship

The different players that are involved in the automotive market are OEMs, R&D centres, Design Engineering centres, Tier 1 suppliers and Tier 2 suppliers. In order to identify the potential client/competitor for Silver Atena, a study of the buyer-supplier relationship in the auto industry will reveal the positioning of Silver Atena in the supply chain.

A study on Italian auto industry (Zirpoli and Caputo, 2002) has revealed that the supply chain relationship can be broadly categorised into three: Adversarial, Keiretsu and Hybrid based on the level of relationship and dependency between OEMs and suppliers. In Adversarial relationship, OEMs select supplier purely based on price and the supplier gets involved only after the design freeze of the components. This was also confirmed by of one of the personal from Ford during an interview (see appendix 4). So the length of the relationship is highly unstable (Dyer, 1998) with low transparency due to minimal vertical and absolutely no horizontal information sharing. There is increased pressure to cut cost (Nishiguchi, 1994) due to parallel sourcing engaging large number of suppliers. On the other hand, Japanese Keiretsu (Dyer and Ouchi, 1993) is on the other end of the spectrum with very strong relationship between the buyer and supplier. A very small number of suppliers are selected based on trust and technical evaluation and so we see profit sharing among the groups. OEMs in this case are very much dependent on the supplier for R&D and the suppliers are involved in new product development (NPD) (Womack et al., 1990; Whitney, 1995) from the design phase and so vertical information sharing is very high. In between the two, we see a hybrid model followed by Fiat, where even though the suppliers are selected based on price but they are involved from the design phase. The relationship between the buyer and supplier last till the life of the vehicle model and the OEM is highly dependent on the supplier R&D during the life cycle. Though

OEM tries to minimise cost by involving a small number of suppliers selected solely based on technical evaluation. And finally due to the high dependency, we can also see high level of vertical information sharing but no horizontal sharing.

A study on the British automotive industry (Turnbull et al., 1992) revealed that the UK is dominated by OEMs from all over the world i.e. US (Ford, GM), Japan (Nissan, Honda, Toyota), Europe (Peugeot) and British (former Rover, former JLR). Japanese are way ahead of European manufacturer in terms of productivity and quality but the North American plants have comparable levels of productivity and rapidly improving levels of quality. In the UK all vehicle manufacturers have attempted to adopt Japanese style JIT (just in time) manufacturing technique. The study has depicted the evolution of the buyer supplier relationship in the UK. Traditionally, buyer supplier relationship was more adversarial due to price competition between suppliers to gain contract of developing components that have stable, high volume and low variety in production. But after the first oil shock in 1973-4, competition was intensified due to Japanese exports which were of high quality at low cost and was rapidly gaining market share. The focus then shifted towards building partnership relations through a process of cooperation with greater dependency on suppliers. The new arrangement involved reduction in the number of suppliers OEMs were dealing with and increased focus on JIT supply and TQC (total quality control). However, the study finally confirmed that even though there was a shift in the relationship structure but they found little evidence of a partnership model between buyers and suppliers. So it can be safely argued that most British companies follow adversarial supply relationships, with price being the only factor to reserve right to business, something which was also observed in the past by Appleby and Twigg (1988).

The above literature reveals that for Japanese and European manufacturer, the OEMs are totally dependent on their Tier 1 suppliers to do the design, development and production of the components. According to Wasti and Liker (1997), Japanese buyers involve some suppliers heavily in design and development of prototype and forge long term mutual dependency, close communication often coupled with geographic proximity. And so Silver Atena can target the Tier 1 suppliers in this case as their client. But in case of Western OEMs like Ford and others, buyer supplier relations

seem to follow the tenets of TCE (transaction cost economics) with short term contract, arm's length relationship and the R&D and design of the components are kept within the company. So in this particular case, Silver Atena has to target the design centre or Engineer centre of such companies where the new product development takes place. However, according to Kamath and Liker (1990) in case of subcontracting design, analysis, prototyping or testing services by the Tier 1 supplier, the OEM can question its ability to accomplish quick turnaround. Hence, Silver Atena must be ready to align itself with OEM requirements and must have necessary internal accreditations.

Though the above literature is able to paint a picture of the automotive industry and helped in identifying the potential client for Silver Atena but it doesn't provide the nature of relationship between OEM and Tier 2 or Tier 1 and Tier 2 suppliers. In fact many studies have been undertaken on the relationship between OEM and Tier 1 but studies on the relationship with Tier 2 suppliers are very rare. According to a study (Mondragon and Lyons, 2008), the traditional supply chain arrangement is represented as follows:

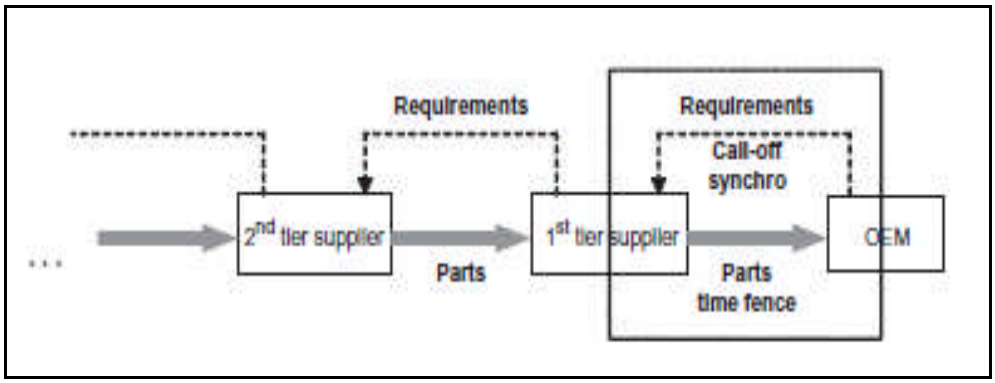

Fig 3: Traditional Supply Chain arrangement

Based on existing structure, an expanded synchronization arrangement as depicted in the study shows that Tier 2 suppliers are not a part of synchronized arrangement:

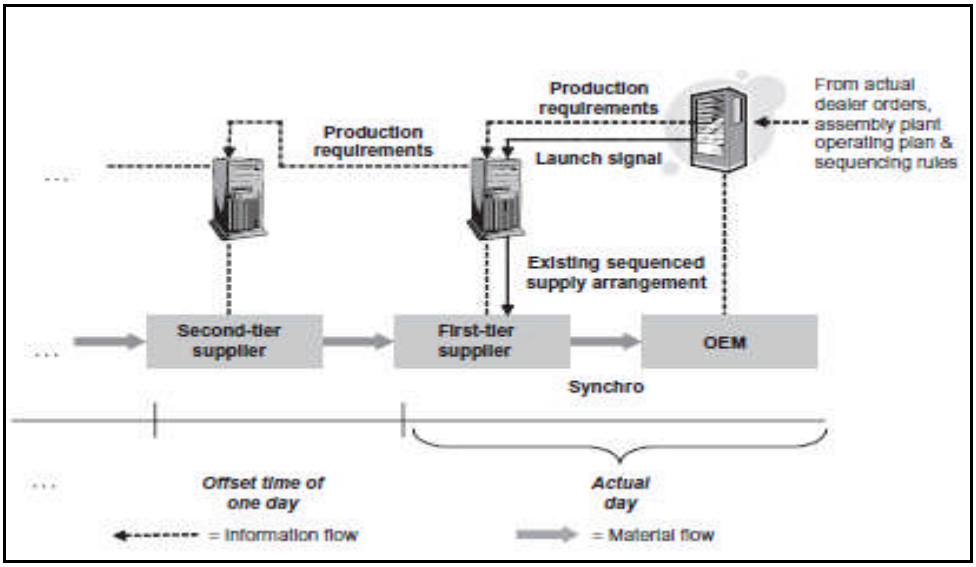

Fig 4: Expanded Supply Chain arrangement

Though the research revealed that if the supply chain synchronization is extended beyond Tier 1 supplier would result in substantial benefits but doesn't provide evidence if Tier 2 suppliers are directly interacting with OEM in NPD or component supply, also supported another study (Turnbull et al., 1992).

2.4.1 Buyer Supplier Relationship in Automotive Safety and Software

In recent years, in response to the increasing number of road accidents, automotive safety has received huge attention from all aspects of the society covering politicians, regulators, automobile manufacturers, consumers and media. A study (Lieb and Wiseman, 2001) highlighted various reasons to affecting highway safety. Driving while intoxicated (DWI) is a major cause of death, serious injury and property damage followed by automobile equipment issues which has led to the proliferation of auto safety features like anti-lock brakes, side impact air bags, ignition interlock system etc. The study also highlighted a number of regulations like mandatory seat belt usage, radar detector that can increase road safety and open ways for new product development related to automotive safety features. In fact, according to McCartt (2011), many luxury cars have various safety features like forward collision warning, emergency brake assistance, Lane departure warning, Blind Spot detection, Adaptive headlamps etc. that has enhanced the occupant's safety.

With proliferation of these safety features, we can see extensive use of electronics and software in these products. According to industry experts (Santarini, 2006), electronics are a cheaper and safer alternative to slow mechanical systems which wear out easily. ECUs based system makes a vehicle safer with fewer hits on warranty, fewer recalls leading to greater expected profits. Following the software revolution in mid 90s, OEMs have become very much dependent on suppliers for various electrical/electronic components. Suppliers have been increasingly pushing OEMs to track their products from initial development through design, manufacturing, sales and maintenance. As now we know unlike Japanese automakers that collaborate with their suppliers, the US and European automakers are split. But there is a growing trend of OEMs to push design responsibility and warrantee responsibility down the supply chain (Ames, 2002). According to Benjamin, OEMs are granting design authority to Tier 1 or Tier 0.5 suppliers. For example, Porsche subcontracted the entire design of its Boxster model to Valmet Automotive, Finland, leaving the OEM doing just the marketing and brand syndication. OEMs like Ford need to be careful with such outsourcing as it should be able to differentiate within its own brand portfolio like Ford, Volvo, Mazda and not cannibalize itself. This pose challenges for design engineering as in order to differentiate and also to keep the vehicle cost low, a single design theme is used across a broad range of products. So, OEMs are trying to address this challenge either by delivering built-to-order cars or by bringing telematics and software items from luxury market to mass market.

The change in the supplier-OEM relationship can also be seen in Japanese automotive where Toyota motors is moving to a horizontal and cooperative model for software development. Instead of developing software for single application, with increased use of micro controllers and sensors in automotive applications like vehicle control, safety, pollution control, applications are developed using standardized software platforms. In Japanese automotive industry, OEMs and suppliers have vertical integration relationship and companies like Toyota uses suppliers to develop OS, middleware and applications (Mamoto, 2005). According to Santarini (2006), OEMs today don't design electrical systems, rather depend on Tier 1 suppliers like Bosch, Delphi, Visteon, Bose etc. that design the electronic subsystems. These Tier 1 vendors again rely on Tier 2 vendors essentially semiconductor and pc board design vendors

to supply design components for ECUs. Automaker provides the rough specification to the Tier 1 suppliers and depends on them for nitty-gritty details. Tier 1 suppliers deliver a prototype which once passes the functionality test at an OEM, then starts designing the actual scale model ECUs with help from a few Tier 2 suppliers.

2.5 Internal Analysis

One aspect ignored by the Porter's 5 force analysis is the need to improve the company's own performance; instead its focus is on identifying areas with less competition. Prahlad and Hamel (1990) have focused on the idea of core competency which is defined as:

"…..the collective learning in the organisation, especially how to coordinate diverse production skills and integrate multiple stream of technologies"

It is through identifying and developing the core competencies, companies like Canon and Honda developed core products which led to the proliferation of end products and grew ahead of its arch rivals like Xerox and Chrysler respectively. Developing core competency will enhance the pace of innovation and in the long run will develop an ability to build products at low cost and more speedily than the competitors. Jay Barney (1991) has also focused on the resources that a firm controls that can be a source of competitive advantage. According to him, due to immobile nature of the heterogeneous resources, a firm may poses sustained competitive advantage. He distinguished between competitive and sustained competitive advantage as follows:

"A firm is said to have a competitive advantage when it is implementing a value creating strategy not simultaneously being implemented by any current or potential competitors. A firm is said to have a competitive advantage when it is implementing a value creating strategy not simultaneously being implemented by any current or potential competitors and when these other firms are unable to duplicate the benefits of this strategy."

In order to understand the sources of sustained competitive advantage, Barney has also suggested a theoretical framework that depends on four attributes: Value, Rarity, Imitation and Organisation popularly known as VRIO framework.

Core competency and VRIO framework will be used in this research for internal analysis. And based on the external and internal analysis, SWOT analysis will be done for Silver Atena. But in order to apply these frameworks, we have to first define and then understand the market in which Silver Atena will operate.

2.6 Financial Analysis

As suggested by Porter (2008), the 5 force analysis will be more informative if substantiated by quantitative data and companies must be aware of the industry profitability and risk involved. So the financial analysis related to this project will be divided into two parts:

a) Calculation of the profitability of the component industry.
b) Measurement of beta as a measure of risk for SA.

2.6.1 Measuring Profitability

The income statement is a summary of the profitability of a firm over a period of time (Bodie, Kane, Marcus). While a Balance sheet provides a snap shot of the financial condition of the firm at a particular moment. However, both Income Statement and Balance sheet are based on accrual methods where revenue and expenses are recognized when transaction happens even if no cash is exchanged. And so cash flow statement gives a better measure of actual cash changing hands. Now in order to compare a company's financial statement with those of other similar companies, we will have to consider the size of the companies and the currency in which the statements are expressed. So to standardize the financial statement, we need to work with percentages instead of total monetary amounts, known as common size statement (HRWJJ). To standardize balance sheet items, we need to construct a common size

statement by expressing each item as a percentage of total assets. And similarly, to standardize income statement items, we need to express each item as a percentage of total revenue.

Ratio analysis also helps in comparing companies of different sizes. For the purpose of this research, the focus will be only on profitability ratios which reflect the firms' earnings. The three best known and most widely used profitability ratios according to HRWJJ are Profit Margin, Return on Assets (ROA) and Return on Equity (ROE). These ratios are intended to measure how efficiently the firm uses its assets, and how efficiently the firm manages its operations.

Profit Margin or Return on Sales (ROS) is defined as operating profit per dollar of sales. Lowering of unit price will increase quantity demand, which may shrink Profit Margin but the total profit might increase depending on the elasticity of demand. Profit margins are the characteristics of the industry and a low profit margin isn't necessarily bad.

$$\text{Profit Margin}\,(\%) = \frac{\text{Profit}}{\text{Revenue}}\ x\ 100$$

Return on Asset (ROA) measures the profitability of all contribution of capital and is defined as Earnings before interest and tax (EBIT) upon Total assets (current assets and non-current assets).

$$\text{ROA}\,(\%) = \frac{\text{EBIT}}{\text{Total Assets}}\ x\ 100$$

Return on Equity (ROE) measures the profitability for contributors of equity capital, is defined as after tax Profit (PAT) upon the book value of equity.

$$\text{ROE}(\%) = \frac{\text{PAT}}{\text{Shareholders Equity}}\ x\ 100$$

The relationship between ROA and ROE reflects the use of debt financing or financial leverage (HRWJJ). The following derivation is adopted from Bodie, Kane, Marcus (BKM):

$$ROE = \frac{\text{Net Profit}}{\text{Equity}}$$

$$= (1 - \text{tax rate})\left\{ROA + (ROA - \text{Interest Rate})\left(\frac{\text{Debt}}{\text{Equity}}\right)\right\}$$

In absence of Debt or ROA being equal to Interest Rate on Debt, ROE is given as:

$$ROE = (1 - \text{tax rate}) * ROA$$

So if ROA exceeds borrowing rate, the firm earns more money than it pays out to its creditor and the surplus earning goes to the firm's owner. Also with increase in financial leverage, the risk of firm's equity increase and so is the expected ROE. On the other hand, if the ROA is less than borrowing rate then ROE will decline with increase in Debt.

In order to understand ROE, we have to decompose it to evaluate its trend over time and its performance relative to competitors. This is called Du Point system (BKM) and is given as:

$$ROE = \frac{\text{Net Profit}}{\text{EBIT}} * \frac{\text{EBIT}}{\text{Sales}} * \frac{\text{Sales}}{\text{Total Assets}} * \frac{\text{Total Assets}}{\text{Equity}}$$

Where

$$\frac{\text{EBIT}}{\text{Sales}} = \text{Operating Profit Margin}$$

|

$$\frac{\text{Sales}}{\text{Total Assets}} = \text{Asset Turnover}$$

$$\frac{\text{Total Assets}}{\text{Equity}} = \text{Equity Multiplier}$$

Asset turnover or low margin need not indicate a troubled firm and need to be interpreted with respect to industry norm.

Thus, Du Point analysis provides a systematic approach of analysing the profitability ratio which will be used to benchmark the automotive industry in this report.

Now in order to evaluate the performance of an industry, identification of firms that are in same market have similar asset and operate in similar ways can be done by using Standard Industrial Classification (SIC) Codes. Though SIC codes provide a easy way of identifying peer but it is not free from defects. A well-diversified company might be present in many segments and so need to identify a set of primary competitors with similar activities.

In order to understand the variation of a parameter of a firm over years, trend analysis provides a medium for benchmarking performance against own self.

In spite of being a powerful tool to analyse the profitability of the companies operating in the industry, some of the limitations of financial statement analysis highlighted by HRWJJ are:

- Apart from the challenge of identifying peers for a conglomerate as discussed earlier, due to globalization, peers can be present anywhere in the globe and may be subjected to various standards and procedures, making it difficult to compare financial statements across national boundaries.
- Firms might end their business cycle at times of the year, which will pose difficulty to make comparisons at a point in time.
- Finally, any particular firms having unusual event like one time profit from sale of asset will give misleading signals as we compare peers.

2.6.2 Measuring Risk

Apart from profitability ratio, investment risk is also important for Silver Atena. The modern financial theory based on Sharpe (1964) and Lintner (1965) popularly known

as two parameter Capital Asset Pricing Model (CAPM) depicts the sensitivity of stock's beta coefficient to changes in the overall market portfolio, is the sole measure of stock's investment risk. Though beta can be related to firm's financial leverage [Hamada (1972); Beaver, Kettler and Scholes, (1970)] or firm's earning covariance [Myers (1977); Turnbull (1977); Pettit and Westerfield (1972)], but these research suggests that beta could be the soul measure of investment risk. CAPM is built on Markowitz's theory on portfolio selection and diversification which adopted mean variance approach to price assets. Based on this, Sharpe and Lintner derived a relationship between the expected return and risk of any asset as:

$$\mathbf{E(R_i) = R_f + [E(R_m)\text{-}R_f]\beta}$$

Where $\mathbf{E(R_i)}$ = expected return in asset;

$\mathbf{R_f}$ = risk free interest rate;

$\mathbf{E(R_m)\text{-}\ R_f}$ = market risk premium and

$\boldsymbol{\beta}$ = covariance of R_i and R_m / variance of R_m ; known as beta.

However, if the portfolio is not efficiently diversified, standard deviation instead of beta becomes the relevant measure of asset's risk.

On the other hand, there are evidences from Fama and French (1992, 1996) and Jegadeesh (1992) which show that beta is not a good measure of risk as beta could not be empirically related to returns. But a study by Pettengill et al. (1995) on US stock market and Isakov (1999) on Swiss stock market have provided unambiguous support to the fact that beat is a good measure of risk as it is strongly related to returns.

For publicly listed companies, beta can be estimated by regressing companies' returns against market return. But for non-traded companies or for a division, the most common approach is to take the average of betas of comparable publicly listed companies as proxy. Bowman and Bush (2006) in their outline of comparable company approach have highlighted the following steps:

1. Identify a set of comparable firms in the same line of business.
2. Determine the equity beta of the companies.
3. Un-lever the equity betas to obtain the asset betas. The relationship between levered and unlevered beta of a levered firm is given by Hamada (1972) and Rubinstein (1973) is given as:

$$\beta e = \beta a\left[1 + (1 - T)\left(\frac{D}{E}\right)\right]$$

Where β_e = Levered firm's equity beta;

β_a= Unlevered firm's equity beta (asset beta)

T = Corporate income tax;

D = market value of debt and

E = market value of equity.

4. Estimate the average of asset beta of the firms.
5. Re-lever the asset beta to obtain an equity beta estimate of the subject firm or project (using equation from step 3).

One drawback of this method is that if the comparable company is a diversified firm, it may not represent the beta of the industry. Also CCA estimate of beta is reasonably accurate when the comparable companies are similar in size to the private company.

2.7 Conclusion- Literature Review

Thus the Literature Review has identified the tools and frameworks that will be used in the rest of the analysis. It has also put some light on the relationship of Tier 2 suppliers with OEMs and Tier 1s. The financial formulae discussed in this section will be used during determination of profitability of the industry and measurement of risk. Based on the Literature Review appropriate research methodologies will be devised in the next chapter to fill the gaps and simultaneously find answers to the research questions asked.

Chapter 3: Research Methodology

3.1 Introduction

The above chapters help in understanding the level of information needed in order to devise a strategic plan to expand operations in a new market. Business development, despite its many benefits, comes with various challenges. The challenges that have been discussed include understanding the industry structure and forces that decide the profitability of the players. For a company like Silver Atena, getting into the highly competitive automotive market requires accurate identification of its clients and competitors. And to get better approximation of the market dynamics, knowing the profitability which is the inherent characteristics of the industry and the risk of getting into the industry is also essential.

The primary objective of this research is to do an analysis and produce a realistic business case on safety critical software services in UK automotive that can provide a basis for Silver Atena to decide upon entering. In this chapter a research methodology will be designed that will unravel answers to the research questions that could not be answered from the Literature Review done in the previous chapter. According to Amaratunga et al. (2002), research is a process by which one can enquire and investigate in a systematic and methodological way and thus increase knowledge. Before carrying out research, it is important to establish the method but it might vary depending on the course of the research.

3.2 Methods for research: Qualitative and Quantitative

Quantitative research uses facts and figures which represent the reality in the society. According to Patton (1978), quantitative method uses measurements, experimental designs, multivariate, parametric statistical analysis for observations. Quantitative approach also require researcher to be independent of the subject and formulate and verify hypothesis for better understanding.

