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The extent to which data-rich firms operating two-sided platform-ecosystem business models are able to use data to gain an innovation advantage over established one-sided companies

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The Extent to Which Data-Rich Firms Operating Two-Sided Platform - Ecosystem Business Models are able to Use Data to Gain an Innovation Advantage over Established One-Sided Companies.

By

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Abstract

It is the purpose of the dissertation to explore the extent to which data-rich firms operating two-sided platform-ecosystem business models are able to use data to gain an innovation advantage over established one-sided companies.

The dissertation begins with an analysis of business model theory and identifies two viewpoints based on the static and transformational perspectives. The transformational perspective is analysed in more depth and how data is playing a key role in creating an innovation advantage for two-sided platform ecosystem firms.

A detailed explanation of how the platform ecosystem model works is provided in addition to a definition of the four platform typologies and how they compare and contrast with the one-sided business model. This is followed by a critique of the resource-based view of strategy and the relevance of dynamic capabilities, the knowledge-based view and the value chain approaches to strategy.

A comprehensive innovation audit questionnaire (based on a sample of one hundred companies) is used to test whether the two-sided firms have a data-driven innovation advantage over the one-sided firms or not. The results reveal a clear innovation advantage for the two-sided firms who score consistently higher marks across all the dimensions of the innovation audit survey.

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Introduction

It is the purpose of this dissertation to analyse the extent to which data-rich two-sided platform companies have an innovation advantage over traditional one-sided firms. The dissertation explores the extent to which transformational business model innovation is being driven by the data-rich firms and how their unique platform ecosystems and networks provide them with a sustainable competitive advantage over linear one-sided mechanistic structures that are significantly less data intensive. The aims and objectives of the dissertation are outlined below.

Aims & Objectives:

1) Conduct a literature review of business model theory to identify the differences between the static and dynamic perspectives and how the application of the Penrosian (1959) and RCOV approaches (Lecoq *et al.,* 2006) might be developed further using data as the key integrating mechanism that drives business model innovation.

2) Undertake an analysis of platform and ecosystem theories and typologies and explore how they demonstrate the business model innovation advantages achieved by two-sided platform companies over established one-sided firms due to their unique configurations.

3) Critically review the relevance of the resource-based view (RBV) of strategy (including dynamic capabilities and the knowledge based view) and the value chain approach in relation to innovation in the data-rich Internet economy and the advantages of the two-sided platform companies.

4) Test the hypothesis that the two-sided data-rich Internet-based firms have a superior innovation advantage over the established one-sided firms using an innovation audit to evaluate the innovation capabilities of high growth two-sided Internet firms against established one-sided businesses.

5) Undertake an analysis of the research findings and consider the strategic implications of the results. This will involve the detailed application the RCOV model (Lecoq et al., 2006) and will analyse the extent to which data has been a source of innovation advantage for the two-sided firms over the one-sided companies by integrating models and theories from the earlier literature review.

The first three chapters of the dissertation undertake a detailed literature review of theories and concepts relating to business models (Chapter 1), platforms and ecosystems (Chapter 2) and the resource-based view of strategy (Chapter 3).

The review of business models in Chapter 1 highlights a shift towards the new knowledge-based economy away from the traditional industry-based one-sided business model perspective. The analysis also reveals that the transformational perspective has gained ground over the static business model theories due to the increase in business model innovation following the dot-com boom and bust. However, although the knowledge-based view has become increasingly predominant over recent years, there has not been any consideration given in business model theory to the role of data. Moreover, the two-sided platform theories were also under-represented. This is what gave rise to the initial idea of a research gap.

Chapter 2 provides detailed definitions and explanations of the ecosystem and platform concepts including Gawer`s (2009) four types of platform model. The benefits of the frameworks are discussed and how they illustrate changes in competitive forces due to the high levels of business model innovation and how these contrast with the linear one-sided models.

Meanwhile, Chapter 3 provides a detailed critique of a broad range of RBV (resource-based view) theories including dynamic capabilities (Teece *et al*., 1997), Danneels (2008; 2012) second order competencies, Prahalad and Hamel`s (1990) core competences and Grant`s (1996) knowledge-based view. The importance of value networks (Peppard and Rylander: 2006) as a substitute for Porter`s (1990) traditional value chain is also considered as well as the RCOV (Demil and Lecoq: 2010) and the Wheel of Business Model Reinvention frameworks (Voelpel *et al.,* 2004). Meanwhile, the chapter concludes with a discussion of the research gap and how it would be tested using an innovation audit methodology.

The literature review is followed by the methodology section in Chapter 4, which provides a detailed explanation of the innovation audit research approach, how the innovation audit technique has evolved over the years, how the audit questionnaire was formulated (six dimensions and 72 questions) plus the reason for its selection over other methodologies.

In Chapter 5 a data analysis is undertaken where the results from 100 companies are analysed. These consist of 57 two-sided firms and 43 one-sided companies (see Appendix 15). Cronbach`s Alpha is used to test the reliability and consistency of the questions, followed by a correlation matrix, Mann-Whitney *U* test, cluster analysis, factor analysis and the use of box and scatter plots as illustrations.

The results of the innovation audit clearly revealed a significant differential between the median and mean scores for the two-sided and one-sided firms. This strongly suggested that the two-sided firms had a clear innovation advantage over the traditional one-sided businesses due to their data-rich platform business models. Further analysis was undertaken in Chapter 6, where the full strategic implications of the results were discussed using a broad range of concepts including the High Involvement in Innovation (HII) model, chaos and complexity theories, the Cynefin framework, the RCOV model (Demil and Le coq) and Wheel of Business Model Reinvention (Voelpel *et al.,* 2004) framework etc.

A final summary and conclusion regarding the outcome of the research is provided in Chapter 7 at the end of the study where the research objectives and research hypothesis are tested.

Chapter 1 - Literature Review

Business Models & Business Model Innovation

1.0 Introduction

It is the purpose of this chapter to undertake a thorough and comprehensive review of literature relating to the business model concept and business model innovation. In recent years, the business model has been the focus of substantial attention from both academics and practitioners. Since 1995, there have been over 1200 articles published in peer-reviewed academic journals in which the business model concept has been addressed (Wirtz *et al.,* 2016). However, despite the overall abundance of literature on the subject, scholars still haven`t fully agreed what a business model is (Zott *et al.,* 2011).

The chapter will start by exploring the origins and development of the business model concept, followed by an analysis of business model definitions and perspectives. It will then identify the components of the business model. It will conclude with a detailed evaluation of the dynamic business model perspective.

1.1 The Origins of the Business Model Concept and How It Has Evolved

The term business model can be traced back sixty years and was first used by Bellman *et al* in 1957. The business model actually started to gain greater significance following the advancement of information technology and electronic business particularly in the 1990s (Hedman and Kalling: 2002). The uptake of the term grew exponentially during the `new economy` boom (Wirtz *et al.,* 2010). While the term `business model` had hardly been used before 2000, the dot-com boom caused it to become highly relevant and widespread in practice.

Nevertheless, despite a number of emerging themes, the literature is still very fragmented and many authors have commented on the existence of research silos (Zott *et al.,* 2011). Three research fields were identified by Wirtz *et al.,* (2016) which they classified as technology-oriented, organisation-theory oriented and strategy-oriented business models. According to Wirtz *et al.,* (2016), from 2000 - 2002, the technologically-oriented business model article predominated with regards to electronic business but from 2002 onwards more strategy oriented articles were published. In comparison, the organisation-oriented articles played a subordinate role.

The level of abstraction used to view business models was also very important and this ranged from the detailed product level, the business and company level and the aggregated industry level. Authors of the early technology-orientation school (Amit and Zott: 2001; Eriksson and Penker: 2000) considered the business model to represent only a small part of a company. However, this is no longer the view of authors of the modern technological orientation in the `new economy`, who now see business models representing whole companies (Osterwalder and Pigneur: 2010). This view is also shared by the organization-orientation school. Meanwhile, the authors of the strategy orientation school viewed business models from the perspective of providing a picture of a company`s competitive situation or position (Hamel: 2000).

The emergence of the strategy-oriented business model school also gave rise to the debate regarding the similarity between a business model and a strategy and whether they were the same thing. Agreement has been reached that although the business model and strategy are strongly interrelated they are different concepts. According to Casadeus-Masanell and Ricart (2010), although the two are related, a business model is the direct result of strategy but it is not itself a strategy. For example, strategy is concerned with the vision, positioning and future direction of the firm based on fundamental decisions such as its medium and long-term objectives and activities. Alternatively, the business model depicts the value creation logic of a company by providing a holistic description of the company`s activities in an aggregated form (Osterwalder *et al.,* 2005). The business model therefore presents a means for the coherent implementation of strategy (Dahan *et al.,* 2010). The business model can therefore be viewed as the coherent implementation of strategy and a link between future planning (strategy) and the operative implementation (process management). In simple terms, the strategy represents where the organisation wants to go and the business model is concerned with how it gets there.

Casadesus-Masanell and Ricart (2010: 196) also clearly outlined the differences between a business model, a strategy and tactics. The authors stated that a business model referred to the logic of the firm and the way it operated as well as how it created value for its stakeholders. Meanwhile, strategy referred to the choice of business model through which the firm would compete in the marketplace. Finally, tactics referred to the choices open to the firm by virtue of the business model that it chose to employ.

1.2 Business Model Definitions and Perspectives

However, to fully understand what is meant by a business model it is important to analyse the various definitions relating to the concept. Moreover, when defining the business model it is also worth noting that existing literature has mostly adopted a static perspective (Lindner *et al.,* 2010; Van Putten and Schief: 2012). Nevertheless, the dynamic perspective of business models (Casadesus-Masanell and Ricart: 2010; Cavalcante *et al,* 2011; Demil and Lecoq: 2011, Van Puten and Schief: 2012) is also very important and this is discussed in some detail in section 1.4 of the chapter.

With regards to the content-related aspects of business models, there are numerous differences in definitions. The majority of authors focus on the general structure of business models and their components. Hamel (2000), Rayport and Jaworski (2000), Hedman and Kalling (2002) and Johnson *et al.,* (2008) all provided examples of a component definition of the business model. Despite the predominant component view, other authors have focused on concepts such as depiction, frames of reference and architecture (Afuah and Tucci: 2003; Eriksen and Penker: 2000; Teece: 2010). This often involves a high level of abstraction where the business model is seen as depiction or high level architecture illustrating value creation processes, incentive systems or core logics (Timmers: 1998; Linder and Cantrell: 2000).

In terms of business model definitions, the content and component-related business models therefore show a homogeneous trend. These serve to illustrate the structural aspects of the content and the mode of operations of the business model whereby a simplified and aggregated representation of the company`s primary activities and interactions are portrayed. For example, Eriksson and Penker (2000) stated that business models made it possible to present the complex and multi-layered relationships of a company in a clear and compressed manner. This viewpoint was reinforced by Treacy and Wiersema (1996) who saw the benefits of business models as their ability to highlight key processes, actions and interactions of various company parameters. Linder and Cantrell (2000) and Margretta (2002) also emphasized the role of business models in explaining the relevant activities of a company relating to its financial success.

However, there are still inconsistencies relating to definitions regarding the purpose of a business model`s content. The purpose or broader goals are usually only implied and many definitions don`t mention them at all. Generally speaking, the definitions show how business models promote understanding throughout the company; how they highlight the core logic of providing a service and realizing the promise of the service as well as satisfying consumer needs and achieving general success; plus the continuing and new development of the business model (Amit and Zott: 2001). Therefore, in terms of the tasks of a business model`s content and what a business model should fulfil or achieve, the definitions focus on aggregated and simplified explanations of relevant company activities. Regarding the purpose of a business models content, these generally include maintaining the promise of service, the satisfaction of needs and profitability which are normally subsumed under the goal of long-term competitive advantage.

It is also very important not to ignore the dynamic view of business models. Voelpel *et al.,* (2004) researched the business model`s dynamic nature and made a distinction between what they referred to as business model change and business model reinvention. Voelpel *et al.,* (2004) said that new sources of competitive advantage could be obtained through business model reinvention that was based on disruptive innovation instead of incremental change or continuous improvement. The authors therefore advocated for disruptive and radical business model reinvention or innovation and provided a framework called the wheel of business model reinvention that included four critical dimensions comprising customers, technology, business system infrastructure and economics/profitability.

Demil and Lecocq (2010) developed the dynamic perspective further when they claimed that a business model included ongoing dynamics through interactions between and within the core model components. Business model dynamics at the component level, resources and competences level and the value proposition level showed how a business model could remain successful over an extended period of time through continuously revising its components. The authors also indicated how structural revisions in revenues or costs were antecedents to business model evolution.

Casadesus-Masanell and Ricart (2010) also analysed the dynamic interrelations between elements or components in business models but they also considered the influence of globalization, deregulation and the advancement in information and communications technology (ICT) as key drivers of business model innovation.

Cavalcante *et al.,* (2011) went a step further by elaborating on the previously missing links between business model dynamics and innovation. They conceptualized business models from a process-oriented viewpoint and emphasised the key role of the actors or agents in the dynamics of the business model. They also differentiated between four types of business model change, namely: business model creation, extension, revision and termination. They established a direct connection between these types of business model change and the corresponding degree of innovation.