Qualitative research on the other hand uses observation of the researcher to present data. According to Deshpande (1983), qualitative method depends on in-depth, open ended interview and personal observation. It assumes occurrences are linked in some way to the surrounding environment (Smith, 1991).

The distinction between the two methods was clearly quoted by Cook and Reichardt (1981), according to whom,

"..the most telling and fundamental distinction between the paradigms is on the dimensions of verification versus discovery… quantitative methods are developed for verifying, confirming theories and … qualitative methods were purposely developed for the task of discovering or generating theories".

Though there are conflicts (Salomon, 1991) amongst researchers regarding the better method, there are commonalities between the two. Both the methods need to ask a quality question, require some means of validation and finally generalise the findings with respect to the area of study.

In case of this research, a combination of qualitative and quantitative research needs to be done. Qualitative method has the flexibility to use multi method approach for evaluation. Due to the complexity of automotive industry and lack of study on component suppliers especially the tier 2 ones, obtaining hard core data will be difficult. All the literature review has shown that there are many variables involved in environment analysis, 5 force analysis and buyer supplier dynamics in the auto component industry which are both qualitative and quantitative. So it may not be practical to reduce these variables into quantitative terms, which might result in overlooking of certain critical variables. Having said that, there are quite a few market intelligence reports available from SMMT, IMI and other organisations which produce quantitative data on certain parameters. As most of the market research available on automotive are paid or are membership based, this made it inaccessible for this research due to lack of funding. Apart from a few public reports and website related information on the component market, public limited companies have annual reports which provided both qualitative and quantitative data. In fact the financial

ratio analysis and risk calculation will purely depend on the quantitative data available in the public domain or through University of Nottingham library gateway.

Thus, this analysis uses primary and secondary sources and quantitative data for shaping up the research.

3.3 Data Collection Methodology:

3.3.1 Primary data collection

In order to understand the relationship between the buyers and supplier including Tier 2, and their collaboration during new product development (NPD) or component manufacture, semi structured interviews were conducted. This was essential for the first research question in addition to the literature review.

3.3.1.1 Semi Structured Interview

They are useful to gain insight when the area of study is unfamiliar due to their exploratory nature. Due to the complexity of the auto component industry dynamics, open structure allows the exploration of unexpected and new facts and figures (Jarrat, 1996). It also helps to adjust the pace and style of asking questions to understand the complexity of the eco system. It also has the flexibility to prioritize questions to get maximum out of the interviewee and at the same time meet his time constraints. Semi structured interview format helps in gathering the information and opinions of people working in the relevant organisations to understand the structure and working of such organisations.

The interviews were conducted to get the general understanding and were not focused to support researcher's own views. Care was taken to brief the interviewee about the purpose of the interview and to keep the interviewee comfortable all time but also adhere to the confidentiality agreement of the Silver Atena. An interviews conducted have been provided in appendix.

A set of questions were used to target various sections of the automotive industry to unfold the business opportunity available in current conditions. The literature review forms a base for designing the interview. In order to gather information regarding research question one, no specific literature could be found. So in order to fill these gaps in literature, certain questions were framed to explore the possible answers.

3.3.1.2 Sample

One of the most critical aspects of research is choosing the sample as it will have direct impact on the quality of results. According to Curtis et al. (2000), the samples should be chosen in relevance to the area of study or the research questions which will facilitate generalisation and provide rich information. Also random sampling is not advisable in qualitative research (Marshall, 1996); in fact, an appropriate sample that can adequately provide answers is essential.

The following sampling profiles were initially decided to conduct interviews with:

- Motor industry experts / consultants
- Component industry experts / consultants
- Academics from automotive industry

3.3.1.3 Limitation

Establishing the contacts was a tedious task which was done through various sources. Though in these kinds of projects, the client provided contacts are more secured way to establish contacts and conduct interviews. But due to the absence of inputs from Silver Atena, samples were identified and sent cold mails to seek their approval for the interview. The consent rate in this case has been nil. Moreover due to the time involved in establishing contacts, the interviews were pushed to the end of July and August, during which many prospective candidates were on holiday. Therefore, it would only have been possible to conduct a few interviews among these samples. A few other samples were also contacted through references from the project supervisor and other academicians. A few of the contacts have given their consent to be interviewed, the results of which are shown in the appendix.

3.3.2 Secondary data collection

Based on the literature review, in order to understand the competitive environment frameworks like PESTLE, Porter's five forces, Core competency and Internal analysis, apart from the interviews, many other sources were used to analyse the structure of the industry. Most of these sources are available on public domain and through the Nottingham University library gateway. A few websites which were of prime importance are SMMT, IMI, ONS, UKTI which have valuable information on the automotive and parts industry. The main industry report that formed the base for this research is New Automotive Innovation and Growth team (NAIGT, 2009).

The data for client and competitor analysis was solely based on the company websites and their respective annual reports. Infact Annual reports of clients and competitors of Silver Atena are also used to gather initial data for calculating the profitability of the industry. Some of the annual report data were also obtained from FAME database where the company is not public limited.

3.3.2.1 Limitations

The difficulty faced in getting data on the auto component industry was due to the lack of study in this field. In addition, some of the studies that are referred to are not recent. It was also not possible to access the latest reports due to their unavailability in the public domain. Though some of these could have been accessed through membership or cash payments, but constrained by the nature of the study. However, in spite of these challenges, every attempt was made to provide the most relevant information using forecasts from reliable sources and only in absence of sources, out dated data was used to substantiate the understanding.

Chapter 4: Data Analysis

In order to find answers to the research questions, literature review was first done. The literature review identified the tools required to provide answers to some of the research questions. It also revealed the buyer supplier relationship in general and also in safety critical software domain which forms a part of market structure. But literature review didn't provide answers on client-competitors, market attractiveness and branding for which the above methodology (discussed in previous chapter) has been devised and data has been analysed from different sources.

The data analysis is divided into five segments: external analysis, client-competitor analysis, internal analysis, financial analysis and brand awareness. External analysis will provide a base for the first research question. Second research question will be answered based on client-competitor analysis. Internal analysis and financial analysis will provide a base for answering the third research question on market attractiveness. And finally the data analysis on promotional strategies and customer value proposition will provide a base for the fourth and final research question.

4.1 External Analysis:

According to the Literature Review, the tools that are best suited to provide answer to the first question on structure of the auto component industry are PESTLE and Porter's 5 forces analysis.

4.1.1 PESTLE Analysis

Based on the detailed PESTLE analysis (refer appendix 1) done for Silver Atena, a summary of the report is presented below:

Political

Various studies show that till now UK government and public have been less protective of the national industries in relation to their European counter parts. Many

issues had been identified by industry leaders in the past which include Government's less supportive nature, non availability of skills labour, reduced competitiveness of supplier base, low R&D investments to name a few. However, now government will be encouraging automotive companies by reducing corporate tax rate and setting up regional growth funds to push money in advanced technology, innovation centres and expanding apprenticeship and wants to bring manufacturing and supply chain back to UK. Companies like BMW, Nissan have agreed to invest in UK for design, engineering and production of cars. UK government has also taken various other steps to revive auto sector by setting up Automotive Council to promote investment to upgrade existing research and manufacturing facility; The New Automotive Innovation and Growth Team (NAIGT) to support automotive research and development and The Supply Chain group to develop a strong automotive supply base. Cenex is an UK government initiative to promote low carbon and fuel cell technologies and has committed to invest GBP 350 million to encourage ultra low emission vehicles for future.

Economic

The UK auto industry employs 194,000 people in 3,300 businesses, generating some £10.2bn value added in 2007 i.e. the automotive manufacturing sector directly represents around 0.8% of the UK economy in terms of value added, and directly provides around 0.6% of total UK employment. According to 2007 data, UK auto sector is the largest single exporter and a even larger importer leaving a large net trade deficit. Recession in 2008 has altered the landscape of UK automotive industry. Not only OEMs but OESs, including Tier1 and Tier2 suppliers, also have been largely affected by the economic turndown. The UK automotive supply chain largely supports the vehicle programmes assembled in the UK. At present, about only one third of the value of components needed to support UK-based vehicle production is currently purchased in the UK, while two thirds are imported. 'Proximity' was identified as the key competitive advantage of UK suppliers due to lower logistic cost and better support, quick turn around and responsive and also protects against currency fluctuation. However UK suppliers have lost business on the grounds of unit cost, operational execution i.e. quality, cost and delivery (QCD) and access to credit. SMMT has launched two initiatives the Automotive Supplier Finder (ASF) database

and a series of ‘Meet the Buyer’ network events to strengthen the UK supplier industry.

Social

The UK has competitive advantage in terms of labour and customer service as compared to other European and BRIC economies. The most salient weakness that came out was the labour cost and lack of skilled labour and availability of local suppliers. The perception of UK automotive and supplier industry is not strong amongst the people.

Technological

Vehicle companies have indicated their wish to source electronic control units, satellite navigation systems, advanced air conditioning and safety systems in the UK. For the electric vehicle market, an entirely new supply chain will need to be established – for the vehicles and the batteries, the following component areas have been identified as highly desirable for local sourcing: specialist wiring harness, electrical power unit, electric drive-train and gearing. To meet the challenge in terms of CO2 reduction both nationally and globally, NAIGT has identified various emergent alternative fuelled vehicles to reduce emissions as a guide to future development. The use of high tech equipment will become more and more prevalent like in-vehicle telematics which provide drivers instant safety, security and communication services. Voice assisted driving directions, parking, acceleration and vehicle failure detection will become common along with telematics driven infotainment services. Due to shortening of the product life cycle, automakers will also be pressurized to develop global platform upon which vehicles will be designed, engineered and produced to leverage most capital intensive equipment and resources initially and then customize and accessorize later for regional preferences. For example, Volkswagen’s Golf platform PQ35 is shared across the VW, Audi, Seat and Skoda brands. According to SMMT forecast, cars will have various electronic fittings as safety measures in the next 10-20 years. Tier1 suppliers will invest in CO2 emissions reduction technology and increasing car safety. Alternative fuel vehicles are also expected to grow in the future. However, as their importance will grow so

will the relative weakness of the UK to maintain its position in the global automotive industry. The main developments in this space are currently being done in Japan, Germany, France and the USA.

Legislative

Government initiatives like 'Tomorrow's Road Safer for Everyone' or Government policies like End of Life Vehicle directive, Supplier accreditation, Whole vehicle type approval, Emission norms like Euro IV, V or Road tax can provide direction of the automotive sector and drive business behaviour.

Environmental

Manufacturers are committed to low carbon growth and to driving forward sustainable initiatives within the automotive industry which has led to many innovations like Tyre pressure monitoring systems, Gear shift indicators, Low rolling resistance tyres etc to improve the fuel efficiency.

Improvement in technology has led to average reduction in CO2 emission levels by 20.3% to 144.2g/km CO2 in the last 10 years. The transition from present technology to low carbon solutions represents a potential opportunity for UK automotive sector.

4.1.2 Industry Analysis

The Industry analysis starts with defining the scope of the industry. The auto component sector overview is as follows:

UK auto supplier industry employs 82,000 people in 2350 business and generated £ 12 billion sales with £ 3.1 billion of value added in 2009 (Automotive Council, 2011). This number includes the suppliers that supply parts to other non-automotive industries as well. These automotive suppliers include mostly Tier1 and Tier2 suppliers, with very few Tier3 suppliers as well. The table below shows the evolution of the number of automotive supply chain businesses in recent years, and how this break down into the four Standard Industry Codes (Automotive Council, 2011).

	SIC code		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Bodies	34.2 29.2	/	767	764	777	779	803	800	831	876	911	892	902	895	855
Parts	34.3 29.32	/	1,359	1,392	1,449	1,437	1,467	1,487	1,470	1,474	1,486	1,421	1,424	1,472	1,264
Tyres	25.11 22.11	/	124	145	131	148	167	166	161	147	130	126	116	98	78
Electrical	31.61 29.31	/	192	209	215	226	227	229	233	233	248	250	251	201	161
Total			2,442	2,510	2,572	2,590	2,664	2,682	2,695	2,730	2,775	2,689	2,693	2,666	2,358

Fig 5: Automotive Supply Chain Business (Source: Automotive Council, 2011)

The sector has lost considerable capacity through the recession that cannot easily be replaced as business turns up.

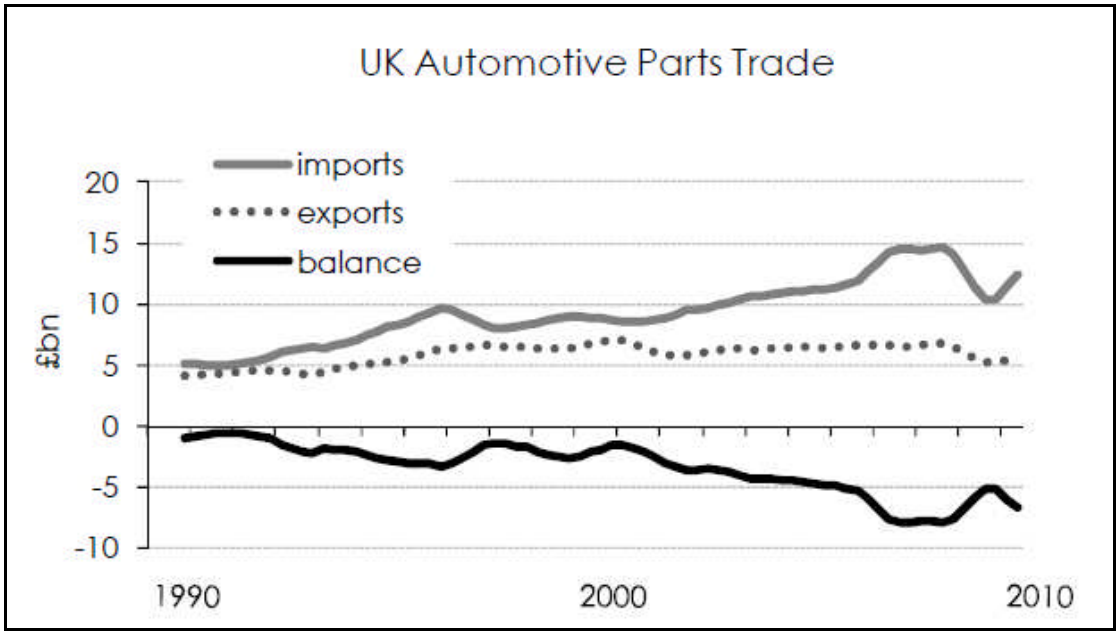

Fig 6: Trade balance of UK auto parts trade (**Source**: Automotive Council, 2011)

Automotive parts sector exports have been fairly flat at a little over £6 billion-worth of goods annually from the mid-1990's, though imports have grown from a similar level, to nearly £15 billion during the peak just before the recession, yielding a deficit of over £8bn at the summit (Automotive Council, 2011). As markets have recovered, parts imports are again rising more rapidly than exports, possibly in part due to the

loss of capacity noted above, and by mid-2010 the parts trade deficit was approaching £7bn on an annualised basis (Automotive Council, 2011). Some major UK auto parts suppliers (Holweg et. al, 2009) are shown below. These suppliers don't necessarily provide safety critical components. Almost all of these are Tier1 suppliers.

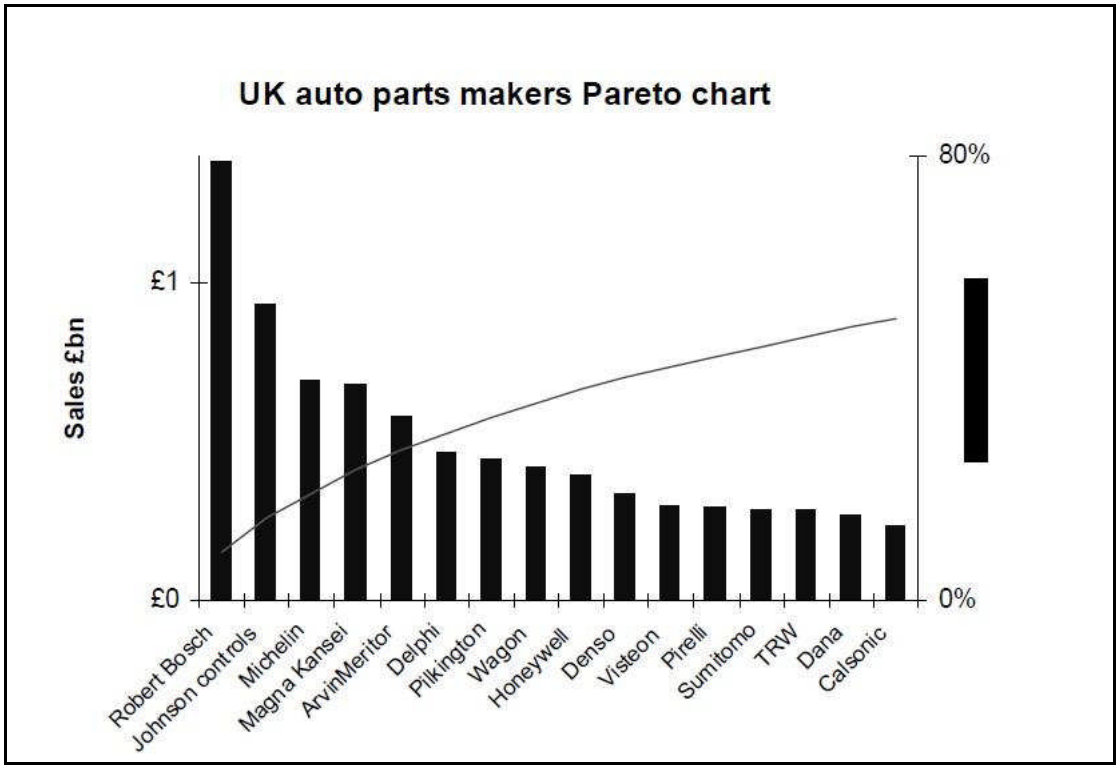

Fig 7: UK Auto parts makers (**Source**: Holweg et. al, 2009)

The below charts show UK's biggest R&D and design providers (both OEM and OES) (Holweg et. al, 2009). R&D and Design patterns could be particularly useful for

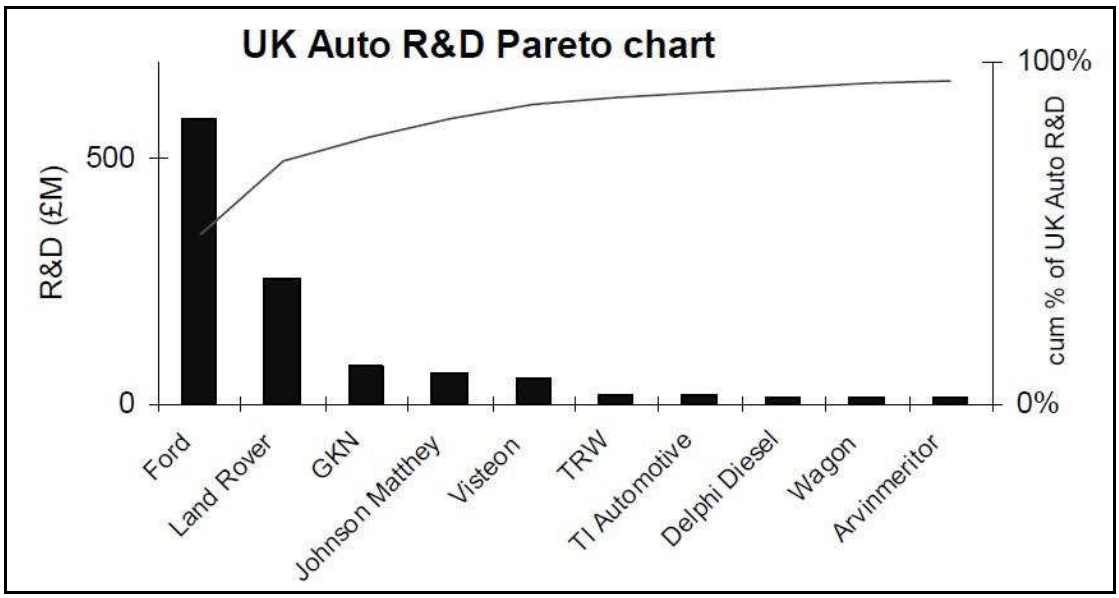

Fig 8: UK Auto R&D centres (**Source**: Holweg et. al, 2009)

Silver Atena as it is during this phase usually that the software related services are required by the particular business (OEM or OES). Hence, more R&D and design

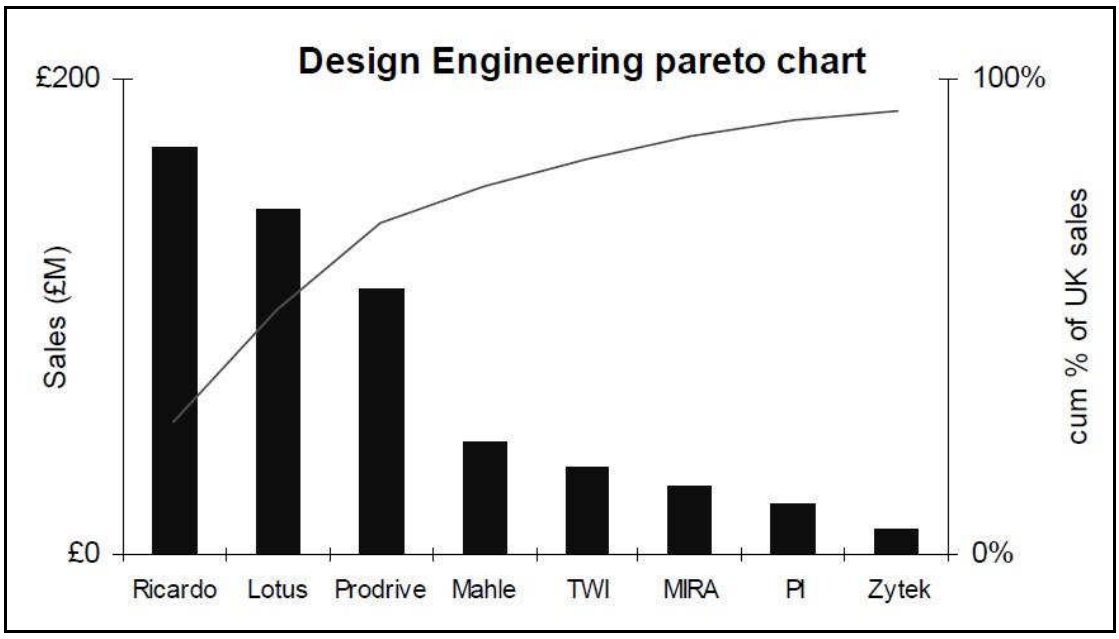

Fig 9: UK Design Engineering centres (**Source**: Holweg et. al, 2009)

investment could well mean more requirement of software services. The companies shown in the chart above for R&D and Design could have software requirement for both safety critical and non-safety critical services. However, Automotive Council

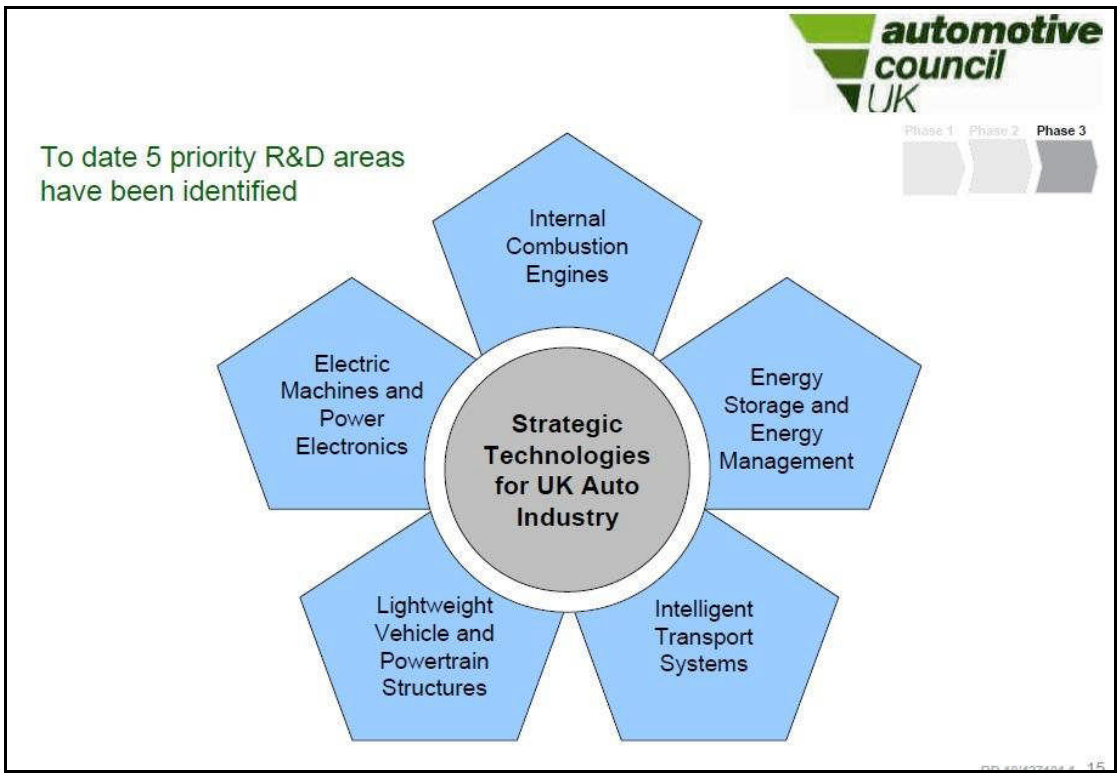

Fig 10: Automotive Council priority areas (Source: Automotive Council, 2011)

(2011) has identified a few areas (refer fig. 10) as top 5 priority areas for R&D, which shows high potential for safety related areas and hence high probability of safety related software services requirement.

The map below shows the regional disposition of the automotive industry. It shows the location of the main vehicle manufacturers (including heavy goods vehicles, buses and construction equipment), as well as the location of the automotive supply base in the UK (Automotive Council, 2011). This does not include companies in the wider manufacturing sector, or service suppliers, though the geographical disposition is likely to be similar (Automotive Council, 2011).

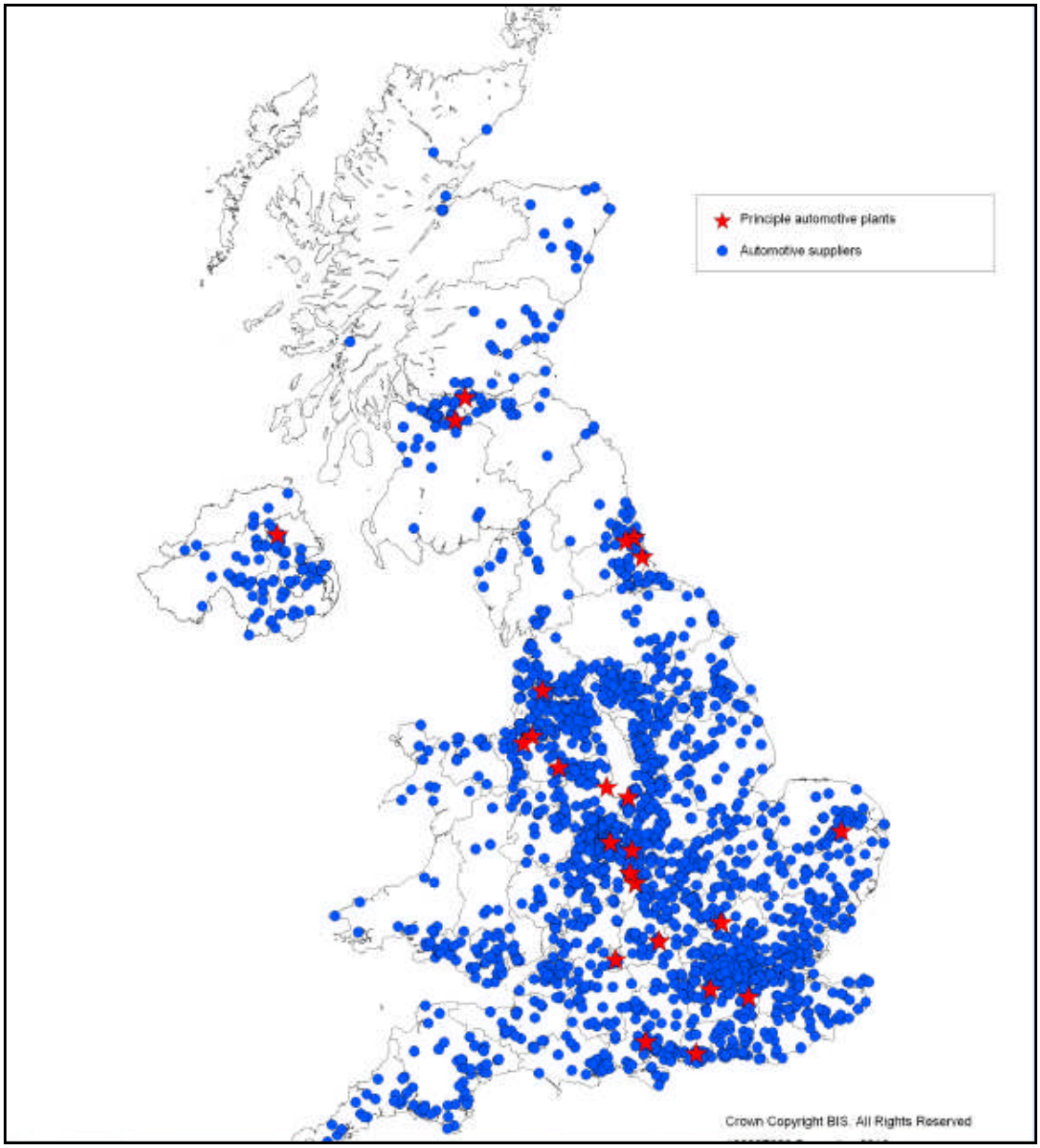

Fig 11: UK manufacturing centre distribution (**Source**: Automotive Council, 2011).

According to Automotive Council (2011), the majority of companies operating in the automotive sector are small and medium sized enterprises. Of 2,900 businesses in the automotive sector (of which 2350 are suppliers) just 80 have more than 250 employees, whilst nearly 2,000 businesses have less than 10 employees.

Based on the industry overview, a five forces analysis has been carried out on Safety critical auto software components. The summary of the 5 Forces analysis is shown below, the details of which is available in the appendix (refer appendix 2).

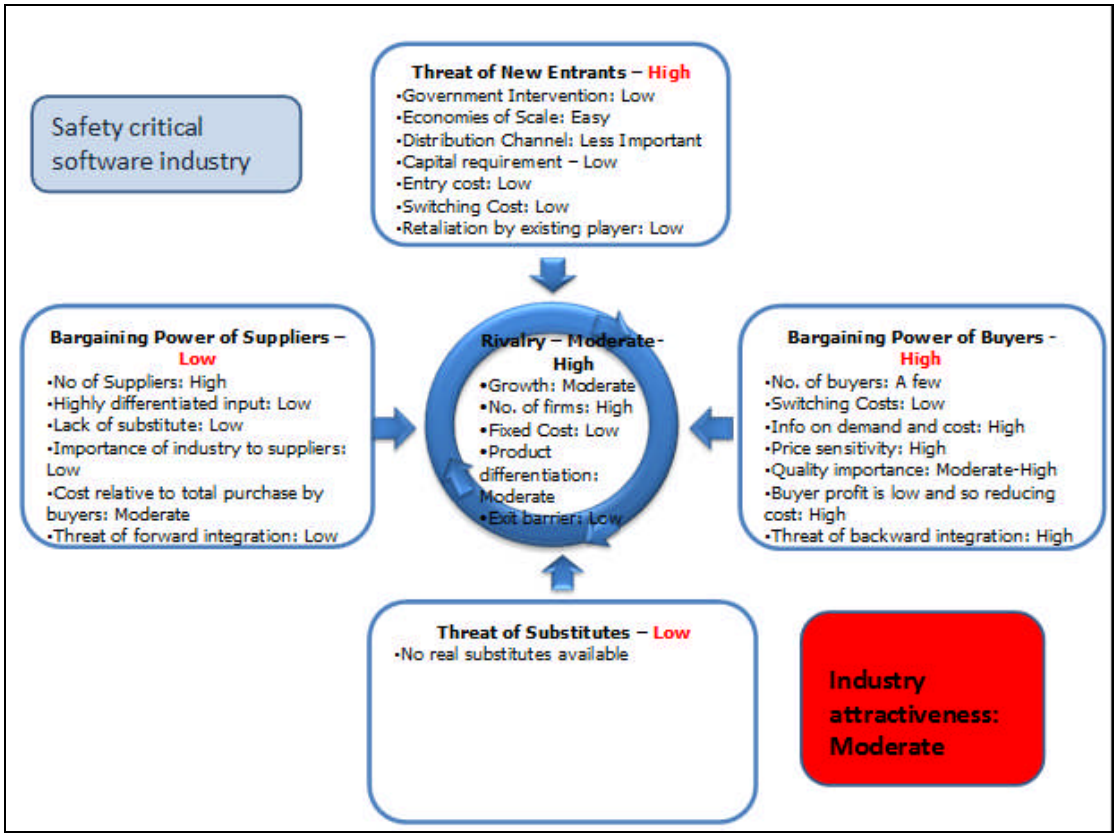

Fig 12: Porter's 5 Forces analysis (Source: Author's own diagram)

According to the 5 Forces analysis, the safety critical software market looks only moderately attractive. Though it seems easy to get into the market with no threat from substitutes, which is in favour of Silver Atena, but due to high bargaining power of buyers and intense rivalry among the existing players, the sector has experienced low profits.

4.2 Client and Competitor Analysis

Based on the literature review it was decided that in order to incorporate the complexity of the relationship between buyers and suppliers, the number of clients has to be chosen from all the segments i.e. Tier 1 supplier group, R&D centres and Design Engineering centres. Also due to huge number of Tier 2 suppliers, the competitor list was selected from various product categories based on SMMT classification. Accordingly a list of 20 clients and 20 competitors were selected. The client-competitor analysis has been done solely based on data obtained from company websites and annual reports.

The client list was selected based on industry analysis done in the previous chapter which lists the major Tier 1 suppliers, R&D and Design Centres.

4.2.1 Client Analysis

Table 1: Client Analysis summary (for details, refer Silver Atena Report, 2011)

Company	Overview	BU for safety-products	Safety Products	Main markets	NPD/R&D
Robert Bosch	**Sales**: €47.3 Bn; **Employees**-283507; **Customer**: BMW, Daimler, Ford, General Motors, Honda, Nissan, PSA-Peugeot-Citroën, Renault, Toyota, Volkswagen and Volvo	Safety Critical System; Chassis System Control Division	Antilock braking system, adaptive cruise control, electronic stability program, night vision system, wheel-speed sensors, steering-angle sensors, yaw-rate sensors, vehicle dynamics management	Europe-59%; America-18%; Asia-Pacific-18%	Compact motorcycle ABS system; Power train electrification and System solutions for hybrid and EV;E-mobility; Side view assist with ultra sound sensors; Cost effective navigation devices
Delphi	**Sales**: $ 13.8bn **Employees**: 99, 700 **Customers**: GM -21%, Ford -9%, Daimler – 6%, VW -8%, PSA -5%, Renault -4%, Fiat -3%, Hyundai/Kia-3%, Toyota-3%.	Electrical/Electronic Architecture (31.3% of 2008 sales), Powertrain Systems (24.8%), Electronics & Safety (22.4%), Thermal Systems	Body Controller & Security Systems, Audio, Navigation, Reception Systems, Mechatronics, Displays & Human Machine Interface, Diesel and	North America - $4.6bn, EMEA - $5.8bn, Asia Pacific-$2.17bn, South America - $1.43bn	R&D activities (including engineering) were approximately $1.0 billion. Delphi seeks to maintain R&D activities (including engineering) in a more focused product portfolio and to allocate the capital and

		(11.7%) and Automotive Holdings Group (7.5%)	Gas Engine Management Systems, Climate Control & Powertrain Cooling.		resources to those products with distinctive technologies and greater electronics content.
Conti-nental	**Sales**: €26.1 Bn; **Employees**: 147288.	Chassis & Safety; Powertrain; Interior		Germany-27%; Europe-33%; NAFTA-19%; Asia-16%; Others-5%	R&D in chassis and safety division involving innovative safety systems, night vision systems.
Autoliv	**Sales**: $ 7.17 Bn; **Employees**: 43300	Air bag and Associated products - 63%; Seat belts and associated products-36.2%.	GM, Renault/Nissan, VW, Ford, Hyundai, Toyota, Honda, BMW, Fiat, Mitsubishi, Mazda	Europe, Japan, North America, Asia	Active safety systems: Night vision system, Short and medium range radar system, Vision system, Next ECU Generation, Active Seatbelts Passive safety systems: Seatbelt Systems, Airbags and Steering Wheel, Crash Electronics, Pedestrian Protection, Anti Whiplash.
Arvin Meritor	**Sales**: $ 3.6 Bn; **Employees**: 14051;	Axles, Undercarriage and Driveline; Brakes and Braking systems		North America; Europe; Asia Pacific; South America	Developed electronic braking systems that integrate anti-lock braking systems technology, automatic traction control, collision avoidance systems and other key vehicle control system components.
Takata	**Sales**: ¥ 350.9 Bn;	Safety critical products	seat belts, airbag systems,	Europe; America; Asia	Involved in developing proprietary new

			steering wheels, child seats, and electronic devices such as satellite sensors and electronic control units		integrated safety systems
Cobra Auto-motive	**Sales**: €130.6 mn; **Employees**: 806; **Customers**: Nissan, Volkswagen, Honda, Mitsubishi and Toyota and Others	Electronics systems	Antitheft systems, parking aid systems, sirens, immobilisers, ultrasonic and anti-intrusion sensors, active and passive recognition devices.	Europe-72.2%; Asia-25.9%; Rest-1.9%	Involved in developing new electronic systems
Hitachi	**Sales**: ¥8.97 Tn; **Employees**: 389752; **Customers**: Ford, General Motors, Suzuki and Toyota	Electronic systems and Equipments, Automotive systems; Components & devices	Anti-lock braking systems, image processing cameras, sensors, lane keeping systems, drive control system	Japan; Asia; North America, Europe; Rest of the world	Vision sensors for automotive; image recognition technologies; brakes; steering parts; suspension
Johnson Controls	**Sales**: $34.3 Bn; **Employees**: 137000; **Customers**: BMW, Daimler, Ford, General Motors, Honda, Nissan, PSA-Peugeot-Citroën, Renault, Toyota, Volkswagen	Driver information, Human Machine Interface Design expertise, HomeLink, Infotainment & Connectivity and Body electronics	Instrument clusters, Displays, Park distance warning displays, Mobile device gateways, Blueconnect hands free systems, Body control, access control, Anti theft systems,	North America; Europe; Asia	

	and Volvo		Tire pressure monitor systems		
Valeo	**Sales**: € 9632 mn; **Customers**: BMW, Fiat, Ford, General Motors, Honda, Hyundai, MG Rover, Mitsubishi, Navistar, Paccar, Porsche, PSA Peugeot Citroën, Renault-Nissan, Subaru, Toyota, Volkswagen and Volvo trucks	Automotive (Power train Systems-28%, Thermal Systems-30%, Comfort and Driving assistance systems-17% and Visibility systems-24%)	Adaptive lighting, blind spot detection systems, lane departure warning system, modular front end, night vision system, ultrasonic park assist	South America: 8%, Europe: 60%, North America: 13%, Asia: 19%.	Second generation start stop technology iStars, High performance torque, Intelligent drive system, active pedestrian detection system, visibility system
TRW	**Sales**: $ 14.38 Bn; **Customers**: Volkswagen (Volkswagen, Audi, Skoda, Porsche)-19.5%, Ford (Ford, Volvo)-15.6%, GM (General Motors, Opel)-11.5%, Others-53.4%	Chassis systems, Occupant safety systems, Automotive components and Electronics	Airbags, Modules, Aftermarket, Brake controls, Electronics, Steering wheels, Body control, Anti-lock braking systems, adaptive cruise control, electronic stability control, forward collision warning, lane departure warning/guidance, tire pressure monitoring	Europe: 50.9%, US: 30.4%, Asia: 13.7%, Rest of the world: 5%	R&D in Electric Park Brake, Forward collision warning, electronic stability, Lane departure warning, Adaptive cruise, Electronic control panel

			systems etc.		
Visteon	**Sales**: $7466 mn; **Employees**: 26500; **Customers**: Ford (38% of 2007 sales), GM/Chrysler (4%), Hyundai-Kia (15%), PSA Peugeot-Citroën (5%) and Renault-Nissan (11%). Other customers include BMW, Honda, Mazda, Toyota and Volkswagen	Automotive (Climate, Electronics, Interior and Lighting)	Advanced front lighting systems, blind spot detection systems, lane-change/merge warning, lateral drift warning system, night vision system	Germany: 2%, Europe: 39%, US: 20%, Asia: 41%.	Blind spot monitoring system, rear cross path system, Curve speed warning, forward collision warning, lateral drift warning system, Infotainment.
Denso	**Sales**: $32bn **Customers**: Daihatsu, Chrysler, GM, Ford, Hino Motors, Honda, Isuzu, Mazda, Mitsubishi, Nissan, Suzuki and Toyota.	Information & Safety Systems segment – 17.7% of total business	Air bag sensors and ECUs, ABS/ESC actuators, Adaptive cruise control systems.	Japan – $21.94bn, Americas - $5.7bn, Europe - $4.4bn , Asia - $5.7bn,	Organic Electroluminescence Display, Exhaust Temperature Sensor with Higher Temperature Detection Accuracy. R&D spend - $3bn
Mobileye	Mobileye is a Tier 2 supplier of automated driver assistance technologies **Customers**: OEMs: BMW, Buick, Cadillac, Delphi, GM and Volvo	Automotive (Driver assistance technology)	Adaptive cruise control, advance warning system, blind spot detection, collision mitigation, forward collision warning system, headway	Netherlands, Sales and Marketing offices in Michigan (USA) and Tokyo (Japan)	Forward Collision Warning with Auto Brake, EyeQ platforms.

			monitoring/warning, lane change aid, pedestrian recognition, sign recognition		
GKN	**Sales**: £ 5429 m **Employees**: 40,000 **Customers**: Volkswagen-15%, BMW-4%, Peugeot-Citroen-3%, Mitsubishi-6%, Ford-8%, Toyota-8%, GM-8%, Fiat-10%, Renault-Nissan-12% and Others-26%	Automotive and Driveline.	Constant velocity jointed systems, All-wheel drive systems, Trans axle solutions, eDrive systems (electric rear axles and electric transmissions).	For Automotive Driveline Brazil: £ 218 m, Japan: £ 426 m, North America: 428 m, Europe: £ 886 m, Others: £ 185 m, India: 81 m, China: 209 m	Electric drive axles, electric drive eTransmission, Direct Torque Flow technology, Face Spline and Twin Ball CVJ, ElectroMagnetic Coupling Device (EMCD), Front electronic limited slip differential.
Aisin Group	**Sales**: ¥ 2,054,474 mn **Employees**: 73,213 **Customers**: Toyota-67.7%, Others-28.2%. Others include Volkswagen, Suzuki, Ford, Mitsubishi, GM, Mazda, Volvo, Nissan, Hyundai	Body related products – 18.8%, Brake and Chassis related products – 20.2%, Engine related products – 10%, Information related products – 5.9% and Drivetrain related products – 41%, Life related products – 4.1%.	Power sliding doors, Power seats, Actuator for electric active stabilizers, Air suspension system, power tilt and telescopic steering column, Intelligent park assist, Driver monitor control systems, Automatic transmission, automated manual	Japan about 75%, followed by North America-10.15, Europe-6.1%, Asia and others – 8.8%.	Electronically controlled brake system, HDD Navigation system supports, heat management systems, transfer efficiency of motive power and oil pumps.

			transmission		
Ricardo	**Sales**: £ 162.8 mn **Employees**: 1500 **Customers**: Automotive OEMs and Tier 1 suppliers.	Agriculture and Industrial vehicles, Commercial vehicles, Motorcycle and Personal transportation, Motorsports, Passenger Cars	Engines, Driveline and Transmission systems, Vehicle systems, Hybrid and Electric vehicles, Intelligent transport system, Strategic consulting.	UK: £ 42.7 m, Germany: £ 21.6 m, Europe: £ 91.8 m, US: £ 40.6 m, Asia: 29.7 m.	Electrification of transport (FuturEVision), ultra-low carbon emission engines, advanced driveline technologies, alternative powertrain technologies, hybrid drive and energy management systems, Intelligent Transport Systems
Zytek	Zytek Automotive is a specialist power train and vehicle engineering enterprise.		Electric engines, Hybrid engines, R&D and Engineering, mechanical design, System and Application engineering, Vehicle Integration, Engineering and Electronic design.		Hybrid commercial vehicle Demonstrator, Gordon Murray design T27, IPCEV.
MIRA	**Sales**: £ 32.5 mn	Automotive	Product Engineering (Styling, Body, Chassis, Electrical systems. Powertrain, Programme Management), Testing, Software	UK: £ 26.45 m, Rest: £ 6.06 m, Revenue from R&D: 28.156 m and Others: 4.344	Low Carbon Vehicles, Intelligent Transport Systems and Autonomous Vehicles, electrically controlled drive, braking and stability systems, Intelligent Transport Systems
Lotus	**Sales**: £ 108,982 **Employees**: 1083	Automotive (Passenger cars,	Lightweight Platforms, Efficient Performance,	UK: £ 26,862 and Overseas:	Intelligent HALOsonic system, Hydrogen fuel cell system,

		Motorsport).	Electrical and Electronic integration Drive Dynamics, Engineering software, Power train testing.	£ 82,120.	Lotus Evora 414 Hybrid

4.2.2 Competitor Analysis

Based on the detailed competitor analysis done for Silver Atena in the Silver Atena Report, 2011, a summary is presented in this report. The choice of the competitors has been made from SMMT supplier finder database and care has been taken to consider only those Tier 2 suppliers who are involved in safety software services.