To conclude this section, a very comprehensive definition of a business model was provided by Wirtz *et al.,* (2016: 41) who said:

> *A business model is a simplified and aggregated representation of the relevant activities of a company. It describes how marketable information, products and or/or services are generated by means of a company`s value-added component. In addition to the architecture of value creation, strategic as well as market components are taken into consideration in order to achieve the superordinate goal of generating or securing the competitive advantage. To fulfil this latter purpose, a current business model should always be critically regarded from a dynamic perspective, thus within the consciousness that there may be the need for business model evolution or business model innovation, due to internal or external changes over time.* (Wirtz *et al.,* 2016: 41)

This definition explains the core content and workings of a business model not just from a static perspective but it also incorporates the dynamic view and the need for ongoing innovation. The chapter will now review the actual literature relating to the components of a business model.

1.3 Business Model Components

To develop a clear understanding of the business model concept it is important to analyse the literature relating to the relevant business model components. An important starting point is to consider the role of strategy as an essential influence on business model development. For example, Hamel (2000) said that the `Core Strategy` was a central component of a business model. Other authors (Hedman and Kalling: 2002; Afuah: 2004; Yip: 2004; Tikkanen *et al.,* 2005) considered the implications of corporate strategy within the business model as being important and significant by specifying the vison/mission and strategic development paths of the firm.

In addition to strategy, the internal and external resources and capabilities (competencies) were also considered to be important business model components (Currie: 2004). In the resource model the core competencies needed for the company and the core assets of the business model are specified. It represents a summary of all the important tangible and intangible input factors of the business. Meanwhile, a network-oriented view has also been considered and networks and partnerships have been shown to have a significant influence on the value creation of companies and therefore has to be considered as part of a business model. The network model includes the mainly external interactions of a business model and represents a management tool for checking and controlling value distribution based on joint value creation (Barney: 2004).

Customers are also a crucial component discussed in the academic literature which considers either the role of the customer or the design of the customer interface. The customer model portrays all relevant offers including products and services for specific segments of the business model or the co-creation of various offers via different channels (Hamel: 2000; Mahadevan: 2000; Prahalad and Ramaswamy: 2004; Yip: 2004). Another related component is the market offering model. This incorporates the value proposition or the benefit/value a customer receives through the business model (Johnson: 2010; Demil and Lecocq: 2010). In some instances, the market offering model also focuses on the competitors and the entire market structure into which the value proposition is being transferred (Kallio *et al.,* 2006); not just the immediate customers.

The revenue model also represents a core component (Osterwalder *et al.,* 2005; Osterwalder and Pigneur: 2010). Nowadays a wide range of revenue generation models are available and these include transaction-dependent and independent direct revenue models plus indirect forms of revenue model. The revenue structure and revenue streams have to be designed in order to maximize revenues. It is also determined within the revenue model which revenue streams the business model is being supported by (Kaplan and Norton: 2004).

Service provision has also been observed as being a component in business model literature (Afua: 2004; Johnson: 2010). The model for service provision depicts the value creation and how goods of lower order are converted to goods of higher order by internal company processes. However, procurement has only appeared as a business model component on a few occasions (Hedman and Kalling: 2002; Yip: 2004). The financial model, meanwhile, assumes the role of control and financial planning through the monitoring of capital flows and the analysis of cost structures (Afuah: 2004; Demil and Lecoq: 2010: Osterwlader *et al.,* 2005).

According to Wirtz *et al* (2016), the analysis of the literature relating to the business model components is still significantly heterogeneous with some authors only adopting a few components whereas others were seen to consider a broad range of models. Those adopting a broad perspective were in the minority by more than two-to-one. However, the highest level of agreement between the authors related to the \`market offerings\` and \`resources\` components with little agreement regarding strategy, revenue and procurement.

Wirtz *et al.,* (2016) recommended an integrated and comprehensive approach to the application and analysis of business model components. This was largely due to its importance as a conceptual framework for organizing the value creation of a company in order to guarantee its profitability. They said that the internal as well as the external factors needed to be considered to provide a holistic viewpoint. This resulted in a business model consisting of three core components, namely:

1) The strategic components, customer and market components and the value creation components. These were further divided into sub-components or

models. For example, the strategic components were divided into the strategy model, the resource model and the network model.

2) The customer and market components consisted of the customer model, market model and the revenue model. Finally, there was the:
3) Value creation component whereby the manufacturing model, the procurement model and the financial model were all incorporated within the same component.

However, these components are only presented in this manner for abstraction purposes. In practice this level of separation wouldn`t exist and the components would therefore be integrated and inter-related.

1.4 An Evaluation of the Dynamic Business Model Perspective

Due to the rapid changing business environment and the emergence of the `new economy`, organizations have been forced to change their business models in order to survive in the new business landscape (Hitt *et al.,* 2003; Voelpel *et al.,* 2004). This has meant that organisations have had to recreate and reinvent new business models through innovation instead of just pursuing continuous improvement in a relatively static and linear manner. This section of Chapter 1 will therefore analyse the dynamic business model perspective in more depth.

Overall, both evolutionary business model change (e.g. Demil and Lecocq: 2010) and more radical business model innovation (e.g. Voelpel *et al.,* 2004) have their place in the literature about business model dynamics. Initially, business model innovation was seen as an independent self-contained concept in the literature. According to Johnson *et al.,* (2008), business model innovation represented the complete reinvention of the current business model which was new or game changing to the market. In this conceptualisation of business model innovation, reinventing the business model was the equivalent to the development or creation of entirely new business models (Voelpel *et al.,* 2004) as opposed to only revising particular parts over time. On the one hand, these newly created business models could be connected to developing entirely new companies or even industries due to the emergence of new technology. Alternatively, it could relate to already existing organisations which completely reinvented themselves and their business models. Regarding the latter instance, business model innovation occurred when a firm adopted a novel approach to commercializing its underlying assets (Gambardella and Mc Gahan: 2010).

Generally speaking, business model innovation includes a more comprehensive approach and involves more revolutionary implications than the long-term evolutionary change of business models. Voelpel *et al.,* (2004) confirmed this when the said that in today`s volatile and fast changing environment, new sources of sustainable competitive advantage could often only be achieved from business model re-invention based on disruptive innovation and not on incremental change or continuous improvement.

Further analysis of the dynamic business model perspective will now be undertaken based on the outputs of a broader range of peer-reviewed academic sources starting with an article by Amit and Zott (2012) entitled `Creating Value Through Business

Model Innovation`. Amit and Zott (2012) stated that due to environmental pressures more firms were resorting to business model innovation rather than product/service or process innovation in order to enhance performance and/or their chances of survival. They claimed that changing how a company did business was often easier than changing the products or services themselves. In the article, the authors use the example of how Apple defeated HTC using business model innovation rather than product innovation following the launch of the iPod music player and the iTunes music store. This illustrated how difficult it is for a company to imitate or replicate an entire ecosystem than a single product or process. Apple`s innovation at the business model level was too much of a competitive challenge for HTC as well as other handset makers such as Nokia and Blackberry.

Amit and Zott (2012) also illustrated three ways in which business model innovation could occur. These included adding novel activities through forward and backward integration (new activity system `content`) i.e. a computer hardware company selling services (IBM in the 1990s). Second, by linking activities in novel ways (new activity system `structure`) i.e. online travel agencies. Third, by changing one or more parties that perform the activities (new activity system `governance`) i.e. franchising. By changing one or more of these elements enough the organisation would also change its business model.

Finally, Amit and Zott (2012) identified four major drivers that were essential to developing the right business model. These comprised novelty, lock-in, complementarities and efficiency. Novelty was the degree of business model innovation embodied by the activity system. Lock-in referred to the business model activities that created switching costs i.e. Nespresso coffee capsules could only be used in Nespresso coffee machines. Complementarities referred to the value-enhancing effects of interdependent activities i.e. eBay`s payment mechanism. Finally, efficiency referred to the cost savings achieved through interconnections of the activity system i.e. Walmart`s logistics system connecting suppliers, stores and customers. The presence of each of these value drivers therefore enhanced the value creation potential of a business model.

1.4.1 The Role of Ecosystems in Business Model Innovation

The role of ecosystems in business model innovation was another important topic covered in the academic literature. Ron Adner (2006), in an article entitled `Match Your Innovation Strategy to Your Innovation Ecosystem`, discussed the relevance of complementary resources, partners and adopters to the success of product innovation strategies. According to Adner (2006), due to information technology, ecosystems had become a core element in the growth strategies of firms in a wide range of industries. Ecosystems were so important that when they worked properly they would allow firms to create value that wasn`t possible when operating alone. However, ecosystem innovation incorporated three types of risk which included: initiative risks, interdependence risks and integration risks. The initiative risks entailed the problems of delivering a project on time and to specification and which risks should be managed internally and which risks should be transferred to a partner (s) i.e. an ecosystem approach.

If an external solution was favoured then this incurred inter-dependence and integration risks. An inter-dependence risk existed where an innovation was a component of a larger solution that was also under development so the innovation`s success not only depended on its own successful completion but the successful development and deployment of the other components in the system. Put simply this was the ability of the firm to co-ordinate with complementary innovators. The sale of 3G spectrum licences in 2000 and the ability of third parties to provide hand-sets and base stations were used as examples. Meanwhile, in an ecosystem there are also integration risks where intermediaries are positioned between the innovation and the final customers. According to Adner, the further up the value chain the firm resides, the more intermediaries there are likely to be. Put simply, this is the risk of having a product solution adopted across the value chain (involving a broad range of intermediaries) and Michelin`s run-flat tyre innovation was used as an example.

Integration delays caused by poor synchronization of product development cycles between ecosystem partners could ruin a product launch where timing such as first-mover advantage was concerned. In order to overcome such challenges Adner recommended an ecosystem map that incorporated the identification of intermediaries and complements, the estimation of inter-dependence, adoption and intermediary delays before estimating a time to market for the product.

1.4.2 Business Models & First Mover Advantage

Another important theme relating to business model literature concerned the area of first mover advantage. According to Markides and Sosa (2013), the business models that pioneers or late entrants adopt when creating new markets or entering existing ones, could have a big impact on the benefits and sustainability of first-mover advantages. However, the authors also claimed that extant literature on first mover advantages (FMAs) largely ignored the business model concept. They did, however, say that the literature considered the firm`s resources and capabilities as important FMAs.

Markides and Sosa (2013) believed that business models played an important role in explaining the success (or not) of pioneers. For example, research by Markides and Geroski (2005) revealed that early pioneers of new markets were rarely the ones that dominated the markets. The firms that ended up dominating the mass market that grew as soon as the dominant design emerged were those whose who possessed the dominant design at the time of its establishment or entered the market just as the dominant design was emerging (Geroski: 1991; 1995). However, timing wasn`t considered to be enough since a business model designed to grow the market from a niche into a mass market was also necessary.

According to Markides and Geroski (2005), a winning business model consisted of six important elements. These included targeting the average consumer rather than the early adopters, supporting low prices by driving down costs, reducing customer risk through branding and communication, building distribution to serve the mass market, creating alliances with key suppliers and producers of complementary goods and protecting the market by exploiting first mover advantages.

The authors also researched how business models could explain the success of late entrants into a market. Apparently, most new market entrants failed and 90% of all new entrants used imitative strategies to attack incumbents (Geroski: 1991). Those new entrants that did succeed used innovative and sometimes disruptive business models as part of their strategy (Porter: 1985; Markides: 1997; Shankar *et al.,* 1998). A potential criticism of the research was that late entrants such as Amazon and Southwest were not really late entrants but pioneers of new markets. However, this was considered to reinforce the proposition that new business models had the potential to erode the sustainability of first mover advantages (FMAs) irrespective of whether the markets were new or not.

Finally, it was also believed that business models could explain the success of incumbents in responding to innovative late entrants. For example, not all late entrants that used innovative business models succeeded in their attacks and this was largely due to how the incumbents responded. One such model involved ways of reducing the price of established products while simultaneously raising the value proposition. This resulted in an integrated low cost differentiation strategy that was difficult to replicate (Markides: 2012).

1.4.3 How Business Models are Changing Strategy

According to Rita McGrath (2010), business models are now changing the way we perform strategy. This has been driven by the emergence of the Internet and ubiquitous communication plus the increasing uncertainty and complexity in fast-moving environments. Insight, rapid experimentation and evolutionary learning are now subsuming traditional strategic approaches such as competitive positioning and the resource-based view (RBV) etc. Conventional measures of strategic planning were considered to be nonsensical in high uncertainty environments since if the future could be predicted accurately, little advantage would be gained. Hence the need for discovery-driven strategic thinking.

McGrath (2010) also said that the business model concept offered four ideas that were either new or had not figured significantly in historical strategy formulation. The first new idea was that the business model promoted an outside-in rather than an inside-out focus by shifting the emphasis form internal `core competences` to a more external ecosystem perspective and co-creation. Second, a business model cannot always be anticipated in advance but must be learned over time involving experimentation in the discovery of new business models. Third, dynamism takes on a new form of competitive advantage and is no longer `sustainable` (Porter: 1985) but `temporary`. Fourthly, strategy itself has now become discovery-driven rather than planning oriented.