Table 2: Competitor Analysis Summary

Company	Overview	BU for safety-products	Safety Products
Plextec	Plextec is a specialist in product and system design for communications automotive, aerospace, defence and medical applications. It has a range of clients in all the sectors. Tier1 supplier such as Denso is also a client to Plextec. **Location**: Essex	Technologies: Embedded software, OS & Application software, Image processing, Digital and Analog; Design Service: Industrial & Automotive, Security and Defence; Consulting: Strategy, IP. Manufacturing: development, manufacture, commissioning and maintenance of test equipments.	Multi-media head units, Bluetooth hands free kits, Dashboard systems, Electric vehicle systems, Navigation engines, GPS systems, Tracking systems, Fleet management
BWIGroup	BWIGroup is a premier chassis supplier that designs and manufactures brake and suspension systems for the global transportation market. Along with	BWIGroup is a full service supplier of chassis, suspension, and brake products. Vehicle Dynamics Mechanism Analysis o Vehicle Simulation o Suspension	Magneride Controlled suspension, Manual Selectable ride, Active Stabilizer Bar Systems, Magneto-rheological mounts , Passive Shock

	its global subsidiaries, acquired what was formerly the Chassis Division of Delphi. **Location**: Bedfordshire	Geometry Analysis o Loads Analysis Chassis Design and Vehicle o Suspension o Steering o Brakes o Halfshaft/Driveline o Chassis Structure o Tire Envelopes o Fuel System o Exhaust System	Absorbers and Struts, Damper Modules, Electronic Level Control Systems
EVIDA Power Ltd.	Established in 2009, Evida Power, Inc. is a venture-backed designer and manufacturer of energy solutions for the electric vehicle (EV) market, with activities in Europe, China, the United States and Israel. **Location**: Coventry	Electric fleet solutions and Recharging solutions.	Evida's develops and produces specialty battery packs and battery management systems for the EV market. Evida provides both manufacturers and end users - access to state-of-the-art recharging hardware and software solutions to complement our battery packs. Product category: Electric/ Hybrid Transmissions & Fuel Cells and Hybrid Vehicle Drive Systems
Electronic motion systems	The company is a leading provider of custom control modules and systems for power conversion and electric motor drive markets. **Location**: Swansea, Wales **Customers**: Alfa Romeo, Aston Martin, BMW, Citroen, Ducati, Ferrari, Fiat, Ford, Honda, Hyundai, JLR, Maserati, Mazda, Mercedes,	Design capabilities, Manufacturing capabilities,	Electronic Power Steering System, Manufacturing services , Test and Validation Services, Manufacturing Technology in Printed Circuit Boards, Electrical Design, Package Design, Substrate Layout Design, Control Hardware & Software, Testing & Validation.

	Mitsubishi, Nissan, Peugeot, Porsche, Renault, SAAB, Skoda, Vauxhall, VW.		
DTAfast	DTAfast produce state of the art competition engine management systems and accessories. DTAfast designs and manufactures engine management systems for spark ignition engines. It also provides a full range of temperature sensors, crankshaft sensors and wheels, pressure sensors etc. The systems are designed to be fitted to almost any engine. **Location**: Salford **Customers**: Aston Martin, Ford, Volkswagen, Vauxhall, Peugeot, Porsche, Nissan, Mercedes, Mitsubishi, Honda, Lexus, Ferrari, Citroen, Harley Davidson, Renault, Suzuki, Toyota, Volvo	Product category: Engine/ Transmission Management Systems and Engine Management Systems.	Throttle bodies, Wheel displays, Dash displays, ECUs
Bluestreak Electronics	Bluestreak offers replacements of engine management systems, ABS modules and Air flow meters. The company was then fully aquired by Standard Motor Products Europe in 2010 **Location**: Nottingham	Product categories: Electronic Fuel Injection , Electronic Fuel Injection ECUs, Engine/ Transmission Management Systems, Engine Management System Control Units, Engine Management System Software Development, Engine Management Systems, Fuel Injection System, Throttle Body System	ECU and Airflow meter.

		Assemblies.	
Euro Manufacturing and Marketing	Euro Manufacturing and Marketing has been designing, developing and manufacturing Electronic products for the Automotive Industry for over 20 years. **Location**: Shropshire	Product categories: Car Accessories, Commercial Vehicle Fittings & Equipment, Switching, Lighting & Signalling, Switching/ Lighting & Signalling Parts, Electronic Control Systems & Networks, Vehicle Electronic Control Units, Electrical Power Storage & Processing and Voltage Converter.	Special Purpose Electrical / Electronic Assembly, Encapsulation and Formal Coating, Vacuum Formed Parts, Printed Circuit Board Assembly, Connectors, Transformer and Coil Winding.
Buehler Motor	Buehler Motor has capabilities in mechatronic systems, complete solutions for Healthcare and greentech motors. **Location**: Hampshire **Customers**: Audi, BOS, Continental, Daimler, EATON, Eberspächer, Edscha, Faurecia, General Motors, Getrag, Grammer, Haldex, Hella, Johnson Controls, Kostal, Magna, Mahle, MEKRA, Porsche, SAIC, SMR, Volkswagen, Webasto.	Product categories: Cooling System, Coolant Pump Assemblies, Brakes/ ESP Systems Electric Braking Systems, Electronic Braking Systems (EBS), Cooling System, Engine Cooling Fan Assemblies, Electric Motors/ Actuators/ Motorised Systems, Motors Assemblies, Power Steering Pumps.	Buehler Motor delivers demanding, custom-made and long-term reliable drive solutions with the DC/BLDC motors and gear motors. Power train, Under the hood, Interior, Car body.
Precision devices Inc. (PDI)	Based in Middleton, Wisconsin, Precision Devices is a worldwide leader in crystal frequency control devices. **Location**: Cambridge.	Product category: Sensors & Transducers, Pressure Sensors, Other Receivers & Communications Devices, Use Monitoring Systems, Tracking Systems, Driver Assistance Systems, Tyre Pressure Monitoring Systems.	Products: Extremely high-end crystals, crystal filters and oscillators for complex Radio, RF/Microwave, GPS, Instrumentation and MIL-AERO applications. Manufactures low-cost, commercial grade crystals and oscillators, Testing

			services.
CKO International	CKO International has been involved in the design, development and distribution of products to the automotive market since 1985; **Location**: Middlesex	Automotive electronics	Parking/reversing systems and digital video recording systems, In car multimedia, Light and rain sensors.
Automotive Mechatronics	Automotive Mechatronics is a leading producer, service provider for Low carbon and Hybrid electric vehicles in the field of control and instrumentation COTS products and calibration tools; **Location**: Buckinghamshire; **Customers**: Bentley, BMW, Ferrari, Fiat, Ford, Jaguar, Land Rover, Mercedes, Peugeot, Renault, Volkswagen and Volvo.	Automotive (MotoHawk control solutions, CAN tools, Displays, Motor controllers)	Motohawk, COTS ECU, CAN, Embedded displays, Motor controller
GEMS	GEMS Ltd are specialist electronics engineering company producing high quality electronics. **Location**: Surrey. **Customers**: Mitsubishi, Subaru, AEM Electronics, Beru F1, Flybrid Systems, Frazer Nash, HKS Europe, K-Tec Racing, Magsurvey, Omex Technologies, Prodrive, RAC Future Car Challenge.	Motorsport, Aviation, Marine and OEM projects.	Displays, Engine Management Systems, Transmission Control Systems (Clutch control, Active differential control, Active damping); Software (Calibration and Data analysis)
MBE Systems	MBE systems is a leading design,	Automotive, Aviation, Marine and Turnkey	Engine/Transmission Management

	development and manufacture of integrated Engine Management and power train control systems specialising in electronic, software and control engineering works. **Location**: Cirencester; **Customers**: Opel, Honda, Gibbs, GM, Mahle, Mitsubishi, Nissan, Noble, Radical, Toyota etc.	projects.	Systems, Electronic control systems and network, Engine management System software development, Engine management system testing equipment.
McLaren Electronics	McLaren Electronics is a leading manufacturer and supplier of electronics, software and electronic control systems in formula One, World Rally Car, MotoGP and other professional motor sport categories; **Location**: Surrey;	Motorsport, Automotive and Aerospace.	Engine starting/generating, Diagnostic and testing equipment, Engine/transmission management system, Driver assistance systems, Engine management system software development, Engine management system control unit, Tyre pressure monitoring systems, Pressure sensors.
Ashwood	Ashwood is one of the fastest growing clean tech companies in Europe and one of the largest producer and supplier of hybrid vehicles. **Location**: Exeter; **Customers**: UK Border Agency, Transport of London, Royal Mail, May Gruney, Lex Autolease, Hitachi capital, Leeds City Council, Hackney, Coventry City Council, Citroen,	Electric motor vehicles	Eco drive vans, Stop/Start module, Hybrid transit (CV), Retro fit Hybrid system.

	Liverpool CityCouncil.		
Pektron	Pektron is the largest privately owned electronics manufacturer in Europe and a leading supplier of electronics, involved in design, development and manufacturing of embedded systems; **Location**: Derby;	Automotive, Agriculture, HEVAC, EMS, Construction, EV, Fire safety, Consumer.	Automotive (Seat memory, Instrument clusters, Immobiliser, Passive entry, Engine Management, Body control, Gateway module, Door module, Roof control); Electronic Manufacturing service (Design & Development, Test validation); Electric Vehicles (Power train integration, Access systems, Power management).
PI Shurlok	Pi Shurlok is a leading global developer and manufacturer of electronics like Open ECU which has been developed as open, customizable, prototyping technology.; **Location**: Cambridge; **Customers**: MIRA, Cranfield University, JLR, Ford.	Automotive, Transportation, Defence and Industrial	Engine management, Powertrain and emissions , Exhaust after- treatment, Transmissions, Body and Chassis control, Hybrid vehicle systems, Instrument clusters, Infotainment systems, Software Development tools, Rapid prototyping technology, Hardware In Loop (HIL) testing.
TRW Conekt	TRW Conekt is a consultancy and engineering test services company involved in product development, manufacturing and validation; **Location**: West Midlands	Defence, Aerospace, Automotive, CV, Industrial, Intelligent Transport Systems	Steering Systems, Braking Systems, Simulator Equipment, Electronic Control Units, Sensing products
Embitel	Embitel is exclusively focused on providing software services for embedded	Embedded automotive, Industrial automation, testing and validation, Application	Cruise control, Driver assistance systems, Engine starting/Generating, Design and

	automotive and industrial automation. **Location**: London;	development	Development services, Adaptive cruise control, Alternative fuel/hybrid cars, Advanced electronics, entertainment and instruments, Electric vehicle drive, embedded systems software compilers, Engine management system control units, Display screens, Advanced driver assistance control strategy and software design.
Antonov Plc	Antonov specialises in development and production of transmission for electric drives and other engine drives and geared products for automotive industry. **Location**: Warwick; **Customers**: Chongqing Landai Industry co. ltd, Hofer powertrain, Magna	Technology (TX6 Transmission, Electric Transmission, Speed drives, Speed alternators); Engineering services (Transmission design, Transmission analysis, Transmission test and development, Control electronics and calibration)	Hybrid transmission and Fuel cell, Engine/Transmission management system, Hybrid vehicle drive systems, Transmission control strategy design

4.3 Internal Analysis – Silver Atena

As discussed in the Literature Review, the tools that will be used for doing the internal analysis of Silver Atena are Prahlad and Hamel's Core Competency analysis and Barney's Competitive Advantage analysis.

4.3.1 Core Competency

The analysis is done based on the Silver Atena website and an interview conducted with one of the associates of Silver Atena (refer to appendix 3).

According to the interviewee, Silver Atena (SA) has expertise in development of safety critical electronic systems and software services. Silver Atena has maintained a good quality standard, partly owing to its high technical expertise, which is acknowledged by its clients (Customer Satisfaction Index of 4.8/5.0 over last 18 months). Silver Atena (UK)'s expertise is more prevalent in the aerospace and rail domain. These skills, however, are easily transferable to the automotive sector as well. For instance, Silver Atena adheres to the international standard, IEC 61508, related to electrical/electronic safety systems. This standard is applicable across different industries where safety systems are used. Silver Atena also maintains industry specific standards such as EN 50128 (rail), DO-178B/C and DO-254B (aerospace), Def Stan 0056 (defence) and importantly ISO 26262 (Road vehicles). The technical capabilities of Silver Atena range across the software development life cycle in a vast variety of technologies. This allows Silver Atena (UK) to flex its capabilities in relatively related automotive sector. Hence, it is clear that one of the core competencies of Silver Atena (UK) is the technical capabilities in safety critical systems, which are expandable to the UK automotive sector (appendix 3).

The interviewee also mentioned that Silver Atena also has a lot of experience in providing safety critical software services in different sectors including automotive. Silver Atena (UK) has experience of providing services in aerospace and rail domain. Silver Atena (Germany) has extensive experience of similar services in automotive domain. The other important feature of providing these services has been maintaining long term relationships with marquee clients in the long term. Most of the Silver Atena's experience has been as Tier1 supplier, which would prove very useful while acting as Tier2 supplier and Tier1 supplier to the OEMs. The fact that Silver Atena (UK) provides flexibility in providing resources at the client site and even its higher management has been very approachable by the clients is testimony of the kind of proficiency Silver Atena has in providing safety critical system related services. The

fact that Silver Atena (UK) also manages its Indian offshore development centre acts as a competitive advantage in terms of quality, and cost and acts as low risk benefits compared to its peers. Hence, Silver Atena (UK)'s expertise, resources and capabilities well equips it to provide safety critical software services in the UK automotive sector (appendix 3).

Thus, Silver Atena (UK) has following core competencies:

1. Technical expertise to provide safety critical software services in the UK automotive supplier sector.
2. Expertise in services sector and well equipped in terms of capabilities and resources to act as Tier1/Tier2 supplier in the UK automotive sector.

4.3.2 Competitive Advantage

VRIO analysis proposed by Barney has been used for Silver Atena (UK). The VRIO framework is based on analysis of the resources against four attributes: Value, Rarity, Imitable and Organisation.

The following framework is used:

Value: Do a firm's resources and capabilities enable a firm to respond to environmental threats and opportunities?

Rarity: Is a resource currently controlled by only a small number of competing firms?

Imitable: Do firms without a resource face a cost disadvantage in obtaining or developing it?

Organization: Do firm's other policies and procedures organised to support the exploitation of its valuable, rare and costly-to-imitate resources?

Resource/Capability	Value?	Rarity?	Cost to Imitate?	Properly Organised?	Competitive Implications	Performance
Financial Strength & Assets	Yes	No	No	Yes	Temporary advantage	Below Normal
Global Reach	Yes	Yes	Yes	Yes	Sustained competitive advantage	Above Normal
Services across product lifecycle (SDLC, customer service, customer relationship)	Yes	No	Yes	Yes	Competitive parity	Normal
Depth of Knowledge & Technical Expertise (Project Management)	Yes	Yes	Yes	Yes	Sustained competitive advantage	Above Normal
Appropriate Accreditations/ Certifications	Yes	No	No	Yes	Temporary advantage	Below Normal

Fig 13: VRIO Analysis (**Source**: Author's own diagram)

4.4 SWOT Analysis

It has been done based on external and internal analysis and provides a base for Silver Atena to judge if it has the capabilities to explore the opportunities and alleviate its threats:

Strengths

- Strong financial backing of the parent Assytem group.
- Forms good synergy with the parent group.
- Strong technical expertise to provide safety critical services in UK auto sector.
- Has strong previous experience in providing safety critical services.
- Owning an off-shore centre in India provides cost and control advantages compared to its peers
- SA maintains required standards for development of safety related services

Weaknesses

- No experience of the UK automotive sector
- Lack of synergy with German arm of SA which has expertise in automotive safety critical services
- Might require some OEM or Tier1 supplier specific accreditations, to be considered as sourcing option with them

Opportunities

- The main categories in the automotive sector that will provide opportunities are Interior and Exterior parts manufacturing, Power train, body parts and transmission components and Electrical and Electronics parts which include power steering, engine control units and alternators. SA has capabilities to provide safety critical services in these areas
- Proximity to R&D and Design centres of the UK automotive
- May have bias of OEMs and Tier1 suppliers due to SA's base location of the UK
- There are various safety features components in luxury cars like Forward collision warning with automatic braking, Emergency brake assistance, Lane departure, Blind spot detection, adaptive headlamps which provide opportunities for further development in active safety systems to make these technologies more accessible and affordable
- Low carbon vehicle partnerships are promoted in the UK, which provide opportunities in this areas
- Increasing use of telematics in cars in the infotainment area
- Networking events such as "Meet the buyer" frequently organised by Auto supplier finder, which provide opportunities to develop relationships with OEMs and OESs

- Heavy investment in R&D by Tier1 suppliers, related to reduction of CO2 emissions and increasing car safety

- Various studies have revealed that labour flexibility is one of the competitive advantages of UK automotive industry because of relatively lower level of unionisation

- The taxes and tariffs system in UK is at par with its European counterparts overall and can be considered slightly better than most due to relatively lower personal taxes making it a competitive place for auto industry

- In order to make a move towards low carbon transport, NAIGT has developed a technology roadmap which has identified future technologies and key issues against time scale. The acceptance of these technologies will see various Electric car models like Hybrids, Plug-in-hybrids (PHEV), Battery powered electric vehicles (BEV) and Fuel cell electric vehicles (FCEV)

- The NAIGT report has also developed a Research focused roadmap which will be required to support the Technology roadmap in order to build competencies in these technologies. According to this roadmap, future research will take place in the areas of Propulsion, Energy storage, Vehicle efficiency, System controls, Energy Fuel supply and Process tools

Threats

- Tier1 industry not particularly strong in the UK in current scenario, which is affecting Tier2 suppliers to move out of UK

- Due to recession there has been significant loss of economies of scale of Tier1 and Tier2 supplier, leading OEM and OES to source outside UK

- The data on average yearly costs of an employee in motor manufacturing shows that labour costs in Western Europe is rising dramatically faster thus making way for many OEMs and Tier 1s to shift their manufacturing bases to low cost regions. Over the last few years UK has seen closures of many UK plants.

4.5 Financial Analysis

Financial ratios that are included in this research mostly corresponds to profitability ratios which will provide a basis for SA to understand the historic industry averages depending on which it can take decision on attractiveness of the industry and also judge its performance against the industry standards.

The calculation of industry averages largely depends on the size of the sample and since this research is limited by the availability of data in public domain, the selection of companies to make the sample is crucial and tedious. Moreover effort has also been made to select the companies from the list of clients and competitors that have been analysed in the previous section. But during the research it was realised that most of the parent companies from Tier 1 supplier group that are previously analysed are listed in their home country and so only the UK registered wing of these companies have been considered. Also it been observed that most of these UK registered companies are not listed so no financial reports are publicly available. However, the financial data for these selected companies have been obtained from financial database like FAME for carrying out the necessary calculations. Due to the complexity of the auto component supply chain as observed from the literature review, it can be assumed that the characteristic feature of the businesses for Tier 1 suppliers, Design Engineering Companies and Tier 2 suppliers are quite different and they are exposed to different challenges and risks. Due to this internal segmentation of the auto component market, the whole sample has been divided into three. A sample size of 15 Tier 1 companies, 4 Design Engineering companies and 4 Tier 2 competitors has been created; data collections and calculations are then separately done.

The calculation of the ratios in case of Tier 2 competitors show larger standard deviation compared to the other two samples due to small sample size selected from a large number of firms operating in the sector (as observed from Porter 5 Force analysis). This small sample size is due to unavailability of data through FAME database. So the huge variation of figures observed during the period for the sample taken may not clearly reflect the true values of the ratios for the Tier 2 industry.

Also beta values are only available for publicly listed companies; hence this report is also constrained by the beta value calculation of SA depending on the 6 companies which are listed under automotive and parts sector in UK, whose data are available in the public domain.

4.5.1 Calculation of Financial ratios

Based on the sample size of 15 Tier 1 companies, the data with regard to every ratio has been collected for the last 5 years from 2006 to 2010. As observed from literature review, the size of the auto component market has not grown dramatically over the period, and in some cases has in fact reduced due to increased outsourcing of components. As seen from Porter 5 force analysis, it can be assumed that loss for one company is the gain for another due to high level of competition. So in order to reflect the intensity of competition, a yearly industry average pertaining to each ratio has been calculated. The yearly average shows the variation in ratio values during the observed period. However during average calculation, care has been taken to avoid values which show huge deviation from the mostly observed values.

Similar exercise was also done for Design and Engineering company sample and Tier 2 Competitor sample.

The schematic of the data collection process is shown below:

Step 1: Retrieve data from financial statement for calculating the financial ratios for each company for last 5 years (2006-2010) period
Step 2: Calculate the year-wise financial ratios for each company
Step 3: Calculate the yearly industry average for each financial ratio
Step 4: Based on yearly average values, calculate mean, median and standard deviation

The above steps have been repeated for all the three sample groups: Tier 1 suppliers, Design Engineering Companies and Tier2 competitors. The final results from the step 3 and 4 for the three samples are shown below:

Table 3: Tier 1 supplier (Sample size-15):

Ratio	2006	2007	2008	2009	2010	Mean	Median	SD
Op. Profit margin %	2.12	1.17	0.02	-2.34	5.13	1.22	1.17	2.75
PBIT margin %	3.82	3.04	1.13	-1.65	3.72	2.01	3.04	2.31
Net Profit margin %	2.77	2.03	-0.31	-1.07	3.47	1.38	2.03	1.97
ROE %	1.61	23.60	-8.82	5.42	-4.34	3.49	1.61	12.49
ROA %	0.22	7.44	-6.12	-6.18	11.53	1.38	0.22	7.98
Asset Turnover	1.91	1.76	2.51	1.93	2.02	2.03	1.93	0.29
Equity Multiplier	2.88	1.71	1.32	2.68	0.44	1.81	1.71	1.00
Working capital %	22.83	22.46	27.78	26.44	30.26	25.95	26.44	3.32
(PBIT) per employee	19.20	17.75	24.29	14.34	20.91	19.30	19.20	3.69
Turnover per emp	766.35	529.68	656.48	618.32	599.49	634.07	618.32	87.09

Table 4: Design Engineering Companies (Sample Size-4):

Ratio	2006	2007	2008	2009	2010	Mean	Median	SD
Op Profit margin %	0.23	1.26	0.49	2.89	3.25	1.62	1.26	1.38
PBIT margin %	1.62	8.54	1.49	1.55	2.90	3.22	2.26	3.03
Net Profit margin %	0.89	1.07	0.85	0.96	2.42	1.24	0.96	0.67
ROE %	2.02	1.69	1.60	2.51	6.03	2.77	2.02	1.86
ROA %	1.58	8.69	1.45	1.78	3.77	3.46	1.78	3.08
Asset Turnover	0.98	1.02	0.97	1.15	1.30	1.08	1.02	0.14
Equity Multiplier	2.31	1.55	1.94	2.28	1.92	2.00	1.94	0.31
Working capital %	13.32	13.15	13.17	19.74	16.61	15.20	13.32	2.94
Profit (PBIT) per employee	1.19	6.14	1.15	1.33	2.78	2.52	1.33	2.13
Turnover per employee	73.57	71.86	77.39	86.23	95.80	80.97	77.39	9.98

Table 5: Tier 2 Competitors (Sample Size-4):

Ratio	2006	2007	2008	2009	2010	Mean	Median	SD
Op Profit margin %	4.18	-4.58	-7.44	-2.02	2.90	-1.39	-2.02	4.91
PBIT margin %	5.69	-1.40	-4.82	3.33	-0.77	0.41	-0.77	4.13
Net Profit margin %	3.93	-2.15	-8.69	0.30	-5.64	-2.45	-2.15	4.94
ROE %	4.57	11.03	-7.44	8.23	-	4.10	6.40	8.14
ROA %	5.63	-2.22	-5.17	2.89	-0.64	0.10	-0.64	4.25
Asset Turnover	0.90	1.48	1.14	0.81	0.83	1.03	0.90	0.28
Equity Multiplier	-0.99	-1.61	1.34	4.06	14.96	3.55	1.34	6.76
Working capital %	35.72	-12.81	14.63	15.34	-50.66	0.44	14.63	33.37
Profit (PBIT) per employee	-21.66	-29.74	-4.25	30.63	-0.61	-5.13	-4.25	23.34
Turnover per employee	79.82	103.36	97.09	98.76	78.62	91.53	97.09	11.48

4.4.1.1 Data Analysis- Financial Ratio

The profitability ratio measure as calculated from the samples doesn't reflect the solidarity and attractiveness of the industry. The low average measures of these ratios are an indication of the high competitiveness within the industry which is due to large number of players operating in an almost stagnant, in fact a constricting automotive sector. This will be clear from the industry growth performance data (Euromonitor, 2010) from euromonitor international as shown below:

£ million	2004	2005	2006	2007	2008	2009	2010
Total market size	66,567	69,178	71,334	77,054	70,541	58,979	62,468
Turnover of local producers	38,963	40,581	41,412	44,022	41,938	32,700	36,410
Turnover at constant 1997 prices	40,931	41,352	40,851	42,120	42,735	32,357	34,838
Value Added	10,313	10,462	10,317	10,750	9,449	7,889	8,375
Profit Margin EBITDA (%)	3.5	3.1	3.0	3.2	1.3	1.3	0.8
PPI base year 1997 index	95.2	98.1	101	105	98.1	101	105
Number of employees	270,580	255,779	236,776	220,814	206,357	183,191	175,057
Number of enterprises	3,066	3,162	3,066	3,028	3,329	3,272	3,284

Source: *Euromonitor International*
Note: *PPI (Producer Price Index) is a measure of the average change in selling prices over time received by domestic producers of goods and services.*

Fig 14: Industry growth performance

It can be observed that the total market size since 2004 has grown till 2007, but due to the financial collapse of 2007, market size has dropped even below 2004 levels. The profit margin for the industry is also seen to be low which corresponds to the sample evaluation done in this research (considering the standard deviation). Also during this period the number of firms operating in this segment has only increased resulting in greater profit distribution and intense competition. Though the above data are for the whole of automotive and parts industry, the analysis could not be done for the component industry separately due to lack of specific data. However, as learnt from the literature review, the component industry is more competitive than the OEM market, so the figures will be comparable if not worse. The below table indicates the growth rate of the above parameters for the period 2005-2010:

% annual growth	2005	2006	2007	2008	2009	2010
Total market size	3.9	3.1	8.0	-8.4	-16.4	5.9
Turnover of local producers	4.2	2.1	6.3	-4.7	-22.0	11.4
Turnover at constant 1997 prices	1.0	-1.2	3.1	1.5	-24.5	8.0
Value Added	1.4	-1.4	4.2	-12.1	-16.5	6.2
Profit Margin EBITDA	-8.1	-0.4	14.4	-60.9	-25.1	-31.8
PPI base year 1997 index	3.1	3.3	3.1	-6.1	3.3	3.1
Number of employees	-5.5	-7.4	-6.7	-6.5	-11.2	-4.4
Number of enterprises	3.1	-3.0	-1.2	9.9	-1.7	0.4

Source: *Euromonitor International*
Note: *EBITDA (Earnings Before Interest, Taxes, Depreciation and Amortization) is a measure of a company's earnings that ignores the interest expense, profit taxes, depreciation and amortization.*

Fig 15: Industry growth rate

The overall market has shown a moderate growth till 2007 but has experienced a sharp decline thereafter. Only in 2010, signs of recovery can be seen. But correspondingly, the number of firms operating in this sector has not dropped considerably compared to the drop in revenue. This looks like a classic case of stagnant market and increasing competition due to moderate entry barrier (as observed from Porter's 5 force analysis) which has resulted in low profit margin for the companies operating within. The data on individual firms on various financial ratios indicate that there has been constant re-distribution of income levels i.e. gain for one is the loss for another and because of which the average profit margin has dropped considerably. Having said that there are also firms like Bosch, Continental, Visteon which have made considerable profit during this period only at the cost of other firms.

In order to evaluate the current industry performance (EBIT Margin, ROE, ROA, Asset Turnover and Equity Multiplier) and characteristics (Common Size Working Capital, Turnover per employee), let us analyse some of the financial ratio in details. To make this research more informative and to establish the above proposition, a comparison with previous data (Gombola & Ketz, 1983) from a study on manufacturing industry is made. A latest and a more specific study on automotive sector would have provided a better base for comparison. But the study has used SIC number to define the manufacturing industry and the sub groups are seen to have

similar characteristics. The mean values obtained from above calculation pertaining to the mentioned ratios are compared with mean value of the same ratios from the study.

The details are as follows:

Table 6: Industry parameter comparison

Performance Parameters	**Tier 1 suppliers**	**Design & Engineering**	**Tier 2 company**	**Mean value from 1983 study**
PBIT Margin%	2.01	3.22	0.41	10.20
ROE %	3.49	2.77	4.10	13.40
ROA %	1.38	3.46	0.10	14.30
Asset Turnover	2.03	1.08	1.03	1.54
Equity Multiplier	1.81	2.00	3.55	2.25
Characteristics Parameters:				
CS WC %	25.95	15.20	0.44	32.60
Turnover per Employee	634.07	80.97	91.53	No data

The previous study has developed the financial ratios using factor analysis and has employed sophisticated statistical tools like multivariate technique which have been ignored in this research due to constraints of using statistical tool and also due to the broad scope of the project. However, the research is none the less constrained by the authenticity of data and a comparison will provide a basic understanding of the performance and characteristics of the automotive industry.

The above data shows that profitability ratios like PBIT margin, ROE and ROA have dropped considerably since 1980s but factors like asset turnover, equity multiplier have not changed much. This indicate that though most of the firms have been able to use equity funding to create assets (shown by equity multiplier) and used these assets to generate revenue (shown by asset turnover) which are of comparable value with 1980s data, but they have not been able to generate profit equivalently. The productive of employees couldn't be compared due to lack of data but turnover per employee has been pretty consistent during the observed period though a stark

difference can be seen between Tier 1 suppliers and the other two sample groups (refer table 4) indicating the fact that most Tier one supplier are highly productive. This data supports the above proposition that over the years the competitiveness of the industry has increased with more number of players coming in a stagnant or a constricting sector.

Though there could be other reasons for low profit margins like increase in the cost base which can be due to high cost of raw materials, increased labour cost, internal management failure etc. and this research could be extended to explore these factors in future.

4.5.2 Calculation of risk (Beta)

Based on the method discussed in the literature review, the measure of financial risk Beta for Silver Atena has been calculated using CCA (comparable company approach) method. As discussed, due to the non availability of range of public listed companies in automotive & parts sector in LSE or AIM, the calculations are based on the 6 companies only. Also since a perfect range of comparable companies for Silver Atena is not available from the available list of 6 companies, beta is calculated corresponding to all the 6 companies. It can be expected that the beta value for Silver Atena will fall within this range for various projects undertaken in automotive sector. The beta value calculation has then been extended to obtain the cost of equity and weighted average cost of capital (WACC) i.e. the discount factor that can be used for discounted cash flows for evaluating any project in automotive sector. During WACC calculation, it is assumed that any new project will not change the existing capital structure of Silver Atena in the short run.

The beta value calculation for Silver Atena apart from the un-geared beta of its comparable companies will also depend on its own capital structure, corporation tax rate, market risk premium (MRP) and UK risk free rate. The following data were obtained:

For Silver Atena, due to absence of long term debt, the gearing ratio (Debt/Equity) = 0. (Source: FAME database)

Corporation tax = 28%

(Source: http://www.mckinseyquarterly.com/The_real_cost_of_equity_1533)

UK risk free rate = 5.3%

(Source: http://www.ipe.com/realestate/risk-free-rate-reality-check_35464.php)

Market Risk Premium (MRP) = 5.2%

(Source: http://www.cxoadvisory.com/6696/equity-premium/the-2010-equity-risk-premium-from-practitioners/)

The calculations of beta for Silver Atena (SA) are shown below:

Table 7: Calculation of Beta and Cost of Capital

Company	**Beta**	**Gearing (Debt/Mkt value of Equity)**	**Unlevered Beta**	**SA Beta**	**Cost of Equity (SA)**	**WACC**
GKN	2.06	0.49	1.52	1.52	13.22	13.22
Transense	2.05	0.00	2.05	2.05	15.96	15.96
Torotrak	1.08	0.00	1.08	1.08	10.92	10.92
Surface trans	0.50	0.00	0.50	0.50	7.90	7.90
Volkswagen	2.40	2.08	0.96	0.96	10.30	10.30
Ricardo	0.62	0.21	0.54	0.54	8.10	8.10
			Average Beta	1.11	**Average WACC**	11.07
			Median	1.02	**Median**	10.61
			SD	0.60	**SD**	3.10

4.5.2.1 Data Analysis- Beta

The beta is the measure of sensitivity of the firm's return to the market index. For a well diversified firm, the average beta of 1.11% indicates that for every 1% increase or decrease in the return of the index will result in 1.11% movement in the project's return in similar direction. Thus, for Silver Atena, the risk associated with investing in automotive sector is low. But it has to be remembered that the index have equal probability of movement in both directions and risk measure doesn't distinguish between positive and negative movement. Due to the lack of presence of a perfect

comparable company, the standard deviation of beta measure i.e. 0.60 is also high, thus making it difficult to precisely estimate the risk. A more rigorous method of estimating beta in this case would have been better which can be explored in future. The calculation for beta has been extended to compute the weighted average cost of capital. The calculation has made a silent assumption that Silver Atena is a well-diversified company and so the excess return is on risk free rate. The measure of WACC will provide the necessary discount factor which Silver Atena can use to evaluate any of the automotive projects. This research has estimated a range of discount factors which can be used based on the type of project Silver Atena will undertake.

4.5.3 Conclusion-Financial Analysis

The above financial analyses have provided data on the automotive component industry which can be used by Silver Atena to benchmark its performance with the industry in terms of profitability ratio or productivity. Also the estimation of beta for projects in this sector will help Silver Atena estimate the riskiness of investing in this sector which seems to be low. And finally, the range of discount factors will provide the liberty to Silver Atena to choose appropriate discount factor to evaluate projects in this sector that will come their way in future.

Chapter 5: Discussion

5.1 Market Structure

The analysis of the overview on UK automotive and automotive safety and software industry in the literature review has revealed that there is an increased level of competition in the UK auto component sector which has reduced the scope of economies of scale for most players. In spite of these competition and low margin, innovations are taking place in automotive sector in the fields of safety both active and passive and comfort through infotainment and telematics products. Further, the PESTLE analysis has highlighted various government initiatives that are targeted towards increasing road safety and reducing emissions. Most of these innovations can be attributed to the electrical and electronic systems which also involve software and so these provide a good scope for safety critical software companies like Silver Atena.

Additionally, it has been observed that to remain economically viable, most manufacturers and Tier 1 suppliers have adopted the platform sharing across models and even brands and these kinds of platform sharing is also seen in software products.

The pestle analysis supported the above discussion and has revealed some specific attributes of the UK auto industry. It was seen that the UK government is now taking initiatives to revive the industry and major steps have been taken to promote low carbon and fuel cell technologies. Also the UK government is encouraging many OEMs to bring manufacturing back to UK. This will increase their UK sourcing which will be another step towards a sustainable growth in this sector. So it can be assumed that in near future auto sector will see more activities.

An important aspect that came out for suppliers is that though about two third of the components are imported, but due to the economic downturn, many OEMs and suppliers were affected and they are now in favour of reducing their long supply chain. This is an ideal opportunity for Silver Atena to present itself as indigenous UK Tier 2 supplier and at the same time use its off shore development centre to deliver services at low cost which is the current need of the market.

The above discussion based on Literature Review and PESTLE analysis is more focused towards future developments but Porters 5 force analysis have revealed the current scenario. Based on the industry overview, the 5 force analysis has identified three major segments which are contributing to the component market: Tier 1 manufacturers, R&D centres and Design engineering centres. And in the later discussion it will be seen that these form the potential clients for Silver Atena. As discussed in the literature review, Porter's 5 force analysis provide snap shot of the present time, accordingly this analysis have revealed that the safety critical software industry is characterised by high internal rivalry, high bargaining power of buyers, low entry barrier and low bargaining power of suppliers. Though there is no threat from substitutes but overall the industry looks only moderately attractive. Having said this, the analysis reflects only the current industry condition and doesn't reflect the positive discussion that has been made in the beginning of the section.

The above analysis should provide answer to the first research question on the market structure.

5.2 Client-Competitor Analysis

Due to the presence of players from all around the world, the UK experiences all the three types of buyer supplier relationships i.e. Adversarial, Keiretsu and Hybrid. Though a few studies have suggested that in the UK, even though a shift in the relationship structure has been observed from Adversarial to Keiretsu but there are other studies which could not find similar evidence. Hence, based on Literature Review it was assumed that the relationship is more adversarial in nature. Further the Literature Review was able to choose the prospective clients which Silver Atena may target; which are Tier 1 suppliers, R&D centres and Design Engineering Centres. It was also observed that in general there is less dependency on Tier 2 suppliers but when it comes to electronic or software product, the level of dependency shown by OEMs and Tier 1 suppliers are more.

Based on the classification provided by Literature Review, an exhaustive list of 20 clients have been analysed which include Tier 1 suppliers, R&D centres and Design Engineering Centres. From the analysis of clientele of these clients, it seems that most of the suppliers are working with most of the OEMs. Now this could be common in Adversarial and Hybrid relationship but even the Japanese suppliers like Takata, Aisin, Denso have broad customer range and not just Japanese OEMs. This shows that the buyer supplier relationship is highly dynamic in the UK and may not be categorised under the three heads and so needs further research.

The competitor analysis also provided an exhaustive list of 20 competitors that are operating in automotive electronics and software domain. The customer list of these Tier 2 suppliers comprise of all the participants of automotive industry from OEMs, Tier 1 supplies and Design Engineering Centres. This is in line with the inference drawn from Literature Review that potential Tier 2 clientele can be broadly segmented into three. Additionally, the analysis of the product offering of most of these Tier 2 suppliers suggest that their contributions are in the same four domains identified in the Literature Review i.e. power train, vehicle control, driver assistance and infotainment & telematics. However, among the Tier 2 competitor sample studied, the involvement is seen more in hybrid technologies but not much products and services are offered related fuel cell and electric vehicles.

Thus the client competitor analysis in response to the second research question has provided a probable list of clients and competitors and also identifies the current areas of development.

5.3 Market Attractiveness

In order to find an answer to the third research question on market attractiveness, inferences will be drawn from all the above sections. Along with these, discussion on internal analysis will also be used to evaluate if Silver Atena has the capability to explore the opportunities and face the threats present in the market. And finally financial analysis will also be referred to make a quantitative judgement on the industry attractiveness.

As seen for the above discussions, the auto component market is complex due to the presence of various business approaches and as shown by 5 force analysis, the market is highly competitive too. In the auto component market Tier 2 suppliers have low bargaining power making it unattractive for small suppliers. This is also substantiated by the financial analysis carried out in the data analysis section which shows that the industry is characterised by very low profitability. Dividing the whole industry into three segments samples based on business nature i.e. Tier 1 suppliers, Design and R&D centres and Tier 2 competitors, it seems that all the three segments have low profit margins in the past 5 years. The analysis also revealed an important aspect about the industry. It was observed that the industry characteristic as compared to previous study have not changed in terms of asset turnover and equity multiplier ratio. That is the ability of the industry to generate revenue from the asset base or to buy asset from the equity raised and even use of working capital have not changed much but due to high competition, the prices have come down which has affected the profit margins.

In such scenario, for the industry to remain sustainable, it has to either shift the existing industry or increase the demand. Now in the UK context, expanding the profit pool is difficult given the fact that population growth is low and economic growth has stagnated. But shifting the industry can be an interesting proposition. And UK government is focussing on promoting low carbon technology like fuel cells or electric cars and that will require a new supply chain.

So even the current market looks unattractive but if Silver Atena can position itself correctly and be part of the new growth strategy, it can easily enter the market without facing much competition and also gain maximum out of it by partnering with first movers in electric or fuel cell technology companies.

5.4 Brand awareness

For a new entrant like Silver Atena, it is important to participate in the automotive sector activities which will increase its recognition in the auto community. A few

ways to increase acceptance in the industry that came out during the analysis are through memberships, participating in technical events, auto shows, advertising through auto journals etc. Along with this, Silver Atena also needs to showcase its customer value proposition that will differentiate it from other existing players.

Some of the industry news and report related websites identified in the report (Silver Atena Report, 2011) are Automotive Technology, Automotive Intelligence, SAE International, Just-Auto.com, Automotive World, Automotive News, MIRA, KGP. Some of these bodies maintain list of suppliers which provide a easy way to be searched by any buyer. Associating with some of these repositories by publishing technical paper with them will enhance branding of Silver Atena in the auto component market. Membership with auto industry trade associations like Automotive Council, Society of Motor Manufacturers and Traders (SMMT), European Automobile Manufacturer Association, Automotive Distribution Federation provide opportunities to meet prospective buyers and competitors during various events.

One of the basic memberships that Silver Atena should take is with SMMT which will place it in the automotive supplier finder (ASF) database, a repository used by most buyers and suppliers in UK. As discussed in the PESTLE analysis, events like 'Meet the Buyers' will be an excellent opportunity for Silver Atena to strengthen its ties with prospective clients.

Based on the market complexity, as learnt from the literature review and the strengths that Silver Atena possesses, a customer value proposition has been developed that highlights the market needs and the solutions offered by Silver Atena. The following diagram depicts the summary:

SA's Customer Value Proposition	
What market wants	**What Silver Atena offers**
Competitive cost of products and / or services	Wholly owned Indian offshore development centre delivers an optimised low risk-cost benefit against competitors in UK and Europe.
High quality standards to meet safety requirements	Extensive experience in safety critical services in various sectors including automotive; presence of relevant accreditations testify credentials.
Proximity to OEMs and Tier1 suppliers	Located at Swindon, the front office is close to most OEMs/OESs which enables superior information sharing.
Customer satisfaction	Long term relationships with clients and high quality standards have allowed SA to maintain very high Customer Satisfaction Index consistently.
Indigenous product or service base	Headquartered in the UK, Silver Atena provides indigenous service to the UK customers, while exploiting advantages of globalisation due to our global presence.