According to McGrath (2010), two core components constituted a business model. These were the `unit of business` (what the company sold) and the `process steps` (the activities that were used to sell the units of business). Business model innovation had impacted on the `unit of business` by creating a free unit of business where revenues were collected from parties other than those who benefited from what was `sold` i.e. Google and Facebook`s advertising model. Examples of `free` business models included advertising (i.e. companies were paid for attracting users), bundling/cross-subsidization, promotion/give away, `freemium`, bartering, gratis (open source software and `wiki` encyclopaedias).

In terms of the process steps or activities these were measured using key metrics. However, these metrics were normally derived from the most critical constraint or rate-limiting set in a value chain. Inventing a new way around a limiting constraint was therefore the role of business model innovation. For example, Amazon overcame the most traditional retail constraint (limited floor space) by selling over the Internet from warehouses.

McGrath (2010) also observed that when existing business models were no longer relevant new ones would emerge but many of the variables relevant to their success would be unknown at the beginning so experimentation would be essential. The history of technological shifts suggests that most experiments with new technologies fail but without these failures a new dominant design will not emerge. Some additional points raised in McGrath`s (2010) article were that business model experimentation took place across as well as within firms. It was also highly path-dependent i.e. early `failed` experiments shaping the future trajectory of innovation. Finally, it is impossible to tell in advance which design is likely to win. Nevertheless, business model innovation enables the firm to hedge financial risks in these circumstances. Instead of using conventional investment tools such as projected economic value added (EVA) and net present value (NPV), real options reasoning would be used. This is where initial investments were kept small until a concept was proven and then the financial commitment would be scaled up but not until there was evidence that the idea would work. This approach was adopted by Amazon when developing its third party trading platform.

1.4.4 Business Model Innovation - Opportunities & Barriers

According to Henry Chesbrough (2010), business model innovation presented both opportunities and barriers to modern firms. For example, technology by itself had no single objective value and the economic value remained latent until it was commercialized in some way via a business model. He also said that a mediocre technology within a great business model may be more valuable than a great technology exploited via a mediocre business model. Chesbrough (2010) used the example of Xerox Parc in the 1970s to illustrate this phenomenon. Although Xerox was innovating it didn’t know how to deploy and commercialise its new technologies. Companies therefore need to commercialize new ideas and technologies through their business models. Moreover, the same idea or technology taken to market through two different business models is likely to yield two different economic outcomes. These views were reinforced by Teece (2010: 192) who said that great technological achievements commonly failed commercially because no proper attention had been given to designing a business model to take the technologies to market properly.

To assist with this process, Chesbrough and Rosenbloom (2002) also formulated a checklist of key business model functions which included the following:

- Articulation of the value proposition.

- Identifying a market segment and specifying the revenue generation mechanism.
- Defining the structure of the value chain.
- Detailing the revenue mechanism.
- Estimating the cost structure and profit potential.
- Describing the position of the firm within the value network.
- Formulating the competitive strategy.

Chesbrough (2010) also explored the barriers to business model innovation. The barriers that he highlighted included conflicts with existing assets and business models as well as an inability of the incumbent management to understand the barriers. Chesbrough said that processes of experimentation and effectuation and the successful leadership of organisational change were therefore needed in order to overcome these barriers. Chesbrough (2010) asked the question why firms did not probe to create potential new business models when existing models were obviously `broken`. One reason for the resistance was that the four value drivers (novelty, lock-in, complementarities and efficiency) needed for business model development - mentioned earlier (Amit and Zott: 2001; 2012) - were considered to conflict with the traditional configuration of the firm`s assets.

An entrenched `dominant logic` (Prahalad and Bettis: 1995) was also seen by Chesbrough (2010) to lead firms to miss potentially valuable uses of technology which didn`t fit their existing business model. Chesbrough also recommended a number of experimentation techniques including business model mapping to clarify the processes underlying business models that might need to change. One example of this mapping approach came from Alex Osterwalder`s business model canvas (Osterwalder and Pigneur: 2005; 2010) or nine-point decomposition of a business model framework. Wrigley and Straker (2016) also analysed the role of mapping in business model experimentation and the need to deconstruct, prototype and experiment with business models to achieve innovation. The authors recommended five design typologies including customer led, cost driven, resource led, partnership led and price led design components.

Chesbrough (2010) also suggested adopting McGrath`s (2010) discovery-driven planning concept (discussed earlier), whereby planning for a new venture involved envisioning the unknown rather than extending past and existing knowledge and experience into the future (McGrath and Macmillan: 1995). Finally, Chesbrough also recommended Sarasvathy`s (2001) effectuation approach to strategy formation. This approach prioritised action over analysis and planning where there was insufficient data. So instead of firms studying the market and environment they actually enact it i.e. action before planning as a testing and learning process. This helps to reframe the dominant logic of the existing business model and is a highly emergent process.

1.4.5 Business Model Innovation – Dynamic Capabilities & Simultaneous Experimentation

Pisano *et al.* (2015) concurred with Chesbrough (2010) when they said that continuous business model innovation was needed as a dynamic capability in order to react to market changes and survive in the longer term. However, the authors believed that mapping and defining innovative business models did not involve the creation of a new business model but only identified the opportunities for innovation. It was therefore considered necessary to create a framework richer than a simple business model to inspire continuous innovation instead of just refining, evolving and iterating a first draft of a business model. In order to fulfil this goal they formulated the BIC methodology.

BIC stood for business models, innovation and customers. The business model component was needed in order to define how the organisation was structured in respect to particular trends. Innovation was important in order to understand what the driver of change was within the business model. Finally, the customer component was required in order to understand why a customer preferred to buy one product in preference over another. When applying the model, Pisano *et al.* (2015) selected three frameworks linked to the core components explained above. These consisted of the business model cliché which explored how key stakeholders translated an industry, segment or category into patterns in their business model i.e. the clichés represent the widespread beliefs that governed people`s beliefs about how to do business. Second, there was the epicentre of innovation which identified where the focal point of innovation was located within the business model or which element gave birth to the innovation (finance driven, infrastructure driven or customer driven). Third, was the user experience i.e. what important experience(s) linked the customer to the product such as the value proposition, distribution channel, customer relations or revenue streams in a B2B environment?

Pisano *et al.* (2015) used the model to identify eight trends which were linked to competing organisations. The technology trends included 3D printing, crowd funding, gamification smart objects, shared economy, big data, TV on demand and the Internet of Things. This modelling approach was useful in helping entrepreneurs create, modify, change or redefine their business models. The true value of the framework`s methodology was in the holistic view that it provided and the ability to recognise eventual patterns that were common to some firms that were working towards a particular trend.

Meanwhile, Andries *et al`s.,* (2013) research developed this theme further when they undertook extensive research exploring the extent to which simultaneous experimentation was a viable learning strategy under uncertain environmental conditions. This approach built upon the effectuation theory and literature discussed earlier (Sarasvathy: 2001). The research analysed the extent to which both focused commitment and simultaneous experimentation could be pursued concurrently. This meant that an organisation, instead of focusing purely on the development of a single business model, would experiment with alternative business models simultaneously in order to position the firm more appropriately for future environmental change.

The research was based on six longitudinal studies and the authors found that focused commitment, despite enhancing initial growth, limited the variety of business model experiments and hampered long run survival. On the other hand, simultaneous experimentation implied lower initial growth but with carefully selected business models, executed in a disciplined manner, it increased the chances of identifying a viable business model and hence long term survival.

Sosna *et al.* (2010) also explored the need to undertake business model innovation to enhance future positioning of the company whilst still pursuing a business as usual strategy. In their article the authors raised the question of how an established organization could innovate its business model, which was still contributing revenues and profits but whose future effectiveness was likely to be undermined by changes in the external environment. The methods they deployed were simple trial-and-error and they focused on a traditional low technology brick and mortar Spanish dietary products company (Naturhouse).

This revealed a number of important observations and lessons for the firm and the researchers alike. There was an emerging dynamic perspective to the project which saw business model development as an initial experiment followed by constant revision, adaptation and fine tuning on a trial-and-error learning basis. The collective knowledge also had to be adapted sufficiently to face environmental uncertainties for the firm to have a chance to survive. The owner-manager`s cognition and sense-making provided the most important input into the initial business model design. Effectuation (Sarasvathy: 2001) also played a key role with action preceding planning. Small trial-and-error experiments were only scaled up once sufficient positive feedback had been received.

1.4.6 The Cognitive View of Business Model Innovation

So far all the literature relating to business model innovation has been based on the need to respond to environmental change either reactively or proactively. However, research by Martins *et al.* (2015) explores how business models could be innovated proactively in the absence of external change through processes of generative cognition. This adopts the cognitive rather than the rational positioning or evolutionary perspectives of strategy. The article analyses business models as schemas (mental models) that organize managerial understandings about the design of firms` value creating activities. Two major cognitive processes are used through which individuals change their schema (mental models). These involve analogical reasoning and conceptual combination.

The owner-manager`s cognition and sense-making provide the most important input into the initial business model design (Sosna *et al.,* 2010: 387). Schemas (mental models) are people`s theories and concepts about the world and represent accumulated knowledge developed by executives that provide frameworks for interpreting new information. Schemas can be changed and entirely new schema can be created through specific mental operations. Two cognitive processes used to control mental operations are analogical reasoning and conceptual combination (Ward, 2004). Analogical reasoning is defined as the application of structured knowledge from a familiar domain to a novel domain. For example, flight simulation software used to train US Airforce pilots later became the bedrock of modern computer games and a whole new industry. Meanwhile, conceptual combination is a cognitive process through which a focal/target concept is combined with a modifier/source concept in order to create a new concept. For example, Henry Ford`s moving assembly line was based on a reversal of the dis-assembly line used in the Chicago abattoirs.

Meanwhile, Demil and Lecoq (2010) in their article, *Business Model Evolution: in Search of Dynamic Consistency*, highlighted an important theme discussed earlier in the chapter that the use of the term business model in the academic literature revealed two types of approach. These could be classified as the static linear approach and the transformational approach. According to Demil and Lecoq (2010), the static view of a business model acted as a blueprint or a methodology for identifying different types of business model (enabling description and classification) and how the components of the business model affected outcomes and performance. The transformational view, on the other hand, was concerned with how to change the business model. It focused upon business model evolution and dynamic interactions between the business model components. This focused on innovation both within the organisation as well as within the business model itself and the interactions between the components.

1.4.7 Dynamic Consistency & the RCOV Model

Lecoq *et al.* (2006) developed the transformational approach further when they proposed the use of the RCOV model as well as drawing upon earlier research by Penrose (1959). Penrose`s work adopted a dynamic view of organisational growth as well as highlighting the dynamics that occurred between the different components. The Penrosian (1959) approach also underlined the ongoing dimension of change as a permanent rather than a transient state. This was reinforced by Lecoq *et al`s* (2006) research that viewed the organisation as being dependent upon its ability to anticipate and react to the consequences of evolution in any given business model component. This is what they referred to as `dynamic consistency`, which enabled the firm to change whilst maintaining sustainable performance.

Figure 1: The RCOV model: the main Business Model Components and their relationships (Adapted from Lecoq, Demil and Warnier: 2006)

Penrose argued that the growth of the firm resulted from the interaction between its *resources*, its *organization* and its capacity to propose new *value propositions* in markets. Using a business model perspective, Demil and Lecoq (2010), linked this to three core business model components consisting of resources and competences, organisational structure and the proposition for value delivery. The *resources* could come from external markets or they could be developed internally, while the *competences* represented the ability and knowledge to improve or recombine the services that the resources could offer.

The *organisational structure* incorporated the organisation`s activities and its relations with other organisations to combine and exploit its resources. This would include the value chain or value network of activities with external stakeholders. The business model also included the *value proposition* that the company delivered to customers such as products and services.

1.4.8 Business Model Classification

Baden-Fuller and Mangematin (2013) were also critical of the fact that most research on business models focused on their role as descriptors of actual phenomenon often by reference to taxonomic categories i.e. cognitive instruments rather than real phenomenon. The authors therefore proposed a typology that consisted of four elements. These included: (1) identifying the customers and the number of separate customer groups; (2) customer engagement or customer proposition; (3) monetization and (4) value chain and linkages.

Moreover, when analysing the customer identification and customer engagement components of their typology, Baden-Fuller *et al.* (2013) included `project-based` (taxi) and `pre-designed` (bus) systems. Business models using the `project-based` (taxi) approach created value by interacting with customers to solve specific problems i.e. consulting and law firms (Davies and Brady: 2000; Nightingale *et al.,* 2011; Hobday: 2000). Alternatively, those firms utilizing the `pre-designed` (bus) system (car parts makers, car assemblers and mass fast food producers) add value by producing `one size fits all` goods or services in a repetitive manner via standardized mass production processes (Hounshell: 1985; Chandler: 1990; Nightingdale: 2000). According to Demil and Lecoq (2013), Google appeared to be deploying a `bus-based` user engagement system for search engine users but a `taxi-based` user engagement system for its advertisers (who could tailor their advertising offering and set the price they were willing to pay).

Baden-Fuller *et al.* (2013) were also critical of the different approaches to classifying business models. They stated that taxonomic approaches were inappropriate because they simply served as exemplars. These were not as useful as typological categorizations which were conceptually-derived. When using taxonomies it was not possible to fully understand how the nature of the categorization might influence the results. However, by considering typologies of business models this emphasized the configuration possibilities that transcend time and industry boundaries and helps to delve into fundamental questions behind business models and the ability to manipulate and adapt them. The typological business model approach also made it possible to model and articulate different activities within the firm. Baden-Fuller *et al.* (2013) also revealed what they considered to be a new category of business model previously un-noticed called the multi-sided (two-sided) model where engagement and value creation involved several customer groups and a whole new dynamic.

Finally, Voelpel *et al.* (2004), stated that it was essential for firms to create and reinvent new business models and not just seek continuous improvement. They also pointed out that the newly emerging environment (Kelly: 1998; Hitt *et al.,* 2003) had three distinguishing features, it was vastly globalized, it favoured intangible things (ideas, information, relationships, knowledge) and it was intensely interlinked with ubiquitous networks (Voelpel *et al.,* 2004: 4). According to the authors these attributes created a new type of marketplace and society often referred to as the "new economy", "knowledge economy" or the "networked economy" (Tapscott: 1997). This was due to a shift from the industrial-based to a knowledge and information-based economy with human imagination and ingenuity being the main source of value. Voelpel et al. (2004: 8) highlighted the important role played by business ecosystems in the new economy and that these operated across industries thereby requiring a systemic perspective not restricted to traditional boundaries. The authors said that organisations needed to shift from traditional industry focused mechanistic thinking to ones that were systematic, holistic and new-value configuration-focused in nature. The need for organisations to constantly create new business models was also emphasised as a result of these changes (Tucker: 2001) i.e. experimenting with a portfolio of strategies.

Finally, when pursuing business model reinvention, two kinds of innovation were also identified. The first concerned innovation with respect to the firm`s own historic strategy and the second related to firms industry and its competitors (proactively reinventing the industry). In order to operationalise and measure the development of new business models, Voelpel *et al.* (2004: 26) also proposed a four dimensional framework called the `Wheel of Business Model Re-invention`. This was a four stage model comprising customer sensing, technology sensing, business infrastructure sensing and economics/profitability sensing stages. The model was also iterative and dynamic with an emphasis on speed and fast responsiveness.

1.5 Summary & Analysis

The evaluation of the dynamic business model perspective in section 1.4 above has revealed a range of common themes but also some notable gaps as well. Some of the most prominent themes have been listed below:

1) Business model innovation is essential to guarantee firm survival in a fast changing environment (Voelpel *et al.,* 2004; Demil Lecoq: 2010).
2) Business models are essential to the successful commercialisation of technology (Chesbrough; 2010; Teece: 2010).
3) A business model and a strategy are different (Casadeus-Masanell and Ricart: 2010) but interrelated. Business model innovation is also changing the way strategy is now being executed (Sarasvathy: 2001; McGrath: 2013).

4) Knowledge, trial-and-error, learning, sense-making, cognition, experimentation, probing and feedback are all key characteristics of the business model innovation process (Sosna *et al.,* 2010; Andries *et al.,* 2013).
5) A set of generic business model components were starting to emerge which were comparatively focused and narrow which concurred with the analysis undertaken earlier in the chapter (Chesbrough and Rosenbloom: 2002; Lecoq, Demil and Warnier: 2006).
6) A new category of business model, previously un-noticed, had now emerged called the multi-sided (two-sided) model (Baden-Fuller *et al.*, 2013). This category of business model was different because engagement and value creation involved several customer groups and a whole new dynamic.

1.5.1 Gaps & Shortcomings - Data as a Resource & the Two-Sided Business Model

There were, however, some noticeable gaps or shortcomings. First, despite identifying a broad range business model innovation characteristics in item four (4) above (knowledge, trial-and-error, learning, sense-making cognition, experimentation, probing and feedback), data was not considered as a key resource nor was it referred to as a product or source of innovation. Second, although a set of generic business model components were starting to emerge the concept of the two-sided company and market was under-represented, only receiving limited attention in Baden-Fuller and Mangematin`s (2010) article, *Business Models: A Challenging Agenda.*

Two-sided markets (also called two-sided networks) are economic platforms that have two distinct user groups that provide each other with network benefits. A two-sided firm creates value primarily by enabling direct interactions between two (or more) distinct types of affiliated customers. This type of firm is sometimes referred to as a multi-sided platform (MSP). Two-sided networks can be found in many sectors including credit cards (composed of cardholders and merchants), operating systems (end-users and developers), video-game consoles (gamers and game developers), search engines (advertisers and users) and media/communications networks, such as the Internet (Evans and Schmalansee: 2007). These two-sided firms are also normally data-rich due to the nature of the role that they play as intermediaries or information brokers (particularly if they are Internet-based).

This is in contrast to the traditional linear, single or one-sided businesses that predominated in the industrial era. In a one-sided market the consumer is located at the end and value is pushed out to them. The functions of production and consumption are also clearly demarcated and involve a sequence of linear activities similar to those illustrated in Porter`s Value Chain (1990). This is explained in more detail in Chapter 2.

The chapter will now analyse these themes in more depth in order to highlight the respective shortcomings of the literature. For example, when Amit and Zott (2012) analysed the superior power of business model innovation over product and process innovation they used Apple and its large ecosystem of content as an example of how defenceless HTC was against such an overwhelming force. However, the authors did not explore the role that data played in the disruptive process and how Apple had moved from being a one-sided product firm to a data-rich two-sided Internet platform.

1.5.2 Dematerialisation & Disintermediation

Meanwhile, when discussing the three ways in which business model innovation occurred, Amit and Zott (2012) referred to adding novel activities, (forward and backward integration), linking activities in novel ways and changing the parties that performed the activities. The authors did not state how the dematerialisation of products into digital formats could also create novel activities for companies such as Apple i.e. music, movies, books software and apps etc. Linking activities in novel ways could also have referred to how buyers and sellers could be linked together more efficiently using a two-sided platform model. Finally, when discussing `changing one or more parties` the authors could have considered how the downloadable and streaming business models disintermediated the supply chain.

Amit and Zott (2012) also identified four important drivers for developing a business model which were: novelty, lock-in, complementarities and efficiency. Although the complementarities were well validated, there was no mention of how superior data permitted micro-targeting and predictive analytics to generate novel marketing strategies. Instead of lock-in, network effects might have been more appropriate. Although the major Internet firms have been trying to build `walled gardens`, the Internet is still a very open platform. Finally, in terms of efficiency, it would have been useful to have seen some references to how two-sided platforms are able to reduce transaction costs (Van Alstyne *et al.,* 2016) and operate low asset-based business models compared to one-sided firms.

1.5.3 Value Networks & Integration Risks

Ron Adner (2006) discussed the importance of matching innovation strategies to an innovation ecosystem if a firm was to achieve a sustainable competitive advantage. However, when discussing the three different types of risk, the article focuses on physical products (HTVs, tyres, flat screen TVs and the Newton PDA). Adner (2006) also provided examples from supply chain ecosystem platforms not from multi-sided or two-sided markets. Annabelle Gawer (2009) identified four types of platform including product, supply chain, industry and multi-sided markets. The industry and multi-sided platforms were Internet-based and non-linear. Adner, on the other hand refers to intermediaries within a value chain not a value network (Peppard and Rylander: 2006) which is how the industry and multi-sided platforms operate. Meanwhile, since data is the most important source of value in a digital ecosystem there aren`t the same integration risks because networks are a highly efficient means of transferring data. Moreover, interdependence risks are low because the infrastructure required to operate platforms already exists such as smart phones, apps, maps, geo-location and cloud computing (software as a service, platform as a service and infrastructure as a service). So firms such as Uber, Airbnb and Deliveroo can scale very quickly with a high level of integration through the internalisation of structured and semi-structured data and the use of algorithms.

1.5.4 New Rules of Competition

Markides and Sosa`s (2013) article on the relationship between first mover advantage and business models also ignores the unique characteristics of platforms such as network effects, the first to scale, winner takes all (or most) and platform envelopment (Eisenmann *et al.,* 2011; Choudary: 2015). The authors also discuss market entry and incumbent responses. However, Internet-based platforms are normally industry agnostic because their ecosystems cut across market and product boundaries that either become blurred or obsolete. The ability to develop a large community of users and to leverage the data collected from the community is critical. So the first to scale and create network effects takes precedence. Once scale has been achieved the two-sided market must look out for adjacent communities emerging that could encroach upon its user base. If this happens then the community is acquired through a merger or acquisition or the community is subjected to platform envelopment instead. The functionality of the emerging platform is replicated and the user community is subsumed or integrated into the established platform (Eisenmann *et al.,* 2011). Microsoft`s envelopment of Netscape in the 1990s and Facebook`s current envelopment of Snap are examples of this type of behaviour.

1.5.5 New Approaches to Strategy

Rita McGrath`s (2010) article on how the Internet and business models were changing the way strategy was performed was also very important. McGrath (2010) discussed how business model innovations relied to a large extent upon an emergent strategy process (Mintzberg and Waters: 1985). Effectuation (Sarasvathy: 2001) rather than causation or deliberate, rational positioning strategies (Porter: 1980: 1985) was therefore used. This cognitive view of strategy was discovery-driven and relied upon experimentation and evolutionary learning (McGrath: 2010). However, McGrath didn`t mention the role of data as a source of learning and knowledge and how it was easier for platform companies to experiment and probe compared to one-sided business. Since the core product was digitised data and software this could be tested and acted upon using live beta testing methodologies in `real time` thereby generating instant feedback. This was not feasible when marketing physical products using one-sided platforms. The ability to perform data-driven-decision making (DDD) plus predictive and prescriptive analytics (Brynjolfsson et al., 2011) also enhanced the quality of strategic decision making by platform companies such as Amazon which frequently experimented with different business models utilising its vast troves of data.

Andries *et al`s* (2013) research developed the cognitive learning theme further with respect to business model innovation. The authors considered the merits of simultaneous experimentation to develop new business models vs. focused commitment to a single business model. This also drew upon Sarasvathy`s (2001) effectuation theory. Meanwhile, Sosna *et al.* (2010) explored the role of trial-and-error and experimentation as learning tools. This was based on a cognitive view of strategy where schemas (mental models), effectuation and sense-making replaced the prescriptive (Mintzberg *et al.,* 1998) classical approach to strategy. However, although this literature focused upon the role of ideas, information and accumulated knowledge, it ignored the role of data as a key resource at the bottom of the knowledge pyramid (Fricke`: 2008). The research examples and evidence were also taken largely from traditional one-sided businesses such as the Spanish dietary products company Naturhouse.

1.5.6 Overcoming Barriers to Business Model Innovation – Dynamic Capabilities

Chesbrough (2010) also discussed the importance of experimentation, effectuation, probing, envisioning the unknown and discovery-driven planning as methods of overcoming the entrenched dominant logic that acted as a barrier to business model innovation in many organisations. Chesbrough and Rosenbloom (2002) also formulated a very useful set of business model functions. However, these functions were not applied within the context of a modern two-sided digital platform. For example, when discussing articulation of the value proposition and identifying market segments, the role of predictive analytics and Big Data would have been relevant and how platforms could undertake micro-targeting and segmentation. Moreover, the third business model function, defining the structure of the value chain, didn’t consider the differences between the linear one-sided value chain based on physical products and the value network based on digital data and relationships where consumers also acted as producers of content (prosumers).

Pisano *et al.,* (2015) reinforced Chesbrough`s (2010) research and confirmed the need for dynamic capabilities to ensure continued business model innovation. The authors also formulated a three stage BIC framework which stood for business model, innovation and customer engagement. Pisano *et al.,* (2015) also based their research on a range of digital two-sided technology platforms, namely: crowd funding, gamification, the shared economy, big data, TV on demand and the Internet-of-Things. However, the framework did not use two-sided platform components as a template for the business model. Nor did it consider data as the key driver of innovation. Nevertheless, when discussing customer engagement and user-experience there were references to being able to purchase special products easily i.e. on demand. However, it didn`t include the fact that many of these products are now free (McGrath: 2013) and that many of the products were dependent upon user-generated content only possible using a two-sided business model.

1.5.7 Static vs. Transformational Business Models

Demil and Lecoq (2010) identified two approaches to business model analysis that they referred to as static and transformational. Due to the volatile environment, the chapter decided to focus upon the transformational perspective since this was deemed to be the most relevant as a driver of business model innovation. The strength of Demil and Lecoq`s (2010) work is that it proposed the use of the RCOV model which provided a set of generic components for the analysis of business models consisting of the resources and competencies, the value proposition, organization (internal and external) plus the outcomes measured in terms of revenues, costs and the subsequent margin. The model also adopted a dynamic view of business models by emphasising the interactions that take place between the components based on the Penrosian (1959) view of the firm to create `dynamic consistency` in response to environmental change.