Fig 16: Customer Value Proposition (Source: Author's own diagram)

Based on the literature review and data analysis, the market wants could be clearly identified under the following five heads:

- Cost of products and services
- Quality Standards
- Proximity
- Customer Satisfaction
- Indigenous products/services.

The offerings from Silver Atena have been identified based on the internal analysis done in the previous chapters. Silver Atena has been providing their software products and services using the offshore development model since inception. The wholly owned Indian development centre has been working in conjunction with UK and Spain offices to deliver low cost high quality products and services for Aerospace & Defence and Rail sector. The same model can also be applied for UK automotive sector that will reduce the labour cost extensively compared to other European competitors.

During to their long standing experience in safety critical services in domains like Aerospace & Defence, Rail, Energy etc., Silver Atena has acquired various quality and safety related accreditations that testifies its commitment to quality. It can therefore meet the safety standards of the automotive sector easily.

One of the advantages Silver Atena has is due to its location within the UK automotive hub that places it in close proximity with most OEMs and Tier 1s. As seen in the literature review and the external analysis, proximity plays an important role and manufacturers are inclined to reduce their long supply chain.

Also consistent high customer satisfaction index of Silver Atena is an acknowledgement of good relationship management with various clients. And so Silver Atena seems competent enough to handle the complex relationships that exist between OEM and Tier 2 suppliers and Tier 1 and Tier 2 suppliers.

And finally, being headquartered in UK, its indigenous origin will appeal to many buyers and Tier 1 suppliers who are looking for internal sourcing.

So in response to the final fourth question, this discussion highlights the various ways through which Silver Atena can increase its brand awareness and that it is well positioned to meet the needs of the market.

5.5 Challenges for Silver Atena

Software development has increasingly become global software development where offshore developments have increased many fold in the past 10 years (Conchuir et. al 2009). And Silver Atena is no exception. Though there are many potential benefits of Global software development and reduction in development cost due to salary saving is the most evident one. GSD can also lead to reduced development duration due to greater time zone effectiveness and also provides access to a larger and better skilled developer pool. But the study has highlighted the challenges faced by GSD model in relation to control of development process as shown below:

	Temporal Distance	Geographical Distance	Socio-Cultural Distance
Communication	Improved record of communications Reduced opportunities for synchronous communication	Closer proximity to market Access to remote skilled workforces Face to face meetings difficult	Innovation and sharing best practice Cultural misunderstandings
Coordination	Coordination needs can be minimised Typically increased coordination costs	More flexible coordination planning Reduced informal contact can lead to lack of critical task awareness	Greater learning and richer skill set Inconsistent work practices can impinge on effective coordination Reduced cooperation arising from misunderstanding
Control	Time zone effectiveness can be utilised for gaining efficient 24x7 working Management of project artefacts may be subject to delays	Communication channels can leave an audit trail Difficult to convey vision and strategy Perceived threat from training low-cost "rivals"	Proactiveness inherent in certain cultures Different perceptions of authority can undermine morale Managers must adapt to local regulations

Fig 17: Challenges in GSD model (Source: Conchuir et. al, 2009)

Though Silver Atena have been using the offshore development centre for businesses in UK and Spain but it has to be conscious of the control, communication, and coordination that changes with the distance type.

With replacement of mechanical or hydraulic components with ECUs, automotive electronics have to be 100% reliable across stringent running conditions but at the same time be low cost. Such semi-conductors are expected to work under broad range of temperature from -40C to 125C. Automobiles employ various types of microprocessors that store programmed lines of software code instructions, data, in read-write and Random access memory (RAM). There has to be flawless movement of instruction and data through the microprocessor units, RAM and external sources. In case of automotive industry, the software/hardware must be fail safe or have a safe back up in case of fault. Davis (2010) has pointed out that although automotive developers may adopt solutions from non-automotive systems, the specific requirements of the automotive industry may not be transferable which requires

learning curve to solve unique problem. According to the report, the complexities arise due to the following:

- Receive inputs from many sources like sensors and timers instead of a single interactive user or storage device.
- Outputs are produced under time constraints unlike ASAP in a stationary computer.
- Continuous working under no supervision.
- Must be able to able to tolerate the faults of various nodes without jeopardising the safety of the whole vehicle.
- Complexity also increases in order to restrict the interference of one embedded computer with another.

Semiconductor and Tier 1 companies have also to conform to OEM PPAT (production part approval process) requirements with numerous standards like AECQ100 qualification flow, ISO9001 and ISO/TS 6949 (2002), which are quality guidelines for Tier 2 suppliers (Santarini, 2006). Silver Atena will have to ensure these quality accreditations are achieved before getting into the automotive sector.

According to Huhn and Schaper (2007), due to the shift in focus from chips to codes in engineering products, companies that are accustomed to manage hardware development now need to learn new ways of managing software development. As compared to hardware which involves less uncertainty about system functioning, software development involves higher complexity due to more levels of connectivity and greater integration with other systems. The reliability of these embedded software systems will depend on adoption of mature architectures like in case of aerospace. In automotive industry, AUTOSTAR (Automotive Open System Architecture) is trying to establish standards, which can manage complexity, meet reliability standards and can be reused. This is a consortium formed by German automakers and electronics supplier group like BMW, Bosch, Daimler Chrysler, Seimens, Volkswagen and GM that have come up with the following architecture to create software foundation that serves every electronically controlled component in automotive.

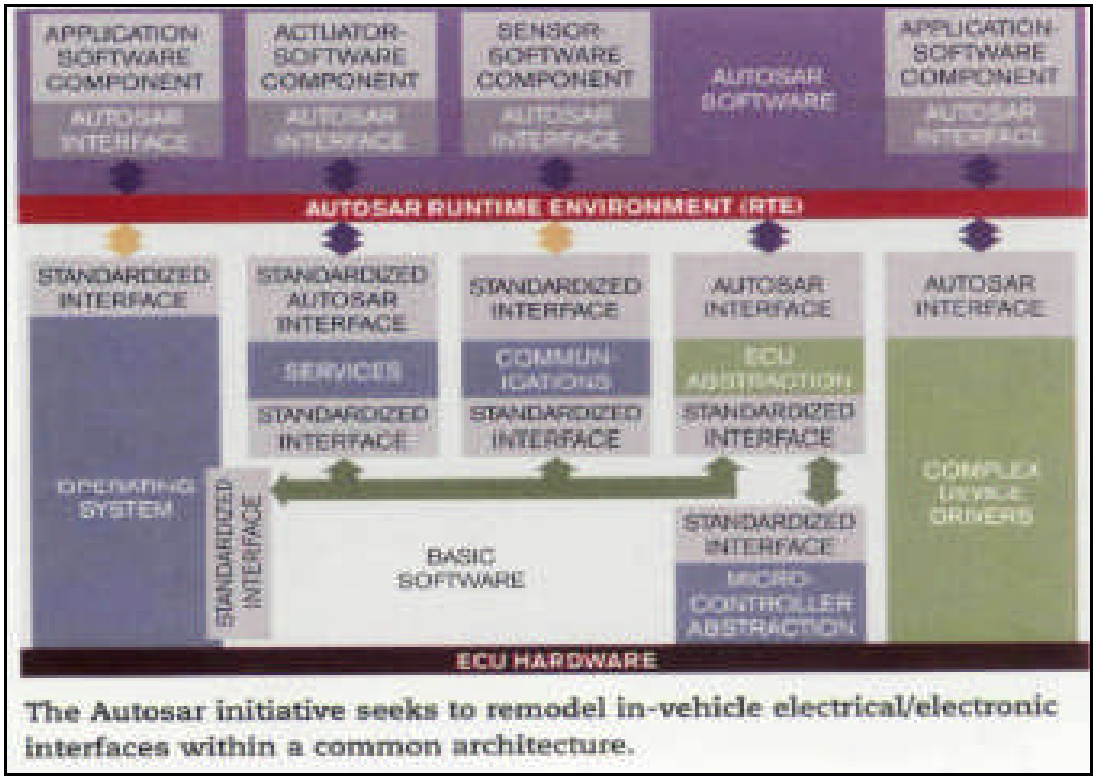

Fig 18: AutoStar framework (Source: Global Report: Automotive; Marsh, 2005)

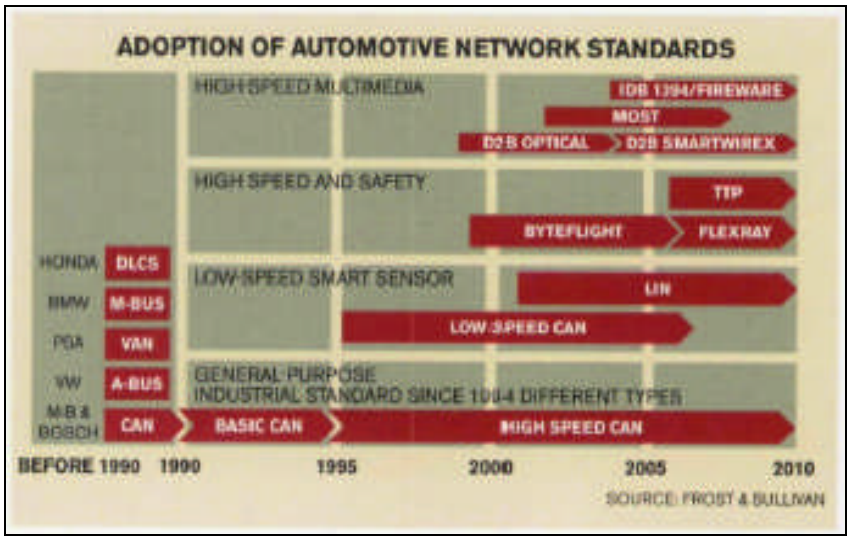

Fig 19: Automotive Network Standard (Source: Global Report: Automotive; Marsh, 2005)

The challenge for Silver Atena will be to adopt AUTOSTAR and other standards in all of their software developments that will accelerate their industry recognition and acceptance process.

Huhn and Schaper (2007) have highlighted that software development in embedded systems is lagging behind in the industry due to lack of software development tools.

As seen from the below figure, with the rise in ECUs, the number of defects per vehicle is also increasing leading to high percentage of electronic related recalls:

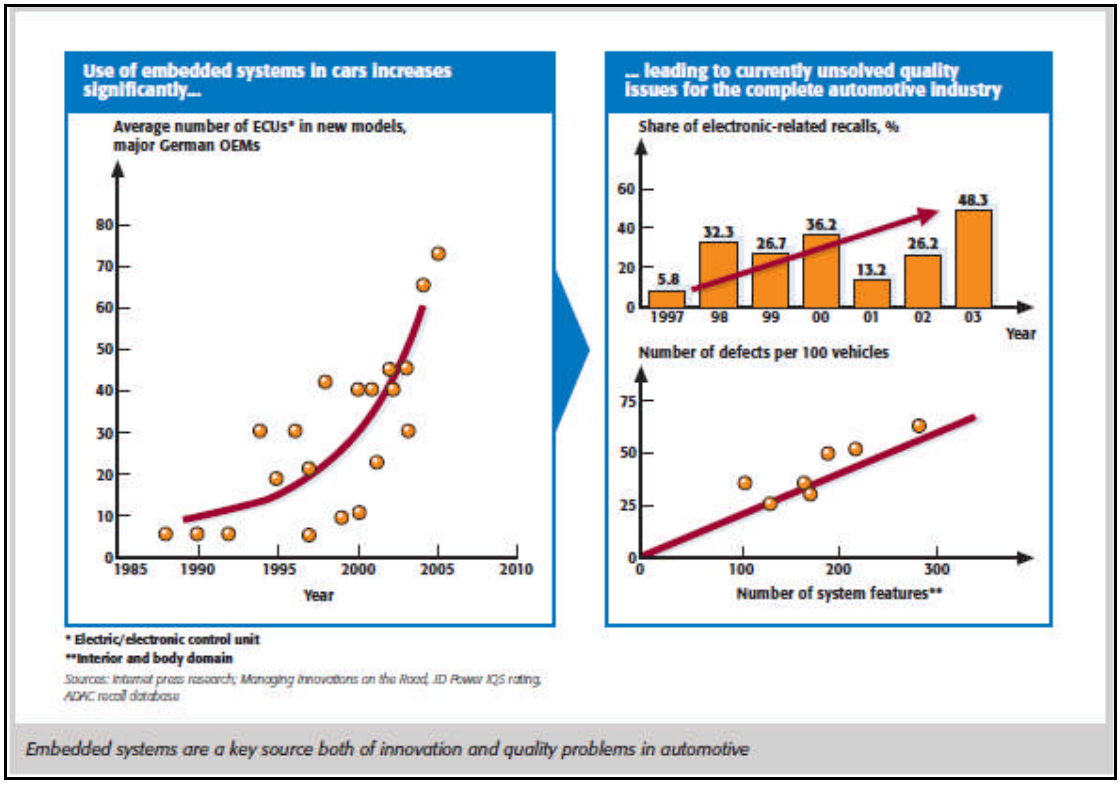

Fig 20: Embedded system growth and challenges (Source: Huhn and Schaper, 2007)

This is because the existing ones only focus on the parts of the design cycle rather than the whole. The software development is also constrained by the fact that embedded system requires expertise in software and hardware engineering, physics and developmental methodologies. As rightly pointed out by Huhn and Schaper, it also requires other improvements like a shift in mentality from hardware development mentality to more iterative software development mentality. And this can only be imbibed by deploying software oriented metrics to measure productivity of the developmental process.

These are a few of the challenges which Silver Atena in spite of their vast experience in safety critical systems will have to consider as they are specific to the automotive software component development.

Chapter 6: Conclusion

This dissertation was aimed to provide a realistic business case for Silver Atena on the UK auto component safety software market. In order to evaluate the market, four research questions were designed. This research provided answer to these questions which collectively represents the business case for Silver Atena.

Premised on the Literature Review, various tools identified for undertaking external and internal analysis provided the framework for data collection and analysis. Additionally, the Literature review unfolded the complex buyer-supplier relationship in general and also provided some insight into the relationship of OEMs/Tier 1 suppliers with Tier 2 suppliers. And it was observed that in case of electronics/ electrical and software components, the involvement of Tier 2 seem more with high level of dependency. But due to the presence of large number of small suppliers, the competition is mostly based on price. The literature review was also beneficial as it helped in identifying the latest developments that are taking place in safety related components which can be classified under four major segments: power train, vehicle control, driving assistance and infotainment & telematics.

The chapter on data analysis extended the research to identify the opportunities present in the UK automotive market. It was observed that the UK government is taking many initiatives to bring manufacturing back to UK which is expected to increase internal sourcing too. And in this regard we have seen many OEMs making commitments about specific models to be built in the UK (Auto Analysis, 2011). Though the future looks promising, but the current condition analysed using Porter's framework supported by the detailed financial analysis revealed that the profitability of the industry has been low. The main reason identified is price competition which is due to the increasing number of players getting into the sector. Further to this, the research has also identified the potential list of clients which Silver Atena can target and an extensive list of competitors who will be competing for market share against Silver Atena.

In spite of these challenges which most Tier 2 suppliers are facing currently, it looks the future will see more activities in low carbon technology field like hybrids, electric and fuel cell where government funding is increasing and strict emission norms will compel developments in those areas. The electric car segment and fuel cell technology are two areas which are not explored yet and have huge potential in future. For Tier 2 supplier like Silver Atena who has experience in developing safety related software products and wants to get into the highly competitive component industry, positioning themselves and partnering with companies in EV or fuel cell technology might provide an easy entry into the automotive sector. This call for further research in this area and the current research can be extended further to focus on the opportunities provided by the developments in electric or fuel cell sector.

In summary, the research concludes that the current auto component market is not attractive but the future looks bright for companies pursuing EV or fuel cell technology.

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Appendices

Appendix 1: PESTLE Analysis

Political

Various studies show that till now UK government and public have been less protective of the national industries in relation to their European counter parts.

Issues

There have been many issues mentioned by industry leaders in the past such as:

1. Government's less supportive nature towards the industry as compared to countries like Germany where national industries have direct and frequent contact to top government officials (Automotive Council, 2011).
2. The availability and skill levels of the UK workforce (Automotive Council, 2011).
3. The competitiveness (and scale) of the UK supply base (Automotive Council, 2011).
4. A severe hollowing out of the industry in the past decade, with a number of suppliers having significantly reduced their manufacturing activity in the country, or exited the country entirely (Holweg et. al, 2009).
5. A parallel reduction in the amount of automotive R&D taking place in the UK (Auto Analysis, 2011).
6. The perception of a lack of status of engineering in general and the automotive industry specifically as a long-term career choice (Auto Analysis, 2011).
7. Improving the monetary and fiscal environment, especially improving the lines of credit and financing available to the industry (Auto Analysis, 2011).
8. Lack of collaboration between the automotive sector and other high-technology industries and the academic world (Auto Analysis, 2011).
9. Lack provision of apprenticeships and low flexibility of the UK labour market in terms of skills and training for the industry (Auto Analysis, 2011).

However, now government will encourage automotive companies by reducing corporate tax rate and setting up regional growth funds to push money in advanced technology, innovation centres and expanding apprenticeship and wants to bring manufacturing and supply chain back to UK. Companies like BMW, Nissan will invest in UK for design, engineering and production of cars (Net News Publisher, 2011). UK government has taken various other steps to revive auto sector in general and also change public's perception:

Steps taken by government

1. The Automotive Council was established in 2009, as a partnership between industry and government, to consider the strategic development of the UK automotive industry. Its role is to promote investment for upgrades to existing research and manufacturing facilities in the UK by co-ordinating nation-wide activity and supporting key initiatives in the UK's automotive industry, including:

- The Technology Group – strategic support for automotive research and development, through the New Automotive Innovation and Growth Team's technology roadmap.
- The Supply Chain Group – feeding into the Automotive Council and focused on the development of a strong automotive supply base in the UK.

The remit of the Automotive Council is to position the UK as a compelling investment proposition, transforming the business environment in the UK and enabling it to secure funding for the research and development of new technology, collaborative research and testing facilities (SMMT, 2011).

2. The IMI is the professional association for individuals working in the motor industry. The institute is the Sector Skills Council for the automotive retail industry and the governing body for the Automotive Technician Accreditation (ATA) scheme (SMMT, 2011).

3. RoadSafe is a road safety partnership that brings together the motor industry and related companies, traffic engineers, the police and road safety professionals. Its mission is to reduce road deaths and injuries by sharing knowledge and encouraging innovation (SMMT, 2011).

4. The 'Manufacturing Strategy 2008' document, which despite its rather selective reporting of KPIs, is providing the „manufacturing matters" message that industry has long wanted the government to give. This document also identifies R&D as the most the important USP of UK manufacturing firms, which in automotive terms has to be seen in context of the sharp decline in both capital investment and R&D the UK has seen, which will place the UK in a very weak competitive position in the long run (Holweg et. al, 2009).

5. Cenex is an UK government initiative to promote low carbon and fuel cell technologies and has committed to invest GBP 350 million to encourage ultra low emission vehicles for future. It is also becoming a centre for electric car manufacturing site with Cenex managing operations of Mitsubishi-MiEV and also administering the launch of Toyota Plug in Hybrid. Nissan is also planning to manufacture electric car Leaf and Toyota will manufacture its first full hybrid Auris (UKTI Report, 2010).

All these steps taken by the government in the recent years promise to eradicate the issues prevalent in the sector. The importance now being given by government to automotive sector assures that investment would increase in the sector and general competitiveness in the sector would improve, leading to increased preference of UK auto suppliers by the OEMs.

Economic

The UK auto industry employs 194,000 people in 3,300 businesses, generating some £10.2bn value added in 2007 i.e. the automotive manufacturing sector directly represents around 0.8% of the UK economy in terms of value added, and directly provides around 0.6% of total UK employment. According to 2007 data, UK auto

sector is the largest single exporter and a even larger importer leaving a large net trade deficit.

Recession in 2008 has altered the landscape of UK automotive industry. Not only OEMs but OESs, including Tier1 and Tier2 suppliers, also have been largely affected by the economic turndown (NAIGT, 2007; Holweg et. al, 2009).

Dynamics of OEMs and OESs in the UK auto sector

The UK automotive supply chain largely supports the vehicle programmes assembled in the UK. At present, about 80% of all component types required for vehicle assembly operations in the UK can be produced by the UK suppliers. However, about one third of the value of components needed to support UK-based vehicle production is currently purchased in the UK, while two thirds are imported (Automotive Council, 2011).

Parts/Supplier sector exports have been fairly flat at a little over £6 billion-worth of goods annually from the mid-1990‟s, though imports have grown from a similar level, to nearly £15 billion during the peak just before the recession, yielding a deficit of over £8bn at the peak. As markets have recovered post recession, parts imports are again rising more rapidly than exports, possibly in part due to the loss of capacity and by mid-2010 the parts trade deficit was approaching £7bn on an annualised basis (Automotive Council, 2011).

Of the entire Tier1 suppliers in the UK, 65% manufacture in the UK, while virtually all Tier2 suppliers operate manufacturing facilities in the UK. The average supplier (Tier1) serves six customers (median), with a strong bias towards those OEMs that operate vehicle and engine assembly plants in the UK (Automotive Council, 2011).

Competitive advantages and disadvantages of UK suppliers

According to Automotive Council Report (2011) ‘Proximity’ was identified as the key competitive advantage of UK suppliers: in operational terms, proximity allows for:

- lower logistics cost, a better support for UK-built vehicles
- a responsive and quick turnaround of configuration of parts
- more flexibility to adjust to volume and product mix fluctuations.
- In strategic terms proximity also acts as a general proxy for risk reduction the supply chain and a hedge against currency fluctuations.