However, Demil and Lecoq`s (2006) article used Arsenal football club as a case study example not modern Internet platforms. Nonetheless, the model can be applied to two-sided platform companies. For example, the resources and competencies would be the data and the ability to perform analytics and to innovate using revenues generated from the data in the same manner as Google and Facebook. The value proposition of a two-sided firm is the provision of convenient, on-demand products and services that are free or competitively priced i.e. Uber, Airbnb and Amazon. The organisational configurations are also unique in that the core of the platform business is now shrinking in many instances and the external periphery is expanding (Van Alstyne: 2016). This is because most of the value is created within the external community by the users with the platform managing the data that flows from this. The resource model is therefore inverted. Instead of the company owning or controlling resources and capabilities that are internal (as in the resource-based view), these are provided by the external ecosystem of individuals and companies (Parker *et al.,* 2016). This is an external value network rather than a linear value chain. Meanwhile, due to the falling cost of computing and the availability of external infrastructure, the costs of operating a platform are low resulting in higher margins than one-sided businesses. High revenues are also possible due to the network effects and the opportunities to scale globally.

1.5.8 The Knowledge-Based Economy

Two years earlier Voelpel *et al.,* (2004) analysed what they referred to as the `new economy` and pointed out that the newly-emerging environment had three distinguishing features i.e. it was globalised, it favoured intangible things (ideas, information, relationships and knowledge) and it was interlinked with ubiquitous networks. The authors refer to these developments as a shift from an industrial-based to a knowledge and information-based economy. Voelpel *et al.,* (2004) also proposed a `Wheel of Business Model Reinvention` comprising four stages: customer sensing, technology sensing, business infrastructure sensing and economics/profitability sensing.

Although the authors did not apply the framework specifically to a modern two-sided business platform the model does work very well. For example, customer sensing involved sensing potential for change in customer/user behaviour and new customer value propositions. Due to the vast troves of structured and unstructured data that two-sided companies are able to gather, this is something that the most successful platforms are very good at i.e. being able to identify changing needs and sentiment in real-time using Big Data and algorithms. Technology-sensing referred to the ability to sense the strength, direction and impact of technology. This is something that the modern platform companies have excelled at. They have been quick to harness the benefits of reduced transaction costs (Van Alstyne: 2016) achievable from operating asset-light business models i.e. Uber and Airbnb don’t own fleets of cars or hotel rooms but use technology to leverage existing under-utilised fixed assets.

Business infrastructure sensing is also very relevant and the sensing of potential value system reconfiguration including organisational structures. The two-sided platform ecosystem companies have inverted the traditional resource model and disintermediated traditional value chains with most of the value being created within external value networks not within the firm. This has been made possible by the existence of a technological infrastructure mentioned earlier i.e. smart phones, apps, cloud computing and geo-location mapping. Finally, there is the fourth stage referred to as economics/profitability sensing. The proliferation of two-sided platform business models is evidence that these firms have sensed the economic feasibility and potential profitability of the multi-sided model.

1.5.9 Typological Classification & the Two-Sided Model

Baden-Fuller *et al.* (2013) were some of the few authors to make reference to the multi-sided business model when they analysed the shortcomings of taxonomic approaches and how typological classifications were needed to understand the unique configurations of two-sided firms and how these transcended industry boundaries. The authors also proposed a typology that consisted of four elements including identifying customers, customer engagement, monetization and value chain linkages. As was the case with Voelpel *et al`s.,* (2004) `Wheel of Business Model Reinvention`, this typology was not applied to multi-sided platforms but it does potentially work well. For example, identification and segmentation of customers is made easy through data analytics (i.e. Google analytics). Customer engagement is high once the network effects have occurred and the platform has reached a minimum scale. Data monetization through advertising revenues has now become a major source of income whilst there are also strong value network linkages since networks favour the efficient dissemination of data (Peppard and Rylander: 2006).

Finally, when analysing the customer identification and customer engagement elements of their typology, Baden-Fuller *et al.,* (2013) referred to the `project-based` (taxi) and `pre-designed` (bus) systems. The taxi system was based on high customer interaction and bespoke solutions whilst the bus represented a one-size fits all approach. The data rich platforms are capable of achieving both outcomes. They have sufficient data and high levels of interaction to undertake micro-targeting as well as adopting a generic approach. The authors use the example of Google which adopts a bus approach for users undertaking a search before offering the bespoke targeting of advertisers.

1.6 Findings

It can be ascertained from this analysis that the transformational school of Demil and Lecoq (2010) provides a detailed evaluation of the need for and drivers of business model innovation. It also highlights the shift towards a knowledge-based economy away from the traditional industry-based one-sided perspective. It also demonstrates how this has given rise to new approaches to strategy with an emphasis on intangible resources and capabilities such as information, knowledge, cognition and innovation etc.

However, although the two sided business model pre-dates the Internet and digitisation (i.e. both credit card and TV companies were two-sided from the outset) there was an absence in the literature of any critical analysis of the role of data as a resource and an input into the innovation process. Originally economists only considered land, labour and capital as the primary factors of production. Data wasn’t included because it was classed as intangible and it was not a tradeable good (Brynjolfsson and McAfee: 2011). However, this has since changed due to the dematerialisation of products into digital formats such as music, films, books and magazines which are traded commercially. The rise of data driven decision making (DDD) and Big data analytics also means that data is now the bedrock of most innovation and forms the basis of the DIKW (Ackoff: 1989) knowledge pyramid. The developments in artificial intelligence are also likely to sustain these trends since large data sets are required for machine learning and deep learning methodologies.

Secondly, the concept of the two-sided company was under-represented in the academic literature, only receiving limited attention in Baden-Fuller and Mangematin`s (2010) article, *Business Models: A Challenging Agenda.*

1.7 Conclusion

This chapter has undertaken a detailed analysis of business models. It has considered the origins of the business model concept and how it gained popularity following the inception of the Internet and the worldwide web in the 1990s. This was followed by evaluation of business model definitions and perspectives and identified two major approaches, namely the static (linear) view of business models and the more recent transformational school. This was followed by an analysis of the nature and range of business model components and how a preference for a narrow selection of variables exceeds the use of a broader set of components.

The dynamic and transformational business model perspective was also explored in more depth because this was considered to be more important and relevant to the changing environment and the need for firms to innovate and reinvent themselves in response to a fast changing environment.

It is therefore the purpose of the dissertation to explore the role of data in business model innovation - and innovation in general - and the extent to which two-sided platform-ecosystem companies have an innovation advantage (due to their rich data resources) compared to established one-sided firms.

Chapter 2 of the dissertation will therefore define and explore the platform, ecosystem concepts in some depth and how they provide an alternative perspective when analysing business model innovation in the current competitive environment.

Chapter 2.0 - Literature Review

Ecosystems Thinking and Modern Platform-Based Ecosystem Theory

2.0 Introduction

The emergence of business ecosystems and platforms represents a very recent development that is having a significant impact upon traditional industries and product/service markets. The speed at which this new form of business model innovation has gained momentum has been largely the result of new technologies in the information and communications technology (ICT) sector such as the Internet (Web 1.0 and Web 2.0), the increasing digitization (and dematerialisation) of products, the rapid diffusion of mobile communications (smart phones), big data and cloud computing. This trend is set to continue with the roll out of the Internet-of-Things (IOT) and the increasing connectedness that will result from this.

This chapter will define what is meant by the terms ecosystem and platform and evaluate a broad range of theories relating to these two highly inter-related concepts. This will build on and reinforce theories discussed in Chapter 1.

2.1 Ecosystem Theory

The ecosystem concept is derived from the biological sciences. Although there are limitless definitions for the term ecosystem, one of the most lucid was coined by a pioneer in the science of ecology, Arthur Tansley (1935), who defined an ecosystem as the interactive system established between biocoenosis (a group of living creatures) and their biotope (the environment in which they live). Central to Tansley`s (1935) ecosystem concept was the idea that living organisms are continually engaged in a set of relationships with every other element constituting the environment in which they exist. Ecosystems could therefore be described as any situation where there were relationships between organisms and their environment (McIntosh: 1985).

However, it wasn't until the 1990s that James Moore (1996: 26) applied ecosystem theory to business. Moore is rightly credited with being the first person to produce a formal definition of the business ecosystem. In fact, Moore produced two separate definitions, one for the biological ecosystem and one for the business ecosystem. Moore (1996: 26) defined a biological ecosystem as:

[A] Community of organisms interacting with one-another, plus the environment in which they live and with which they also interact; for example, a lake, a forest, a grassland, tundra. Such a system includes all abiotic components such as mineral ions, organic compounds, and the climatic regime (temperature, rainfall and other physical factors). The biotic components generally include representatives from several trophic levels; primary producers (mainly green plants), macroconsumers (mainly animals), which ingest other organisms or particular organic matter; microconsumers (mainly bacteria and fungi), which break down complex organic compounds upon the death of the above organisms (Abercrombie *et al.,* 1992).

Moore (1996: 26) then produced his own definition of the business ecosystem as:

An economic community supported by a foundation of interacting organizations and individuals – the organizations of the business world. This economic community produces goods and services of value to customers, who are themselves members of the ecosystem. The member organisms also include suppliers, lead producers, competitors and other stakeholders. Over time they co-evolve their capabilities and roles and tend to align themselves with the directions set by one or more central companies. Those companies holding leadership roles may change over time but the function of the ecosystem leader is valued by the community because it enables members to move towards shared visions to align their investments and to find mutually supportive roles (Moore 1996: 26).

There are strong similarities between these three definitions. Tansley refers to the existence of an interactive system between living creatures and the environment thereby implying the continuous engagement in relationships. Moore`s biological ecosystem definition also highlights interaction between organisms and the environment but he also refers to a community and the existence of a terrestrial food chain that generates energy within the system. In his business ecosystem definition he also refers to interaction between organisations and individuals and uses the term economic community, not just community. He also refers to a food chain or energy source which is the production and consumption of goods and services of value to customers. However, Moore takes the interaction element of the ecosystem to a new level when he refers to co-evolution, alignment, shared visions and mutually supportive roles. Finally, Moore also referred to the existence of leadership roles within business ecosystems. These are sometimes known as the keystone firms (Iansiti and Levien: 2004) or the economic catalyst (Evans and Schmalansee: 2007).

This approach is in stark contrast to the rational, industry structure approach particularly the Porter`s Five Forces model (1979). In Porter`s framework, bargaining power and barriers to entry were the key determinants of success and monopolistic power was the goal not co-creation, co-evolution or shared value involving a large community of participants or members. Moore (1993) also insisted that company`s should be viewed not as members of a single industry but as part of a business ecosystem that crossed a variety of industries. This was one of the reasons for the blurring of industry and market boundaries along with new technologies. The concepts of co-creation, co-evolution and continuous innovation also brought a dynamic perspective to the ecosystem model which was absent from conventional economic models such as Porter`s Five Forces framework (1979).

Moore (1993), also stated that innovative businesses couldn`t evolve in a vacuum and that an ecosystem community was therefore better positioned to out-innovate firms operating within conventional market/industry structures or silos. The only true sustainable advantage for a company came from out-innovating the competition at every stage of the ecosystem`s evolutionary cycle from Stage 1 (birth), to Stage 2 (expansion) as well as Stage 3 (leadership) but particularly in Stage 4 (self-renewal).

Despite the seminal nature of Moore`s (1993; 1996) business ecosystem theory, his research was undertaken before the Internet had gained any traction and did not therefore draw on any examples and evidence from online platform companies. The biological analogies used by the author were also very metaphorical and based on fragmented references to different types of terrestrial ecosystems (lakes, rivers, forest and grassland) and no single overarching biological ecosystem is used.

2.2 Ecosystem Strategy

Marco Iansiti and Roy Levien (2004) also identified a subtle but important difference between biological ecosystems and business ecosystems in that a biological ecosystem was self-organising whereas a business ecosystem did not necessarily follow a similar type of development. A business ecosystem frequently benefited from having a leader or what Iansiti and Levien (2004) referred to as a keystone. In fact the authors identified four main types of ecosystem strategy which they distilled into a four quadrant matrix (see Figure 2.0).

Figure 2.0 Choice of Ecosystem Strategy (Iansiti and Levien: 2004)

We will now look at each of these strategies in more depth starting with the keystone approach. The ***keystone strategy*** or keystone organisation plays a crucial role in business ecosystems. Keystone organisations aim to improve the overall health of their ecosystem by providing a stable and predictable set-of common assets. Microsoft`s original personal computer operating system and Google`s Android mobile software and development tools (that other organizations use to build their own offerings) are good examples of this. Keystones can also increase ecosystem productivity by simplifying the complex task of connecting network participants to one another or making the creation of new products by third parties more efficient. They can enhance ecosystem robustness by consistently incorporating technological innovations as well as encouraging niche` creation by offering innovative technologies to a wide variety of third party organisations. The opening up of ecosystems to third party software and app developers is a very good example of this i.e. Microsoft in personal computer software plus Apple and Google in mobile apps. By continually trying to improve the ecosystem as a whole, keystones seek to ensure their own survival and prosperity. As in biological ecosystems, keystones exercise a system-wide role despite being only a small part of their ecosystems` mass.

An effective keystone strategy consists of two aims. The first is to create value within the ecosystem. This is essential otherwise it will fail to attract or retain members. Second, the keystone must share the value it creates with other participants in the ecosystem. Google created value by giving away its Android mobile software to the telecoms operators. This resulted in a large ecosystem of customers who purchased Android-enabled hand-sets (which benefited hardware firms such as Samsung) and who also subscribed to mobile contracts for Android phones (benefiting the telecoms operators). This large user-base also enhanced the attractiveness of the software standard to app developers who became part of the ecosystem. These developers also received software development kits (SDKs or `devkits`) i.e. development tools to facilitate the creation of software applications for Android. The Android ecosystem is also an open system (open source software) as opposed to a closed ecosystem. This is the main reason for its enormous pervasiveness (88% market share) compared to the Apple iOS mobile software ecosystem (12.1% market share) which is semi-closed or proprietary in comparison i.e. a “walled garden” (Hazlett *et al.,* 2011).

The Android software acts as a platform which forms the foundation of Google`s mobile ecosystem. Iansiti and Levien (2004) described a platform as an asset in the form of services, tools or technologies that offer solutions to others in the ecosystem. Iansiti and Levien (2004) developed their definition further by saying that the platform could be a physical asset such as the efficient manufacturing capabilities that Taiwan Semiconductor Manufacturing offered to computer chip design companies that didn`t have their own silicon wafer foundries or an intellectual asset such as the Windows (or Android) software platform. The keystone therefore leaves the vast majority of the value creation to others in the ecosystem. However, the keystone must also retain some of the value that has been created for themselves. Google achieves this by capturing large amounts of data from the users of the Android software which is monetised in the form of advertising revenues (which also creates benefits for advertisers).

Keystone organisations must make sure that the value of their platforms, divided by the cost of creating, maintaining and sharing them increases rapidly with the number of ecosystem members who use them. This allows the keystone players to share the surplus with their communities. However, during the Internet boom, many businesses failed because - although the value of the keystone platform was increasing with the number of customers (theoretically) - the actual operating costs rose resulting in margin erosion and ultimate collapse.

This approach to strategy is in stark contrast to Porter`s Five Forces (1979) Industry structure paradigm. Unlike, Porter`s industry structure approach, there is no attempt to develop monopolistic rents through high bargaining power and the creation of barriers to entry. Instead of preventing entry and substitution, the ecosystem approach is designed to increase the size of the community (expansionist) and its contribution to innovation, not to reduce it. This approach also contrasts with the resource-based view (RBV) of strategy where competitive advantage is achieved by firms developing superior resources and capabilities to competitors. These resources are owned and/or controlled by the firm and there is a strong internal rather than external orientation. With an ecosystem approach, the keystone doesn`t primarily seek ownership or control but access to producer-consumer networks and enhanced value from a broader range of external capabilities (Parker, Van Alstyne and Choudary: 2016). The ecosystem approach therefore focuses on the co-creation and co-evolution of capabilities at an ecosystem rather than at a firm level or industry level.

The ***physical dominator strategy*** resembles the traditional approach to strategy identified in Porter`s Five Forces model where players seek to gain some form of monopoly power or domination. Whereas keystones exercise indirect power, the physical dominator aims to integrate vertically or horizontally to own and manage a large proportion of a network directly. Once a dominator takes control, there is little opportunity for a meaningful ecosystem to emerge. Iansiti and Levien (2004) use IBM as an example and how the firm dominated the mainframe computing ecosystem. This strategy was effective because it allowed IBM to create and extract enormous value for long periods of time. However, it failed when the personal computer (PC) ecosystem emerged which was more open and distributed and was supported by keystone strategies from Apple, Microsoft, Intel and even IBM at the beginning.

Where a ***value dominator strategy*** is adopted the firm has little control over its ecosystem, occupying just a single hub in some cases. It creates little, if any value for the ecosystem. A value dominator extracts as much as it can by sucking from the network most of the value created by other members. It leaves too little to sustain the ecosystem, which may ultimately collapse and bring the value dominator down with it. Although the digital music ecosystem hasn`t shown any signs of collapsing there is evidence of value dominator strategies by key players such as Google`s YouTube music service which is supported by advertising. The monetary returns to artists and music companies are extremely small representing 40% of music played but only 4% of overall revenues (*Financial Times*: 2016a). This is in contrast to streaming subscription services provided by firms such as Spotify which have generated $6billion in revenues for the industry (*Financial Times:* 2016a). The only factor sustaining the ecosystem is the exposure that artists gain from their music being played on what is the largest global music platform. Another example is the cable TV industry in the US where cable companies have continued to charge high prices for poor services and inappropriate programing leading to a decline in subscriptions as customers migrate on to the Internet (*Financial Times*: 2015c).

In business ecosystems, most firms follow ***niche` strategies,*** aiming to develop specialised capabilities that differentiate them from other companies in the network. These firms leverage complementary resources from other niche` players or from the ecosystem keystone. When they are allowed to thrive, niche` players represent the bulk of the ecosystem and they are responsible for most of the value creation and innovation. They operate in the shadow of a keystone which offers its resources to niche` players. Modern examples of niche` players are the software development firms (apps), the small independent computer games companies (`Indies`) and the microprocessor design firms (Arm Holdings).

Where innovation is low and relationships are less complex, ***commodity strategies*** may prevail. Such strategies have been evident in the telecommunications sector where telecoms operators have been slow to adapt to new technologies and have been competing on price rather than the development of new products and services. Only recently have these firms begun to move towards the provision of bundled quad play products based on content and high speed broadband strategies. However, the broadband networks, speeds and mobile coverage still remain underdeveloped.

It is also important to note that, roles in ecosystems aren`t static. A company may be a keystone in one domain and a dominator or a niche` player in others. For example, Microsoft was a keystone in the personal computer (PC) ecosystem but became a dominator in browsers and search. Microsoft implemented a platform envelopment (Eisenmann, Parker and Van Alstyne: 2011) strategy (this occurs when a platform absorbs the functions and the user base of an adjacent platform) to win the browser wars with Netscape in the mid-1990s. Airbnb and Uber started as niche` software apps but became keystones in online accommodation and transport respectively. Meanwhile, the telecoms companies are trying to move away from commodity strategies to becoming value dominators as they upgrade their networks and threaten to introduce ad blocking software to monetise value from high data traffic from the media platforms they serve (*Financial Times*: 2016b).

2.3 An ICT Ecosystem Perspective

Iansiti and Levien`s (2004) research provides an important development of Moore`s (1993; 1996) original business ecosystem model. However, their work (although useful) was produced within the “shadow” of the dot-com crash and the analysis of technology architecture does not incorporate more recent technological developments such as Web 2.0, cloud computing and big data which have had a transformational impact on the growth of ecosystem platforms. Therefore, the chapter will now consider Martin Fransman`s (2010) work entitled: *The New ICT Ecosystem: Implications for Policy and Regulation.* Fransman (2010).

Fransman`s (2010) research viewed the entire information and communications technology (ICT) sector as a system which he represented in an ecosystem layered model (ELM) consisting of four interconnected layers comprising the following (see figure 4.1 above):

1) Networked element providers who produced items such as PCs and their operating systems, mobile phones and telecommunications switches and transmission systems.
2) Network operators who create and operate telecoms, cable TV and satellite networks.
3) Content and application providers.
4) Final consumers.

Figure 2.1: A simplified Ecosystem Layered Model (ELM) of the New ICT Ecosystem (Fransman 2010: 9)

The interactions between the players in the New ICT Ecosystem` were considered to be symbiotic. Symbiosis implied high inter-dependence between organisations (organisms) which were mutually beneficial. According to Fransman, the symbiotic relationships also existed within the layers of the ecosystem as well as within firms and between the various layers. The six key symbiotic relationships are illustrated in a simplified model below (see Figure 2.2):

The Six Symbiotic relationships are summarised as follows:

1) Relationship between networked element providers and network operators.
2) Relationship between network operators and content and applications providers.
3) Relationship between content and applications providers and final consumers.
4) Relationship between networked element providers and final consumers.
5) Relationship between networked element providers and content and application providers.
6) Relationship between network operators and final consumers.

Fransman`s (2010) model is very useful in providing a number of beneficial insights. First, the model makes it possible to conceptualise the entire ICT sector as a system and understand interdependencies and complex interactions within the system.

Figure 2.2 Six Key Symbiotic Relationships in the Ecosystem Layered Model (Fransman 2010: 38)

Second, it allows readers to identify the role played by markets, firms and other institutions in co-ordinating the activities undertaken within the system. Third, it allows observers to analyse corporate specialisation and corporate strategy and the evolutionary drivers that shape industrial structure in the different layers. The ELM helps to illustrate the role that specific, key companies play in the new ICT ecosystem and to analyse co-evolving demand. Finally, it is also possible to analyse the different levels of profitability in different levels of the system.

There are, however, problems with the depiction of a topographical structure. For example, the ELM model fails to show the dynamics of the system including the innovation processes that are a key part of the dynamics. The model is therefore not unlike many other frameworks in that it is relatively static. More importantly, the model suffers from the same drawbacks as Porter`s Five Forces framework (1979) in that the demarcation between the different layers becomes blurred due to changes in technologies and therefore the underlying functionalities. For example, product convergence due to bundling and envelopment (Eisenmann *et al.,* 2006) make it difficult to classify which firms are performing which functions in which layer. Telecoms companies have now become content providers whilst Internet firms such as Google have also moved into the network operator sector (with Google Fibre) and the network equipment segment (with its handsets). Instead of these being symbiotic relationships they have become disruptive competitive relationships.

Finally, since the model conceptualises the ICT ecosystem as a set of functionalities these become quickly outdated or obsolete and therefore the model needs constantly updating in the current hyper-competitive (D`Aveni: 1994) Schumpeterian (1942) environment. The fact that the current model doesn't incorporate new developments such as big data and cloud computing is evidence of this drawback. However, Fransman (2010: 1) did state very emphatically that innovation was at the heart of the new ICT ecosystem and that the Internet had become a key and ubiquitous infrastructure that was shaping virtually all economic activity (Fransman 2010: 22).

2.4 Platform Theory

This section will now look at a critical component of modern ecosystems which is the platform. An ecosystem will inevitably be anchored by a platform and platforms are now pervasive in high-technology industries (Gawer: 2009). A platform exists when the elements of the ecosystem depend upon common standards and interfaces (Robertson and Ulrich: 1998). Fransman (2010) also stated that symbiotic interactions were shaped by platforms. Gawer (2009: 3-4) defined a platform as:

`…..a building block, which can be a product, a technology or a service that acts as a foundation upon which other firms can develop complementary products, technologies or services`.

In an earlier work Gawer and Cusumano (2008: 30) referred to:

`…….the modern high tech-platform – an evolving system made of interdependent pieces that can each be innovated upon`.

Platforms usually emerge in the context of modular industries (Baldwin and Clark: 2000; Baldwin: 2008) or industry ecosystems (Iansiti and Levien, 2004). Therefore, Gawer and Cusumano`s (2008) belief that platforms were `core` to a technological system (essential to its function) as well as being highly inter-dependent with other parts of the technological system, should not be overstated. Research has shown (Iansiti and Levien: 2004; Eisenmann, Parker and Van Alstyne: 2008; 2009) that the organisation of these ecosystems appears to follow a regular structure, with platform leaders acting as `keystone` members of the network of firms (as discussed earlier in the chapter) who coordinate and orchestrate the platform complementors, with strong inter-dependencies (strategic and technological) between the `core` that is the platform and the other parts of the ecosystem (technological system). The complementors also occupy a peripheral position (Iansiti and Levien`s niche` strategies) in the network with fewer links between them.

Technological platforms have become increasingly pervasive as new computing technologies have become embedded within industrial ecosystems transforming the industrial and competitive landscapes (Hitt *et al.,* 2003) and disrupting the balance of power between firms. This trend has been referred as `The Age of the Platform` (Simon: 2011).

This has fostered high levels of innovation leading to a broad and robust range of research on platforms (Breshnahan and Greenstein: 1999; Gawer and Cusumano: 2002: 2008; West: 2003; Rochet and Tirole: 2003: 2006; Iansiti and Levien: 2004;

Eisenmann, Parker and Van Alstyne: 2006); Evans, Hagiu and Schmalansee: 2006; Gawer and Henderson; 2007).

Annabelle Gawer (2009), developed a detailed typology of platforms which she broke down into four classifications, namely: internal platforms (within the firm), supply chain platforms (within a supply chain), industry platforms (industry ecosystems) and multi-sided markets or platforms (see Table 2.0). The chapter will now analyse these in more detail to determine their relevance to ecosystem theory.