The key reasons why UK suppliers have lost business are:

- the unit cost is not competitive
- operational execution i.e. quality, cost and delivery (QCD)
- financial aspects such as availability of finance and concerns over supplier size and stability

When UK supply business is lost, about one third stays within the UK and Western Europe, one third goes to low-cost countries, while the final third show no clear pattern. **The risk of losing business to low-cost regions rises however considerably for second-tier suppliers**. In terms of suppliers, there is a general consensus that the UK is losing its Tier1 supplier base to continental Europe (France and Germany), which in turn has led to a reduction in Tier2 and Tier3 suppliers in the UK. This is leading to a '**hollowing out**' of the supply chain. Surveys clearly show that the decline in the level of sourcing from the UK has continued for all firms surveyed, and is very likely to decline further over the coming five years. The loss of economies of scale in the component supply chain is detrimental to the future of the UK automotive industry (Automotive Council, 2011).

Opportunities created for suppliers

According to Automotive Council Report (2011) short term opportunities largely arise where OEM sourcing needs match with strategic growth areas of UK suppliers, in other words, where OEMs have a current need that could potentially be met from a UK-based supplier. Here, considerable potential was identified for the 'classic' components sourced:

1. ‘Powertrain & body’ components, where virtually all needs can theoretically be met, with the exception of ‘heavy metals’ processing capabilities (casting, forging, etc) that were identified as supply chain constraint by both OEM and suppliers.

2. ‘Interior and exterior’ components, where virtually all OEM needs can be matched with supplier growth intentions.

3. ‘Electrics & electronics’ components, where some needs can be matched. Critical parts missing are batteries and electronics (such as Electronic control unit) in general.

For instance, GM is the harbinger of change and it has already been reported that GM plans to bring back over £130 million worth of sourcing to UK suppliers (Auto Analysis, 2011). This might be symbolic of the way in which the industry is heading and other vehicle companies will steadily increase UK sourcing for a variety of reasons, including wanting to:

- Minimise exposure to exchange rate fluctuations.
- Minimise the vulnerabilities and costs of an extended supply chain.
- Take advantage of the flexibility of the UK labour market and the generally positive industrial relations environment.
- And, crucially, take advantage of the growing expertise which the UK has in low carbon technologies.

SMMT has launched two initiatives the Automotive Supplier Finder (ASF) database and a series of “Meet the Buyer” network events. The Automotive Supplier Finder (http://www.autosupplierfinder.com/) database contains information on several thousand UK companies which enables vehicle manufacturer and Tier1 purchasing executives to search for potential UK suppliers online. The first of the networking event took place in July 2010 with over 90 meetings taking place between UK suppliers and purchasing representatives (Auto Analysis, 2011).

Social

The UK has competitive advantage in terms of labour flexibility as compared to Western Economies though less compared to Eastern Europe and BRIC economies. The R&D tax benefits, personal tax and tariffs are also competitive with respect to other European countries. The UK also has better customer service as compared to other European and BRIC economies. The most salient weakness that came out was the labour cost and lack of skilled labour which is more pronounced in the mid management level. UK is perceived to be more competitive than FGIS (France, Germany, Italy and Spain) in labour flexibility and barriers to exit, while FGIS are clearly more competitive than the UK in the availability of local suppliers, the skill level workforce, the availability of skilled labour. Most of the western economies have suffered from east-shoring of manufacturing unit but UK has been hit worst due to government's non-interventionist approach which makes it less costly (politically) to close out operations during down turn. **In other words, the UK is currently competing mostly on labour flexibility, and the least cost for capacity adjustment, while suffering from disadvantages in terms skilled labour and the availability of local suppliers**. The perception of UK automotive and supplier industry is not strong amongst the people (APMG, 2011; NAIGT, 2007).

Technological

Key areas of sourcing opportunities for UK suppliers

In the higher technology areas, vehicle companies have indicated their wish to source electronic control units, satellite navigation systems, advanced air conditioning and safety systems in the UK (Auto Analysis, 2011). For the electric vehicle market, an entirely new supply chain will need to be established – for the vehicles and the batteries; the following component areas have been identified as highly desirable for local sourcing: specialist wiring harness, electrical power unit, electric drivetrain and gearing (Auto Analysis, 2011).

A major report undertaken by Ricardo Consulting, supported by government, identified the emerging low carbon vehicle market as the key new opportunity for the UK and also led to the setting up of five expert groups – covering supply chain, technology and business environment issues (Auto Analysis, 2011).

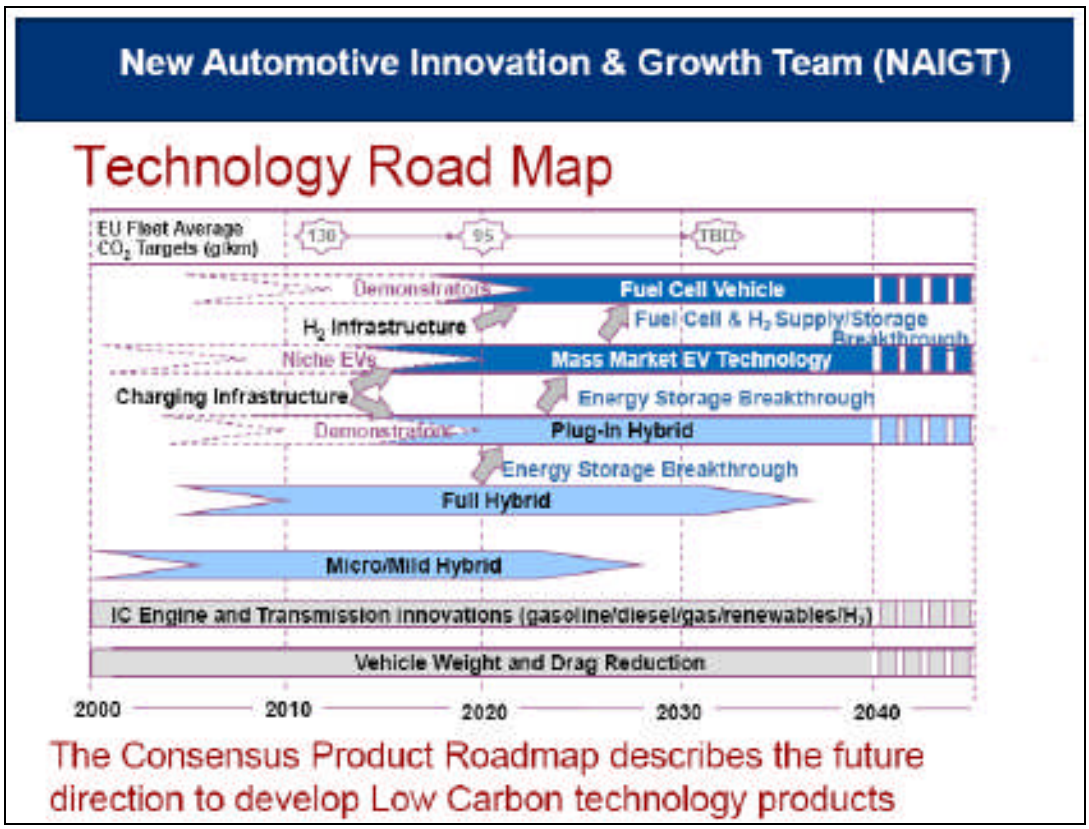

Fig 21: NAIGT Technology Road Map

Increasing use of Telematics in Vehicles

The use of high tech equipment will become more and more prevalent like in-vehicle telematics which provide drivers instant safety, security and communication services. Voice assisted driving directions, parking, acceleration and vehicle failure detection will become common. Telematics driven infotainment services include Blue tooth wireless and satellite radio and future applications will include vehicle to vehicle communication to ensure safe distance and eliminate collision chances. Automakers will also be pressurized to develop global platform upon which vehicles will be designed, engineered and produced to leverage most capital intensive equipment and resources initially and then customize and accessorize later for regional preferences (Banks S, 2010). Eg. Volkswagen's Golf platform PQ35 is shared across the VW,

Audi and Skoda brands. **Hence, suppliers will have to be equipped with technology and provide the technology which would be acting as standards in the industry.**

Rapid change is technology used as platform

Suppliers will also have to keep up with the improvements and latest updates in the technologies used in digital systems and electronic systems in the car. For instance, the improvement in semiconductor technology in the form of PLDs (Programmable logical device) are a viable replacement for ASICs and ASSPs as they can reduce engineering development time and cost and can be programmed and reprogrammed during the design process and can be upgraded easily. The PLDs have grown over the past 3 to 4 years and is expected to rise at 40-50% CAGR over the next five years. The evolution of platform concept was needed to respond to the short design cycle times by sharing of different car model on same basic design (Altera, 2011).

Expected developments in car technologies

SMMT forecasts that in the next 10-20 years, the following developments could be fostered into vehicle production (IMI Report, 2009):

- Zero failure electronics with self-monitoring circuits and active intervention
- Switches that do not have to be pressed but respond to finger pointing
- Sleep/drowsiness monitoring
- On-board computers that predict vehicle and pedestrian movements and automatically trigger the car to respond to an emergency
- Real conversation voice control

Key areas of development in future: Green technology and Car Safety

There is possibility of heavy investment in R&D by the Tier1 suppliers in technologies related to reducing CO2 emissions and increasing car safety. Alternative fuel vehicles are expected to grow in the future, such as use of vehicle

with hydrogen fuel, bio fuels, hybrid, electric and so on. Alternative low carbon powertrain parts will gradually phase-in, however, these will be in addition to traditional parts, so the shift is only partial. At present, alternative powertrain (such as hybrid, hydrogen, fuel cell and electric) vehicles make up a small proportion of the market only. However, as their importance will grow, so will the relative weakness of the UK to maintain its position in the global automotive industry. The main developments in this space are currently being done in Japan, Germany, France and the USA.

Legislative

Government policy can provide direction to the automotive sector and drive business behaviour.

- The End of Life Vehicle directive aims to reduce the amount of waste from vehicles (cars and light goods vehicles) when they are finally scrapped. Future investments in End of Life Vehicle directive will ensure that by 2015 95% of new vehicles will be fully recyclable. Suppliers will have to take care to supply sustainable components (SMMT, 2011).
- One reason why OEMs in UK source from suppliers outside UK is that there are not sufficient numbers of „accredited suppliers". The accreditation levels here include OEM-specific programmes, as well as generic ones such as ISO/TS16949:2002, ISO9000 or ISO14001 (Automotive Council, 2011).
- Euro IV emission norms were made mandatory for all vans registered after 31st December 2006, Euro V which limits fine particles, hydrocarbon and nitrous oxide came into force from Sep 2009. A tighter Euro IV for Nitrous oxide emission will apply from September 2014. Euro V reduced pollution certificate entitles vehicle owners to a reduction in Vehicle Excise Duty if their vehicle is fitted with on-board diagnostics systems and torque-control mechanisms that check and control emission levels, came into effect in 1st October, 2007. Suppliers will have to stick to these emission norms and be aware of changes in these norms in the future (Key Note, 2008).
- Whole Vehicle Type Approval will be made compulsory for all commercial vehicles by 2014 which will ensure that vehicles are safe to use on the road

without having to inspect and test every single one. Suppliers might have to make appropriate technological changes for the same (Key Note, 2008).

- Government has recently made a number of legislative bodies. It is important that the OEMs and OESs keep an eye on the changes these bodies make related to various areas such as CO2 emission, tax rebate on R&D investments, mandatory requirements of any technologies, any legislation affecting competition in the industry and so on. Some of these bodies are: SMMT (Society of Motor Manufacturers and Traders), Automotive Council, APMG, NAIGT (New Automotive Innovation and Growth Team), ASF, BIS (Business Innovation and Skills), MISRA (Motor Industry Software Reliability Association), IMI (Institute of the Motor Industry Home), ATA (Automotive Technician Accreditation) etc.
- The sale of green cars is expected to outnumber those of heavy petrol users due to road tax benefits provided by the government. The government is planning to accelerate the process with extra tax to be levied on gas guzzlers (Key Note, 2008).
- Government initiatives like 'Tomorrow's Road Safer for Everyone' have led to the development in vehicle safety innovations that include rear seatbelts, airbags and improved braking systems (Key Note, 2008).

Environmental

Manufacturers are committed to low carbon growth and to driving forward sustainable initiatives within the automotive industry. This has led to many innovations. For e.g.:

- Tyre pressure monitoring systems measure the pressure of each of the tyres and will give a warning through the dashboard display if they become under-inflated.
- Gear shift indicators show the driver the optimum time to change gear (up and down) while driving (SMMT, 2011).
- Low rolling resistance tyres are designed to improve the fuel efficiency of a vehicle by minimising the energy wasted as heat when the tyre rolls down the road (SMMT, 2011).

Tier1 companies have continuously invested in R&D technologies related to environment. Constant innovation by vehicle manufacturers has seen CO2 emission levels drop dramatically and in 2010, average emissions for all new cars fell 3.5% on 2009 figures to 144.2g/km CO2, 36.8g/km or 20.3% below the level in 2000. Hence, a common contention is that the future opportunity for the UK automotive supply chain lies with the development and large-scale production of low-carbon vehicles (SMMT, 2011).

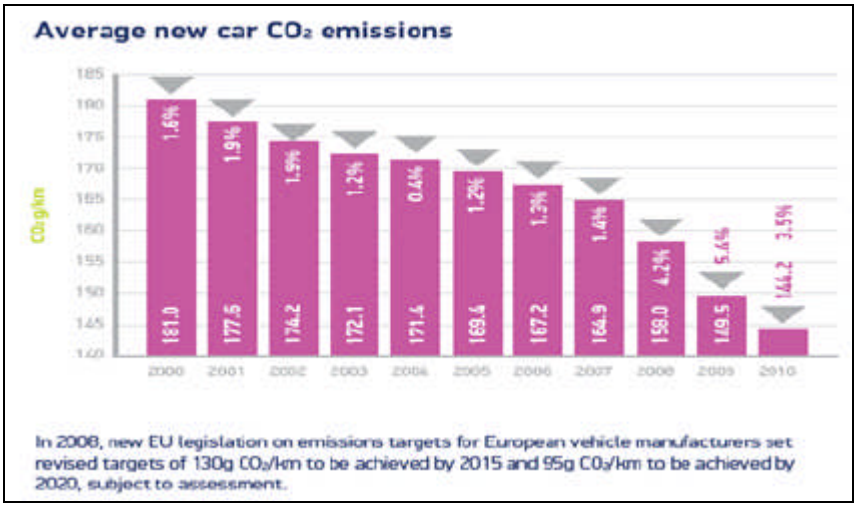

Fig 22: Average New car CO2 Emission

Average new car CO2 emissions have fallen 20.3% in the last 10 years to 144.2g/km CO2. Hence, there is continuous improvement in this regard over the years. There are approximately 1,800 Authorised Treatment Facilities (ATFs) in the UK and environmental performance statistics are published biennially by the Department of Business, Innovation and Skills and in SMMT's Annual Sustainability Report (SMMT, 2011).

The transition from present technology to low carbon solutions represents a potential opportunity for UK automotive sector. However, this transition also represents a significant risk as if low carbon technology isn't developed and manufactured in UK then present indigenous auto sector may see a significant shrinkage.

Appendix 2: Porter's Five Force Analysis

Automotive Safety Critical Software components industry

Bargaining Power of Buyers

In automotive safety critical software industry, the buyers are the OEMs or the Tier 1 suppliers who tend to monitor and influence the supply chain in terms of standards and processes. As the number of buyers is less and their size being large, they have a strong bargaining power against the safety critical software suppliers. These buyers have full information on the demand and cost of the safety critical software products and services. Though there is importance on quality but due to low profit, they are very price sensitive and there is an increased pressure from buyers to reduce cost. Most auto component buyers require their suppliers to lower their process in order to improve productivity. Also due to their sheer size, OEMs and Tier 1s pose a high threat of backward integration. In fact companies like Robert Bosch are vertically integrated and have internal software division to produce safety critical and other automobile software. So the bargaining power of buyers is **exceptionally high**.

Barrier to Entry

The main barrier for companies entering the auto component industry is the substantial capital investment and the industry is seen as highly capital intensive. In component industry, latest and highly specialized technology is used which are costly and hence increases the exit barrier. But in safety critical software industry, the initial capital investment is negligible and only requires substantial initial investment in human resources and constant training of employees. Also there are numerous requirements in terms of standards, certifications and accreditations that include the regular ones and the customer specific ones. Also, knowhow of safety software industry requirements including SDLC cycle and project management pose a barrier for entry. In addition to these, due to global presence of some players they can easily leverage low production cost business model.

In safety critical software industry, product differentiation is considered as moderate as mostly standardized products are used in auto components. This also makes the switching cost low for the buyers. Most of the safety critical software development

takes place in house with OEMs and Tier 1 suppliers and depends on relationship building and so there is low dependency on the access to distribution channel. Due to the presence of large number of players in the software market, the retaliation by the existing players is considered to be low and only depends on how cost effective they are.

Though there are significant barriers for entry of new auto parts manufacturers due to the nature of the industry, the safety critical software industry seems to provide only **low** barrier.

Internal Rivalry

There are nearly 2600 business units which are active in the auto component sector of which 80 companies represent 74% of sector sales and 96% of employment (Holweg et. al, 2009). The number of auto component manufacturers is pretty high that are operating in UK. Giants like Robert Bosch have their internal software teams to develop safety critical software components. As auto parts manufacturing companies have high capital investment making the exit barrier costly, there is increased focus on product differentiation and cost optimization. Due to slow growth of the overall industry and low profit margin, the competitiveness is high.

But for companies providing only software services to the OEMs and Tier1s, the capital investment is low making the exit barrier easy and the profit margin is better amongst the players. However, to remain competitive the product differentiation is moderately high. Also considering the high level of globalization of the auto industry, it would be inappropriate to exclude international competition. But since most product development and R&D takes place in house so global players are unlikely to participate. So, for safety critical software industry, the competitiveness can be considered **moderate to high** as opposed to highly competitive auto parts rivalry.

Bargaining Power of Suppliers

In auto industry, OEMs and Tier1 suppliers command the bargaining power and often instruct and monitor suppliers. The buyers normally provide all the requirements on production standards and certifications. These also provide suppliers with necessary accreditations and affiliations with substantial bargaining power. In safety critical

software industry the suppliers are the skilled labour force and there are is no dearth of technical skills in UK due to its high education standards with number of courses running on automotive technologies in UK universities.

The human talent does not provide much differentiation in terms of skill set but there are also no substitutes of these skilled technical people. Though there are increased focus on automation and mechanization but in product development or R&D phase is mostly skilled labour intensive. Due to high labour cost, high man hours in R&D and product development phase, the cost of acquiring these skills makes up a large portion of the input cost. This increases their bargaining power to some extent also supported by the fact that these skill set will find use in other industries and so not very dependent on only automotive industry.

However, due to the access to global workforce, in an effort to become more competitive the buyers tend to outsource work to acquire high skilled labour at lower cost. Also there are very little chances of forward integration by these suppliers and so overall it seems the bargaining power of suppliers is **low**.

Threat of Substitutes

There seems to be no likely threats of new products that could replace automobiles and so auto component replacement is unlikely. But due to high energy cost and emission norms, there is increased focus on low emission and high efficiency technologies which drives the innovation in the industry. So there is an affinity among OEMs and Tier1 suppliers to manufacture automobiles and auto components that are substantially different from today's standards such as hybrid vehicles, electric vehicles and fuel cell power train etc. Overall, threat of substitutes is **very low**.

Thus, **Industry attractiveness: Moderate.**

Appendix 3: Evaluation of capabilities and resources of Silver Atena (UK)

Questions Answered by Nilanjan Das Gupta from Silver Atena (UK)

1 a) Considering the fact that Silver Atena in Germany is into Product development, does the German office has experience in providing services as outsourcing partner of OEMs and Tier1 suppliers in automotive sector? Generally, in what ratio the revenue is generated from products and services?

Ans:- Yes to your first question. I would say the ratio of revenue generated from products to services is in between 1:8 and 1:10

b) If Silver Atena in Germany provides outsourcing services, does it provide services as Tier 1 supplier or Tier 2 supplier?

Ans: Mostly as a Tier 1 supplier to automotive clients

c) Does Silver Atena in the UK have experience in providing services as outsourcing partner to Companies operating in Aerospace, Defence, Rail and Gas turbine sector?

Ans: Yes

2. a) What is the average length and size of contracts for Silver Atena in Germany operating in automotive sector? Can you provide specific details of various developments in the field of hydrogen fuel technology, hybrid drives, control by wire, engine control etc.

Ans: 1 to 1.5 years

b) What is the average length and size of contracts for Silver Atena in the UK operating in different sectors?

Ans: At this point of time 8 months to 1 year on fixed price projects. Given the economic condition in UK for the past couple of years most of our resources have been working for clients onsite, integrated in their team (on a Time and Material basis- i.e. hourly rate basis)

3. a) What according to you is the competitive advantage of Silver Atena in Germany in automotive sector? What are generally the USPs of Silver Atena in Germany when pitching for a contract?

Ans: According to me Germany has a matured automotive market with big automotive OEMs close to our offices in Germany. SA Germany has been operating in the automotive market more than the past decade that gives them the credibility, experience and reference in the local market, whereas SA UK has never worked on any automotive project in the past.

Germany USPs: Quality is first and foremost although price is a little on the higher end; Experience in high end technology work; Highly productive; financial stability because of large parent company – Assystem group; References from OEMs and Tier 1 companies in the automotive sector.

b) What are the competitive advantages of Silver Atena in the UK operating in different sectors?

Ans: UK USPs – Local European front office (HQ located near to office of major clients such as GE Aerospace, Invensys Rail); wholly owned Indian offshore development centre managed by our HQ in UK, which gives our clients an optimised low risk-cost benefit; Our higher management is very much approachable by our customers (as and when needed); Most of our present business is based on relations that we have built with clients in the past (long term customer relationship); Good quality – e.g. Customer Satisfaction Index in the last 18 months have been 4.8 on scale of 1 to 5; financial stability from our parent company – Assystem group; More than a decade experience in managing/offshoring aerospace and rail projects (high integrity safety critical projects – i.e. a niche market sector)

4. a) What are the automotive related software technologies Silver Atena in Germany is working on?

Ans: Provided in Page 6 of the SA company brochure provided to NUBS students. Also present in the slides provided to you. (See below)

b) What are the technological (software) skills of Silver Atena in the UK?