According to Gawer (2009: 46), the first widespread use of platforms occurred in the early 1990s within the context of product development. Gawer (2009: 46) referred to these as ***internal platforms*** otherwise known as ***`product platforms`*** (Wheelwright and Clark 1992: 73). Meyer and Lehnerd (1997) defined product platforms as a set of sub-systems and interfaces that formed a common structure from within a stream of derivative products that were efficiently developed and produced. The benefits of designing and using product platforms were to reduce fixed costs, gain efficiency in product development (through the re-use of common parts), the ability to produce a large number of derivative products as well as gaining flexibility in product design (Robertson and Ulrich: 1998; Sawhney: 1998; Krishnan and Gupta: 2001; Muffato and Roveda: 2002).

Table 2.0 Typology of Platforms (Adapted from Gawer 2009: 47- 48)

Although most of the product platform literature was manufacturing based (i.e. automotive), most of the concepts and variables could also be applied to the context of services. The processes involved in the design of services could be broken down into parts that could then be assembled or integrated and later customised (Robertson and Ulrich: 1998; Meyer and De Tore: 1999; Voss and Hsuan: 2008).

Moreover, with Gawer`s (2009) internal (product development) platform all the activity takes place within the organisation and only involves a single firm. There is subsequently no external economic community with which the platform interacts to co-create and co-evolve new products (Moore: 1993; 1996) and the platform configuration is linear and silo-oriented.

Gawer`s (2009) second platform typology was the ***supply chain platform.*** According to Gawer, the supply chain platform extended the product platform concept to firms within the context of a supply chain. The main difference between the two platforms was that product design, development and manufacture happened externally and not internally involving different suppliers and final assemblers. This often involved formal alliances and cross-ownership such as in the automotive industry where all the leading firms were in some form of partnership agreement. The objectives of the supply chain platforms were similar to the internal platforms (see Table 2.0) in that they sought to improve efficiency, reduce costs, reduce the variety of parts and increase product variety (involving the systematic re-use of modular components).

However, with the supply chain platform typology there are frequently divergent incentives between the members of the supply chain or alliance and trade-offs often occur between optimizing the performance of sub-systems and optimizing the performance of the overall system (Zirpoli and Becker: 2008). This is at odds with Moore`s (1993; 1996) definition of a business ecosystem where there is a shared vision between the members of economic community based on mutually supportive roles.

The members of the economic community should also co-evolve themselves and not just co-create products. Moreover, within these supply chain platforms there is a clear hierarchy with the bargaining power resting with the final assembler. However, in the business ecosystem, coordination is through symbiotic inter-dependent relationships which add value. According to Fransman (2010), successful platforms actually shaped symbiotic relationships. Finally, supply chain platforms are industry-based and still conform to the principles of Porter`s positioning school of strategy. They are also linear and do not benefit from broader network effects outside the supply chain silo.

Gawer`s (2009) third typology was the ***industry platform*** which she defined as:

`…….products, services or technologies that are developed by one or several firms and which serve as foundations upon which other firms can build complementary products, services or technologies` (Gawer 2009: 54)

A key distinction between supply chain platforms and industry platforms is that within industry platforms the firms developing complements don`t necessarily buy or sell from each other, they are also not part of the same supply chain nor is there any need for cross-ownership.

These platforms consist of a large number of firms that Gawer referred to as industrial ecosystems which develop complementary technologies, products and services. Examples include, key players in the information and communications technology (ICT) sector highlighted in Fransman`s (2010) ELM model (in Figure 2.1) such as the network infrastructure providers (telecoms equipment companies) and the network operators (telecoms, satellite and media companies). Network infrastructure providers include ZTE, Huawei, Ericsson, Nokia Networks (NSN), Alcatel Lucent, Dell, Hewlett Packard, IBM, Cisco, Intel, Qualcomm and Samsung etc. The network operators would include British Telecom, AT&T, Vodafone, Verizon, DT, Sprint, China Mobile, Comcast and Dish Network etc. Many of these industry platform companies also demonstrate elements of the two-sided business model as the two typologies appear to be converging.

In fact, the first studies of industry platforms were based on computing, telecommunications and other information-technology-intensive industries. For example, in their study of the emergence of computer platforms, Breshnahan and Greenstein (1999) defined platforms as a bundle of standard components around which buyers and sellers coordinated their activities. West (2003) also defined a computer platform as an architecture of related standards which allowed modular substitution of complementary assets such as software and peripheral hardware. Iansiti and Levien`s (2004) `keystone firm` could also be compared to what Gawer and Cusumano (2002; 2008) called a platform leader i.e. a firm that drives industry-wide innovation for an evolving system of separately developed components. Meanwhile, Gawer and Henderson (2007) described a product as a platform when it was one component or subsystem of an evolving technological system i.e. when it was functionally dependent with most of the other components of the system.

As mentioned earlier, there are important differences between industry platforms and internal or supply chain platforms insofar as industry platform leaders (or platform owners) aim to leverage the innovative capabilities of external firms (which are not necessarily part of their supply chain) particularly where there is an `open` as opposed to a closed or semi-closed platform ecosystem (Chesbrough: 2003; Eisenmann, Parker and Van Alstyne: 2009; Greenstein: 2009; Schilling: 2009). Platform leaders therefore strategically facilitate and stimulate complementary third party innovation through careful management of the ecosystem relationships (Gawer and Cusumano: 2002; Iansiti and Levien: 2004).

Gawer and Cusumano (2002) therefore proposed four levers designed to enhance this form of platform governance. The first lever was *firm scope* and required the platform leader to decide what activities would be performed in-house and what should be left to other firms (markets vs. hierarchies) i.e. should some complements be developed in-house? The second lever was *technology design and intellectual property* and required the platform leader to decide what functionality or features to include in the platform, whether the platform should be modular and to what degree the platform interfaces should be open to outside complementors and at what price (i.e. the use of APIs – application programming interfaces). The third lever covered *external relationships with complementors* and required the platform leader to manage the complementors and to encourage them to contribute to the ecosystem. The fourth and final lever was *internal organisation* and was concerned with how platform leaders should use their organisational structure and internal processes to facilitate external complementors.

This approach is in stark contrast to Porter`s industry attractiveness, Five Forces model (1979) where the driving forces consist of bargaining power, barriers to entry and monopolistic power. The four governance levers can therefore be viewed as alternative coordination mechanisms that focus on achieving long-term Schumpeterian (1942) rents from innovation rather than short-term monopoly rents (Porter: 1979; 1985) from monopolistic competition (Farrell and Katz: 2000).

It was also found that there was an element of overlap between the design principles or design rules of industry platforms and supply chain platforms such as the need for a stable architecture. However, there were also some important differences. For example, the design principles that are used for the supply chain are inverted when applied to industry platforms. Instead of the firm acting as the `master designer` or assembler who conceives and designs an end product and then disseminates instructions and tasks to other firms for modularisation; the starting point is a core component that is part of a module structure and the final result of the assembly is either unknown or ex-ante. With industry platforms, the end-product or service is not pre-determined. This creates limitless scope for innovation on complementary products, services and technologies.

The fourth and final typology that Gawer (2009) considered was the ***double-sided (or multi-sided) market.*** The term, two-sided markets was coined by two French economists Jean Charles Rochet and Jean Tirole (2003) following earlier research by William Baxter (1983). Double-sided markets (also known as two-sided markets, multi-sided markets or multi-sided platforms) are technologies, products or services that create value primarily by enabling direct and indirect interaction between two or more customers or participant groups.

Prominent examples of double-sided markets and the participants they connect include Alibaba.com, eBay, Taobao and Rakuten (buyers and sellers); Airbnb (dwelling owners and renters); the Uber app (professional drivers and passengers); Facebook (users, advertisers, third party game or content developers and affiliated third party sites); Apple`s iOS and Android operating systems (application developers and users); Sony`s Playstation and Microsoft`s Xbox gaming consoles (game developers and users); American Express, Pay Pal and Square (merchants and consumers); shopping malls (retail stores and consumers); Fandango (cinemas and consumers) Ticketmaster (events venues and consumers) and the Google

Internet search engine (advertisers and users). This range of platforms is increasing all the time as the cost of computing power declines i.e. new financial technology (Fintech) and health platforms are emerging.

Baldwin and Woodward`s (2009) research found common features between the architecture of multi-sided markets and the industry platforms (industry ecosystems). This is reinforced by the long list of examples of double-sided markets above. The similarities that Baldwin and Woodward (2009) identified were the existence of indirect network affects (sometimes referred to as cross-side network effects) that arise between the two sides of the market when participants have to affiliate with the platform in order to be able to transact with one-another (Armstrong: 2006; Caillaud and Jullien: 2003; Evans: 2003; Hagiu: 2006: 2014; Rochet and Tirole: 2003: 2006).

However, Gawer (2009), was critical in her research when she stated that not all double-sided or multi-sided markets were industry platforms based on the earlier definitions in this chapter. Gawer (2009) indicated that these platforms were not always building blocks that acted as foundations upon which other firms could develop complementary products, technologies or services. She singled out those double-sided markets which were pure exchange or trading platforms (i.e. dating sites) where the role of the platform was purely to facilitate transactions between different sides of the markets without the possibility for other players to innovate and she therefore considered this typology to belong to a different category:

The key distinction I make is whether the multi-sided market facilitates or not innovation in new products, technologies or services. All industry platforms do – but some multi-sided platforms don`t seem to (Gawer 2009: 58).

However, as the diffusion of smart phones, apps and cloud computing have increased exponentially since the publication of Gawer`s research (Gawer and Cusumano: 2002: 2008; Gawer and Henderson: 2007; Gawer: 2009), the number of multi-sided platforms has proliferated. A key driver of this proliferation has been business model innovation which has occurred in three ways: first, through de-linking assets from value; second, through re-intermediation and third, through market aggregation (Parker, Alstyne and Choudary 2016: 69-73).

Airbnb and Uber are good examples of how a multi-sided platform using a low-cost base *de-links assets from value*. These app-based platforms do not own real estate or automobiles (fixed assets) but through the use of their software infrastructures and network effects they are able to generate significant value for buyers and sellers by leveraging the under-utilised assets of third parties that would otherwise not yield any likely return i.e. the assets have little (if any additional value) without the complementary effects of the two-sided platforms.

Further evidence of business model innovation on the part of two-sided markets occurs when an industry platform (industry ecosystem) disintermediates an existing supply chain such as travel agents. However, we are now seeing *re-intermediation* platforms emerge such as Skyscanner and Trip Advisor. These services are not only free but accessible 24/7 thereby enhancing the value proposition. In fact, multi-sided platforms have created a new layer of reputational information by leveraging social feedback relating to producers. Platforms such as Yelp, Angie`s List and Trip Advisor (mentioned earlier) have created an entirely new industry based on certifying the quality of product and service advisors.

The third form of business model innovation is *market aggregation.* Two-sided platforms create new efficiencies by aggregating unorganised markets. This is the process whereby the platforms provide centralised markets to serve widely distributed individuals and organisations. Market aggregation provides information and power to users who previously engaged in interactions in a haphazard fashion often without access to reliable or up-to-date market data and/or infrastructure. Platforms such as Upwork bring thousands of skilled professionals together making it easier for potential employers to evaluate, compare and hire them.

Both the industry platform (industry ecosystem) and the multi-sided market/platform typologies conform to Moore`s (1996: 26) definition of a business ecosystem. They both involve an economic community of suppliers, buyers, competitors and other stakeholders within the broader community. The community participants are also aligned with the directions of a `keystone` or platform leader and there are shared visions relating to intended outcomes and value.

This is in contrast to the linear, single or one-sided businesses such as the internal (product development) and supply chain platforms (see Figure 2.3).

Figure 2.3: The Traditional One-Sided Business (Evans and Schmalensee 2007: 11)

In a one-sided market the consumer is located at the end and value is pushed out to them. The functions of production and consumption are also clearly demarcated. One-sided firms also compete through resource ownership and control and scaling through vertical integration and mergers and acquisitions. With the platform ecosystem model, value is enabled by the platform leaders and is co-created via a network of participants. Successful, modern ecosystem platforms create huge value not through their access to physical resources but through leveraging data to coordinate physical and digital resources across the ecosystem.

2.4 A New Architectural Perspective – The Platform Stack

Platform-based ecosystems are now restructuring the ways that businesses create and deliver value across a broad range of markets and industries, not just the information-intensive sectors. According to Choudary (2015: 23), we are in the midst of a transformative shift in business design as business models move from `pipes` (linear one-sided businesses) to `platforms` (multi-sided ecosystems). Although the one-sided business model served as the dominant design throughout the capitalist industrial era, new trends are now emerging at an exponential rate due to Moore`s Law (Ishmail *et al.,* 2014) as more platform-based ecosystems are disrupting a broader range of sectors including media (newspapers, magazines, books, music and TV); financial services and insurance, travel and tourism, real estate and hotels, automobiles, health and many others.