Ans: I shall attach a slide for this answer along with this email. The slide shall be depicting most of the technology and software skills used in the industries that we operate in, but we are not limited only to these many skills.

Appendix 4: Interview with Industry Expert

1. Whether safety features are generally developed in-house or outsourced and if outsourced, what are the lengths of the contracts?

Ans: The complexity of the vehicle manufacturing comes from combining Engine controller, Cruise controller, Braking System etc which are the safety components. Parts of the components like Engine controller are outsourced but Diesel engines are in house developed. So not all the components are outsourced and some are produced in house.

The contracts are long term and the competition is on price.

2. Can you share your knowledge about the sub contracts by the Tier1 safety components suppliers for safety software services?

b) Do you deal with tier1 suppliers only or Tier2 suppliers as well?

Ans: a) Bosch, Continental manage most components including software. These Tier 1s internally outsource many of their components or parts to Tier 2s. The Tier 1s develop most of the components outside UK and then import.

b) Tier 1 only. The interviewee couldn't disclose much of the information.

3. What are the selection criteria for the safety critical component suppliers?

Ans: A year ago it was very much over price but now stability of suppliers also is important.

The design is done by Ford but manufacturing and production is done by Bosch or Continental.

4. How is the competitiveness of safety component market? (Number of vendors, rivalry, differentiation factor etc.)

Ans: Power is balanced between Tier 1 and OEMs.

5. What are the major developments in safety critical systems in UK and Europe and what are your reflections on the growth of software usage in safety components?

Ans: In the areas of power train, vehicle control, driver assistance.

6a) Are the suppliers of safety systems based in UK or abroad? Can you tell us name of few major players of Safety software service providers in the UK and abroad?

b) How much development of software services takes place in UK and how much in other parts Europe?

Ans: a) According to him, Bosch and Continental provide all the safety systems including software and they internally might outsource some parts to Tier 2. The components used by UK manufacturer are mostly imported by the Tier 1s.

b) Since most of the software is provided by Tier 1 suppliers, so couldn't provide internal Tier 1 details.

7. What portion of safety systems is comprised of software and what is its effect on cost? Which safety products have more potential for software usage in future?

Ans: 25-30% of the total cost. No answer was provided for the 2nd part.

8. Your reflection on the growth of software usage in safety components?

Ans: Couldn't provide specific answer.

9. What is the sales projection/potential size of market for safety systems/safety software services?

Ans: Being a technical person he couldn't provide answer.

10. Are the technologies used for development of safety software different for different car/commercial car segments?

Ans: Couldn't be asked.

11. Are there any govt. regulations regarding use of safety components in UK?

Ans: Couldn't be asked due to time constraint.

12. How long usually is the new product development of Tier1 suppliers?

Ans: 1-1.5 years.

13. Are there any safety components in aftermarket that require software services?

Ans: Couldn't be asked due to time constraint.

14. Which kind of vehicle is expected to have more software usage- Hybrid, Electric or Combustion?

Ans: Due to complexity involved, hybrids are expected to have more embedded software.

Appendix 5: Interview with Academic Expert

1. What is your view on the UK automotive industry? Where do you see it heading towards?

Ans: The UK manufacturers serve the global market and not just the local market. Eg. Ford Engineering Centre produces diesel engine for whole world.

The Tier 1s fight over cost all over the world to secure business but at the same time they are highly innovative.

2a) Even though cars are produced in UK, but the reports say that most of the components used are outsourced and the trend will continue in future? What is your view on this?

Ans: Yes, most components are outsourced by the manufacturers.

Low carbon technology innovations involve huge amount of software and it is ever increasing.

b) Are the low carbon developments taking place in UK?

Ans: Didn't make specific comment.

c) Are software involved in these developments?

Ans: Software will only be involved in the R&D or design phase of the component and the licensing will be transferred to the OEMs after product development.

3. Does technology Strategy Board work on automotive technology? If so what are they? Are there any developments related to automotive safety component?

Ans: Power train efficiency.

4. How do you see the growth of fuel cell technology wrt to automotive? Is this technology in R&D phase or in production? Do you see this technology to be used for mass production or luxury cars? What do you think will be the impact of such technology on the cost of the vehicle?

Ans: Its closer than many people think they are. May be a 5 years away. R&D is taking place to reduce the cost involved.

On Software involvement: Fuel cell technology will also demand use of software in the power train design.

5. What is the competitive position of UK as compared to other European countries and US? DO you see any scope of developments of power train related to fuel cell to take place in UK in future?

Ans: Couldn't be asked due to time constraint.

6. What is govt's attitude towards fuel cell in terms of assisting or funding R&D?

Ans: Low Carbon Vehicle Program is a government initiative for promoting low carbon vehicles.

7. Do auto suppliers or auto manufacturers have access to this technology? Are they in a position to develop this technology? When can we see this technology in production?

Ans: Couldn't be asked due to time constraint.

8. Will the power train developed with fuel cell technology be a mechanical unit or a combination of mechanical and electronic/electrical unit? If so, what could be the percentage of electronic/electrical in the whole component i.e power train?

Ans: The fuel cell power will also involve software as in hybrids or contemporary diesel or petrol engines.

9. We have found from a few researches that in present day cars almost 40% component cost is for electronic/electrical items. What is your view on this?

Ans: Couldn't be asked due to time constraint.

10. Can you provide some insight into the competitiveness of automotive safety component market –buyer power, supplier power, internal rivalry, threat of new entrant, threat of substitutes? What are the major developments taking place now? What safety technologies can we see in future?

Ans: Didn't provide specific answer. Just that competition is mostly price based.

11. Are there any researches or products for automotive industry that are taking place in Carbon abatement technology? If so what are those products/research? When can we see those technologies in market?

Ans: Couldn't be asked due to time constraint.

12. What do you think will be the composition of such product i.e. what portion of it might comprise of electronic/electrical component?

Ans: Couldn't be asked due to time constraint.

13. Who is supporting these research, is it only govt or car manufacturers and Tier 1 suppliers are also investing in such research?

Ans: Couldn't be asked due to time constraint.

Appendix 6: Tier 1 Supplier Data (From FAME)

Company: Aisin					
000 GBP	**2006**	**2007**	**2008**	**2009**	**2010**
Turnover	26489	23660	18728	15383	
Operating profit	1045	202	-726	2204	
PBIT	1253	1258	-495	2222	
Net Profit (PAT)	757	1034	-739	1624	
Curr Assets	12995	13317	10261	13509	
Non Curr Assets	3345	3008	2531	1965	
Curr Liabilities	8314	7266	4787	5843	
Non Curr Liabilities	0	0	0	0	
Debt	0	0	0	0	
Shareholders fund	8026	9059	8005	9631	
Total Assets	16340	16325	12792	15474	
Check Total assets	0	0	0	0	
Employees	183	172	146	103	
Company: Cobra					
000 GBP	**2006**	**2007**	**2008**	**2009**	**2010**
Turnover		9276	7324	7548	9519
Operating profit		175	-8883	193	158
PBIT		281	-8855	195	158
Net Profit (PAT)		-1755	-10923	-2139	-2595
Curr Assets		4252	3732	4634	5889
Non Curr Assets		15956	5184	5002	4825
Curr Liabilities		8071	2448	3239	4294
Non Curr Liabilities		13362	18622	20691	23309
Debt					
Shareholders fund		-1226	-12154	-14294	-16889
Total Assets		20208	8916	9636	10714
Check Total assets		1	0	0	0
Employees		29	27	24	25
Company: Continental					
000 GBP	**2006**	**2007**	**2008**	**2009**	**2010**
Turnover	44182	58598	74463	50421	29678
Operating profit	3995	5140	2578	1548	3702
PBIT	4186	13760	10009	2092	6321
Net Profit (PAT)	2550	9254	5210	-158	2638
Curr Assets	12970	19720	23658	27619	19370
Non Curr Assets	3313	1503	981	709	616
Curr Liabilities	7619	8254	10266	6759	4088
Non Curr Liabilities	3952	1703	1174	9793	3766
Debt	0	0	0	0	0
Shareholders fund	4712	11266	13199	11776	12133
Total Assets	16283	21223	24639	28328	19986
Check Total assets	0	0	0	0	-1
Employees	196	153	100	113	135
Delphi Automotive					

000 GBP	2006	2007	2008	2009	2010
Turnover	116241	159800	148812	99646	
Operating profit	2012	16696	7849	13	
PBIT	7518	24804	14726	3450	
Net Profit (PAT)	4680	16631	7595	919	
Curr Assets	112381	146338	118245	122042	
Non Curr Assets	6145	5541	5246	2852	
Curr Liabilities	93977	116044	82453	92651	
Non Curr Liabilities	18988	8734	22038	28380	
Debt	0	0	0	0	
Shareholders fund	5561	27101	19000	3863	
Total Assets	118526	151879	123491	124894	
Check Total assets	0	0	0	0	
Employees	207	224	222	230	
Company: Delphi Diesel					
000 GBP	2006	2007	2008	2009	2010
Turnover	347698	376951	408719	240756	
Operating profit	-6371	12874	17873	4631	
PBIT	19116	52800	60305	4952	
Net Profit (PAT)	11656	34379	40351	3188	
Curr Assets	192113	223457	183295	158139	
Non Curr Assets	161247	157819	155300	144200	
Curr Liabilities	200686	189197	106003	66351	
Non Curr Liabilities	42022	46452	72174	97726	
Debt	0	0	0	0	
Shareholders fund	110652	145627	160418	138262	
Total Assets	353360	381276	338595	302339	
Check Total assets	0	0	0	0	
Employees	2840	2901	3087	2620	
Denso Manufacturing					
000 GBP	2006	2007	2008	2009	2010
Turnover	202306	209907	246803	196524	170631
Operating profit	1807	1360	-469	-14285	-2408
PBIT	7554	1678	2223	-13925	-2406
Net Profit (PAT)	11224	1449	1769	-13940	-1944
Curr Assets	62329	48672	48328	29639	44409
Non Curr Assets	51198	59892	57387	55449	48505
Curr Liabilities	30313	32504	30632	23318	32455
Non Curr Liabilities	1381	1581	3388	868	868
Debt	0	0	0	0	0
Shareholders fund	81833	74479	71695	60902	59591
Total Assets	113527	108564	105715	85088	92914
Check Total assets	0	0	0	0	0
Employees	1472	1453	1448	1145	887
GKN Driveline					
000 GBP	2006	2007	2008	2009	2010
Turnover	97156	92761	87880	51758	
Operating profit	-25178	-6451	-4109	-6409	
PBIT	-25100	-9182	-15598	-6409	

Net Profit (PAT)	-23806	-3908	-11116	-3022	
Curr Assets	24309	25308	18422	24513	
Non Curr Assets	22245	15802	4374	14230	
Curr Liabilities	12935	12196	8881	13052	
Non Curr Liabilities	5622	4825	1048	846	
Debt	0	0	0	0	
Shareholders fund	27997	24089	12867	24845	
Total Assets	46554	41110	22796	38743	
Check Total assets	0	0	0	0	
Employees	776	696	655	521	
Company: Hitachi					
000 GBP	2006	2007	2008	2009	2010
Turnover	95265	95907	102428	92353	85499
Operating profit	3186	-327	4893	46	4862
PBIT	3304	1062	4474	320	4894
Net Profit (PAT)	2411	577	2563	307	3526
Curr Assets	32048	29517	35265	21877	23896
Non Curr Assets	9509	8556	13188	11351	10927
Curr Liabilities	29726	25986	35426	20079	18009
Non Curr Liabilities	2195	1850	709	524	663
Debt	0	0	0	0	0
Shareholders fund	9636	10237	12318	12625	16151
Total Assets	41557	38073	48453	33228	34823
Check Total assets	0	0	0	0	0
Employees	124	126	129	129	122
Johnson Controls					
000 GBP	**2006**	**2007**	**2008**	**2009**	**2010**
Turnover	883852	662648	609440	442153	571095
Operating profit	-21610	-21221	4402	-31546	18264
PBIT	-2896	-139	6749	-31130	25478
Net Profit (PAT)	-4309	-1835	5440	-31625	19873
Curr Assets	224130	170052	153877	194651	187808
Non Curr Assets	53157	46169	42649	41954	39514
Curr Liabilities	262753	223172	202322	142242	118265
Non Curr Liabilities	26591	7364	5106	113330	107069
Debt					
Shareholders fund	-12057	-14315	-10902	-18967	1988
Total Assets	277287	216221	196526	236605	227322
Check Total assets	0	0	0	0	0
Employees	2810	2607	2018	1434	1447
Company: Meritor					
000 GBP	**2006**	**2007**	**2008**	**2009**	**2010**
Turnover	26764	19988	21486	21581	23147
Operating profit	919	45	444	531	367
PBIT	939	55	605	934	367
Net Profit (PAT)	939	55	605	934	367
Curr Assets	10177	22271	8776	7818	8579
Non Curr Assets	0	0	0	0	0
Curr Liabilities	5044	17083	2983	1091	1485

Non Curr Liabilities	0	0	0	0	0
Debt					
Shareholders fund	5133	5188	5793	6727	7094
Total Assets	10177	22271	8776	7818	8579
Check Total assets	0	0	0	0	0
Employees	4	5	4	4	7
Company: Robert Bosch					
000 GBP	**2006**	**2007**	**2008**	**2009**	**2010**
Turnover	409413	468758	472656	339618	322000
Operating profit	8054	19748	27449	-35619	44061
PBIT	9345	22269	29154	-32526	47846
Net Profit (PAT)	4573	17045	18864	-26508	32036
Curr Assets	112894	131208	123142	120219	186370
Non Curr Assets	77618	69923	60044	16660	15056
Curr Liabilities	105924	102064	81687	54048	91407
Non Curr Liabilities	13819	10461	10617	19812	12664
Debt					
Shareholders fund	70769	88606	90882	63019	97355
Total Assets	190512	201131	183186	136879	201426
Check Total assets	0	0	0	0	0
Employees	1772	1922	1827	1362	1214
Company: TRW Ltd					
000 GBP	**2006**	**2007**	**2008**	**2009**	**2010**
Turnover	283400	299406	275770	240808	288906
Operating profit	-202300	-25747	-43983	-13603	-8263
PBIT	-154800	-5785	-39499	-4941	-8497
Net Profit (PAT)	-158100	2414	-48879	-50470	-9311
Curr Assets	656700	248210	176829	63593	100754
Non Curr Assets	40400	37564	25199	30248	31379
Curr Liabilities	492700	83622	98689	122656	149732
Non Curr Liabilities	25600	23731	17318	15032	16848
Debt					
Shareholders fund	178800	178421	86021	-43847	-34447
Total Assets	697100	285774	202028	93841	132133
Check Total assets	0	0	0	0	0
Employees	2416	2350	2111	1685	1646
Company: TRW Systems Ltd					
000 GBP	**2006**	**2007**	**2008**	**2009**	**2010**
Turnover	300500	261759	230031	179511	208567
Operating profit	12100	2888	-464	-14778	-2656
PBIT	12000	11640	-3610	-8996	-14368
Net Profit (PAT)	11700	11525	-3695	-9109	-14383
Curr Assets	109300	122719	103589	104446	107120
Non Curr Assets	43600	41352	32437	29673	24641
Curr Liabilities	59600	59611	35777	45421	45242
Non Curr Liabilities	7900	7400	6884	4442	16647
Debt					
Shareholders fund	85400	97060	93365	84256	69872
Total Assets	152900	164071	136026	134119	131761

Check Total assets	0	0	0	0	0
Employees	1756	1698	1579	1218	1087
Company: Valeo					
000 GBP	**2006**	**2007**	**2008**	**2009**	**2010**
Turnover	28198	33104	35118	38339	
Operating profit	-232	439	-290	1230	
PBIT	-232	439	-290	1230	
Net Profit (PAT)	-458	113	-609	1140	
Curr Assets	10764	9933	10221	12005	
Non Curr Assets	2910	3390	3237	2854	
Curr Liabilities	11101	10565	11042	12785	
Non Curr Liabilities	1500	1500	1500	0	
Debt					
Shareholders fund	1073	1258	916	2074	
Total Assets	13674	13323	13458	14859	
Check Total assets	0	0	0	0	
Employees	80	83	76	80	
Company: Visteon					
000 GBP	**2006**	**2007**	**2008**	**2009**	**2010**
Turnover		24682	60450	46249	55483
Operating profit		939	-316	-5364	10292
PBIT		939	-293	-7474	9140
Net Profit (PAT)		839	267	-7487	8002
Curr Assets		6029	2613	8393	15771
Non Curr Assets		9945	5056	4019	2960
Curr Liabilities		4885	4318	15313	13687
Non Curr Liabilities		10200	6103	15773	14119
Debt					
Shareholders fund		889	-2752	-18674	-9075
Total Assets		15974	7669	12412	18731
Check Total assets		0	0	0	0
Employees		531	461	355	332

Appendix 7: R&D Centre and Design Engineering Centre Data (From Fame)

Company: Lotus					
000 GBP	**2006**	**2007**	**2008**	**2009**	**2010**
Turnover	145067	116881	91995	83817	108982
Operating profit	6555	1651	1283	5599	8414
PBIT	-6207	-2749	2434	-5120	-8767
Net Profit (PAT)	-7245	-6264	917	-6640	-10077
Curr Assets	46776	29534	45430	60287	63240
Non Curr Assets	23639	23311	32694	54651	67266
Curr Liabilities	54826	40515	49253	95661	89408
Non Curr Liabilities	61088	9932	19987	24248	64213
Debt					

Shareholders fund	-45499	2398	8884	-4971	-23115
Total Assets	70415	52845	78124	114938	130506
Check Total assets	0	0	0	0	0
Employees	1164	1040	890	937	1083
Company: MIRA					
000 GBP	**2006**	**2007**	**2008**	**2009**	**2010**
Turnover	29281	28384	29874	32510	37265
Operating profit	66	358	145	940	1211
PBIT	474	2425	444	503	1082
Net Profit (PAT)	262	305	254	311	902
Curr Assets	9440	8517	13105	12402	12959
Non Curr Assets	20522	19387	17592	15832	15705
Curr Liabilities	5450	4848	9063	6829	8197
Non Curr Liabilities	11536	5025	5794	8995	5519
Debt					
Shareholders fund	12976	18031	15840	12410	14948
Total Assets	29962	27904	30697	28234	28664
Check Total assets	0	0	0	0	0
Employees	398	395	386	377	389
Company: Ricardo Plc					
000 GBP	**2006**	**2007**	**2008**	**2009**	**2010**
Turnover	173100	171500	197700	178800	162800
Operating profit	15800	13200	15900	15100	12600
PBIT	17200	15200	17400	19100	13800
Net Profit (PAT)	12200	15100	12400	14700	10300
Curr Assets	112400	80700	101700	74700	73100
Non Curr Assets	71300	71900	80200	81500	87300
Curr Liabilities	95000	56000	81100	54900	59300
Non Curr Liabilities	39200	35400	34100	34400	36300
Debt					
Shareholders fund	49500	61200	66700	66900	64800
Total Assets	183700	152600	181900	156200	160400
Check Total assets	0	0	0	0	0
Employees	1651	1646	1799	1630	1530
Company: Zytek					
000 GBP	**2006**	**2007**	**2008**	**2009**	**2010**
Turnover					
Operating profit			1251	471	995
PBIT			1251	445	995
Net Profit (PAT)			904	271	719
Curr Assets			3922	5084	9381
Non Curr Assets			634	683	871
Curr Liabilities			3703	4620	8365
Non Curr Liabilities			19	40	64
Debt					
Shareholders fund			834	1105	1824
Total Assets			4556	5767	10252
Check Total assets			0	2	-1
Employees				138	139

Appendix 8: Tier 2 Competitor Data (From Fame)

BWI Ltd					
000 GBP	**2006**	**2007**	**2008**	**2009**	**2010**
Operating profit				917	
PBIT				917	
Net Profit (PAT)				624	
Turnover				14643	
Curr Assets				20424	
Non Curr Assets				2838	
Curr Liabilities				13432	
Non Curr Liabilities				3221	
Working Capital				6992	
Shareholders Fund				6609	
Total Assets				23262	
Employees				128	
Electronic Motion Systems					
000 GBP	**2006**	**2007**	**2008**	**2009**	**2010**
Operating profit	-16191	-25450	-5399	-2679	
PBIT	-15501	-24366	-5080	12409	
Net Profit (PAT)	-15501	-25544	-6034	11537	
Turnover	28727	40850	19015	15198	
Curr Assets	24917	6531	9947	7289	
Non Curr Assets	10852	10290	7565	6279	
Curr Liabilities	22435	18399	6160	5743	
Non Curr Liabilities	24661		18964	3900	
Working Capital	2482	-11868	3787	1546	
Shareholders Fund	-11327	-1578	-7612	3925	
Total Assets	35769	16821	17512	13568	
Employees	327	287	207	112	
Pektron					
000 GBP	**2006**	**2007**	**2008**	**2009**	**2010**
Operating profit	802	1557	3128	1712	
PBIT	1090	2795	3537	1801	
Net Profit (PAT)	754	1951	2595	1417	
Turnover	19169	20645	25366	20010	
Curr Assets	15338	15609	17155	17698	
Non Curr Assets	4005	5913	5605	4930	
Curr Liabilities	2862	3703	3921	2430	
Non Curr Liabilities		136	61	5	
Working Capital	12476	11906	13234	15268	
Shareholders Fund	16482	17682	18777	20194	
Total Assets	19344	21521	22759	22629	
Employees	267	267	262	234	
PI Shurlok					
000 GBP	**2006**	**2007**	**2008**	**2009**	**2010**
Operating profit		-1223	-455	-201	162

PBIT		-1197	-122	-201	-43
Net Profit (PAT)		-1007	-333	-397	-315
Turnover		7325	7285	3804	5582
Curr Assets		3779	2650	2502	2858
Non Curr Assets		3086	3291	3726	3843
Curr Liabilities		5372	4781	5465	6253
Non Curr Liabilities		0	0	0	0
Working Capital		-1593	-2131	-2963	-3395
Shareholders Fund		1493	1160	763	448
Total Assets		6865	5941	6228	6701
Employees		81	71	64	71