The key drivers behind the increasing growth and pervasiveness of platform ecosystems has been new technological trends such as the rapid adoption of smart phones, 3G and 4G Internet connectivity, apps, cloud computing services, software embeddedness and digitisation, the Internet-of-Things and big data. The proliferation of smart phone adoption and the ubiquity of Internet connectivity via 3G and 4G networks has made it possible for new platforms to engage with a vast consumer audience. Apps and cloud computing services (software as a service, platform as a service and infrastructure as a service) have meant that entrepreneurs can scale new platforms very cheaply and very rapidly with minimal capital outlay i.e. Airbnb, Uber, Snapchat and Spotify etc. As more products have become Internet-enabled (the Internet-of-Things) with sensors or dematerialised through digitisation; and as many activities have been substituted by software robots; the rise and spread of platform ecosystems into traditional one-sided markets has increased. The data deluge created by these changes has also led to the emergence of platform firms with `Big Data` capabilities (using structured and unstructured data) such as Google, Amazon, Microsoft, Facebook and Alibaba who can perform high speed predictive and prescriptive analytics which enables them to reduce costs, enhance their marketing and risk management capabilities and to outperform conventional one-sided businesses.

Although companies across industries are actively building platforms, these individual platforms are also vastly different. For example, from the perspective of software developers, Android, Salesforce and Facebook Connect are vastly different. Medium and Wordpress are blogging platforms but have little in common with software development platforms. You Tube, Facebook, Instagram and Snapchat are described as social platforms, while Uber and Airbnb are referred to as marketplace platforms. This becomes even more complex when one considers that the Nest Thermostat is called a platform and Nike is working on a platform to connect shoes, while GE claims to be using a platform approach to manage its factories (the Internet-of-Things).

The fact that these businesses are vastly different from each other creates problems when trying to plan strategies from two perspectives. First, how to plan strategy from the position of a newly evolving or established platform and second how to plan strategy from the position of an incumbent firm in an industry that is under the threat of disruption from a platform ecosystem i.e. Nokia`s recent demise at the hands of the Apple iPhone. Research undertaken by Choudary (2015), revealed that across all types of platform three distinct architectural layers repeatedly emerged. This has made it possible to formulate a unifying architectural framework - referred to as the

`Platform Stack` (see Figure 2.4 below) - to explain the different types of platform configuration. This forms an important basis from which future platform strategies can be planned. We will now look at each of these configurations in more detail starting with the network-marketplace community.

Figure 2.4. The Platform Stack (Choudary 2015: 61)

Network-Marketplace-Community-Layer: the first layer of the platform comprises participants and their relationships and includes social networks. This also involves the matching of buyers and sellers with regards to goods and services. Some platforms may have an implicit community layer. For example, users of Mint.com are not connected to each other but every user`s financial analytics are benchmarked against that of similar users. Every user therefore benefits implicitly from the community without the requirement to connect with others explicitly. So the external network of producers creates value in the network layer but to enable this value creation, platforms need a second layer: infrastructure.

Infrastructure Layer: this layer encapsulates the tools, services and rules that enable interaction to take place, this is sometimes referred to as “plug-and-play” (Choudary: 2015). This layer has little value on its own unless users and partners create value on the platform. External producers build on top of this infrastructure. For example, on Android, developers produce apps, on YouTube video creators host videos, and on eBay, sellers host product availability.

On development platforms such as Android, the infrastructure layer may be very dominant. On other platforms such as Instagram the infrastructure layer may be thinner. Therefore, the infrastructure layer provides the infrastructure on top of which value can be created i.e. the software upon which application programmes can run or other services. However, large-scale value creation leads to the problem of abundance. With an abundance of production, search costs increase for consumers. Too many videos on You Tube may make it harder for consumers to find the best ones. To solve this problem, the platform stack needs a third layer: data.

Data Layer: this is the final platform layer. Every platform uses data in some way since the data helps the platform to match supply with demand. The data layer creates relevance and matches the most relevant content/goods/services with the right users. In some cases the data layer may play a very dominant role. For example, the Nest thermostat is a data-intensive platform, where value is created entirely through the data aggregated across thermostats. The same principle applies to GEs Predix, Internet-of-Things (IOT) factory platform.

While platforms function across these three layers, the degree to which each one dominates may vary. The platform stack helps to reconcile the differences between different platforms while also acknowledging the similarity of the business models across all these instances. To understand the different types of platforms, the chapter will now explore three basic configurations of the platform stack in more depth.

Basic Configuration 1 – The marketplace/community platform: Airbnb and Uber and most marketplace platforms have a thick marketplace/community layer and the network is the key source of value. Online communities like Reddit, social networks like Twitter and content platforms like You Tube benefit from thick or dense community layers. All three layers play a role although one may be more dominant than the others. The stack helps to illustrate that every platform will have its unique configuration. Certain platforms, like Craigslist and some online platforms, focus almost exclusively on the marketplace or community layer with almost no infrastructure and without much leveraging of data (see Figure 2.5 below).

Figure 2.5 Platform Stack – The Marketplace Community Platform Configuration (Choudary 2015: 63)

Basic Configuration 2 – The Infra

structure Platform: development platforms such as Android provide the infrastructure on top of which apps may be created. In tandem with the Google Play marketplace, Android`s development infrastructure is the key source of value for developers. Traditionally development platforms have focused on the infrastructure layer without a marketplace for apps. As a publishing platform, WordPress provides infrastructure exclusively. It doesn`t provide network benefits or any value through data (see Figure 2.6 below).

Figure 2.6 Platform Stack – Infrastructure Platform Configuration (Choudary 2015: 63).

Basic Configuration 3: The data platform: the third basic configuration is the one where the data layer plays a dominant role. The data layer plays an important role on every platform. Facebook uses data to fashion newsfeeds and Airbnb uses data to match hosts to travellers. However, on certain platforms the data layer itself constitutes the key value created on the platform. Some of them may not even seem like platforms but they follow the same stack while focusing almost exclusively on the data layer (see Figure 2.7 below).

Figure 2.7: Platform Stack – Data Platform Configuration (Choudary 2015: 64)

Wearables are a good example, Nike`s shoes and Fuelband constantly stream data to an underlying platform that integrates the user experience across the shoe, the wearable and the mobile apps. Wearables such as Jawbone create value through the data platform. The wearable produces data constantly and the platform provides analytics back to the user based on the data. The platform also pools data from many users to create network-level insights. Wearables therefore benefit from implicit network effects.

The Nest thermostat and the Internet of things are also good examples. The Nest thermostat uses a data platform to aggregate data from multiple thermostats. This aggregation of data enables analytics for thermostat users and powers services to the city`s utilities board. The Internet-of-Things (IOT) will also give rise to new business models in similar ways through the creation of data platforms.

Finally, GE is focusing on the `Industrial Internet` which is another example of a data platform. Machines embedded with sensors constantly stream activity data into a platform that helps each machine learn from other machines and provides network intelligence. These machines benefit from implicit network effects and every machine learns from the community of machines it is concerned with.

If a platform is to scale successfully it must be centred on the goal of value creation. In terms of the Platform Stack, this is known as the `core value unit` concept. The core value unit is the minimum standalone unit of value that is created on top of the platform. This will depend to a large extent on how the platform is configured. For example, the core value unit could be network/marketplace/community-dominated, infrastructure-dominated or data-dominated.

The core value unit on platforms that have a dominant network/market place/community will be the goods and services that they offer. Where the platform acts as the underlying infrastructure on top of which value is created then apps form the core value unit i.e. on development platforms. Meanwhile, the minimum unit of content constitutes the core value unit on a content platform i.e. videos on You Tube. Finally, on data-dominated platforms, the data itself is the source of value. For example, on a retail loyalty platform the data profile of the consumer is the value unit. It is the core source of value to a retailer interested in targeting that consumer.

When implementing platform scale, successful platforms such as Uber, Airbnb, Facebook, You Tube and Upwork always start at the infrastructure layer first. It is important to build the infrastructure first in order to enable interactions to take place in the layer above. As the infrastructure gains adoption, an ecosystem of producers and consumers starts to evolve. For example, drivers and travellers start using Airbnb and developers and users start adopting Android. This becomes the next discernible stage in the evolution of the platform. Finally, activity by producers and consumers on the platform generates significant amounts of data. The data layer then serves to make future interactions more efficient and keeps users regularly engaged in the platform. As the data layer grows stronger, the network or ecosystem layer also increases in strength.

Most multibillion dollar start-ups (Choudary 2015: 319) have achieved platform scale using this evolutionary template (Amazon, Google, Facebook and Alibaba etc.). However, although this template works for start-ups it doesn't work for traditional one-sided businesses seeking to develop a platform. Traditional businesses according to Choudary (2015: 320), lack a culture of data acquisition and data management. Choudary (2015: 320) therefore recommended that the journey to platform scale needed to start with the data layer, followed by the infrastructure layer and then the development of the network-marketplace community. Choudary recommended five key stages in this evolutionary development:

1) Build a culture of data acquisition.
2) Enable data porosity and integration.

3) Leverage implicit data-driven network effects.
4) Build explicit communities.
5) Enable explicit exchange.

The first stage for a traditional business, according to Choudary (2015: 321), was to create a culture of data acquisition. The firm needed to understand that higher data acquisition meant greater monetisation opportunities. All digital services that are introduced to users should be integrated at the data layer and every service should seek to acquire data that can be monetised in some form in the business. A strategy that intended to leverage platform scale should therefore start with a coherent data strategy.

Once a strategy of data acquisition had been established, the second stage was to institute infrastructural change by integrating the internal organisation. The firm must integrate all processes, workflows and touchpoints at the data layer. Firms must restructure their internal systems to be more data-porous with internal application programming interfaces (APIs) and avoid silos that prevent cross-communication. The third stage is where the firm starts to leverage its existing user base. Once users have been profiled on the database the business can start to target them with recommendations etc. Once the first three stages are complete the firm should then start to build a community. There has been a tendency (Choudary 2015: 324) for traditional firms to skip the first three steps and then fail because of the inability to leverage intelligence due to the lack of integration at the data layer. If the firm reaches the final stage it will be able to operate as effectively as a modern platform company.

2.5 The Implications for Strategy and Competition

The platform stack concept and the architectural approach to the analysis of complex platform ecosystems is in stark contrast to the classical, positioning and RBV approaches to strategy. It is therefore worth exploring the benefits of the approach and making some comparisons with well-established models from the classical, positioning and RBV schools.

First, the platform stack provides a useful tool that helps to understand the different types of platforms that exist. This could be considered to be an alternative approach to the strategic group analysis (Barney and Hoskisson: 2006). It can be used to identify potential threats from both new and established platforms and/or highlighting opportunities to provide complementary assets.

Second, the platform stack helps to decide which layers a platform should differentiate itself in and how. This can be likened to the resource based view (RBV) where a strategy is selected based on the most appropriate fit between the resources at hand and the demands of the external environment and marketplace (Barney: 1991; Grant: 2008; 2013).

Third, the platform stack helps platform-builders to understand the key drivers of value and how to benchmark a platform on these key parameters against competition and substitutes. In this instance the platform stack can be viewed to be a substitute for the Value Chain (Porter: 1990) model. It not only helps to identify the core value units but also how the value is configured. It also provides an easy to use benchmarking tool when analysing the value configurations of competitors.

Fourth, although there has been a focus on the differential aspects of the platform stack and how firms often dominate specific layers over others; some of the very large Internet firms (Amazon, Alibaba and Google) are dominant in all three layers and this is known as `building-out-the stack`. This could be likened to Porter`s (1979) monopolistic power (Five Forces Framework) where a small number (oligopoly) of very large data-rich firms hold a dominant position. This is likely to strengthen as these firms develop artificial intelligence capabilities. These are also what Tidd and Bessant referred to as high involvement in innovation (HII) companies (Tidd and Bessant: 2013).

However, the analysis does still raise a number of important questions. The speed at which technological change is occurring has meant that the current theories now need updating. Gawer`s (2009b) typology of platforms does not take account of the business model innovation and disruption being created by the new multi-sided platforms and how this type of platform is becoming even more pervasive than the original industry ecosystem. In fact the two types of platform ecosystem are now converging and the boundaries between them blurring or disappearing altogether in some instances. Meanwhile Fransman`s (2010) layered ICT ecosystem model doesn't recognise how the sectors boundaries have now extended to include artificial intelligence (AI) and all forms of data transmitted via the Internet. Nevertheless, Fransman did state quite emphatically that:

`……the Internet is not only a network of networks; it is also a platform of platforms` (Fransman 2010: 19).

The chapter will conclude with a summary and discussion of the key differentiators that characterise the classical and resource-based views (RBV) of strategy and the platform-ecosystem approach.

2.6 The Key Differences between the Classical and RBV Approaches to Strategy and the Platform-Ecosystem Perspective

The purpose of this section is to clarify and illustrate the key differences between the traditional linear industry structure and resource based views (RBV) of strategy and the two-sided platform-based ecosystem model and emphasise the limitations of the conventional approaches to strategy.

We will start by considering Porter`s (1979; 1980; 1985) industry structure approach that has its routes firmly set in the industrial and manufacturing age. Porter`s strategic approach, using the Five Forces Framework (1979), is based upon supply-side economies of scale. In the manufacturing era, firms had massive fixed costs and low marginal costs which meant that they had to achieve higher sales than their competitors in order to lower the average unit cost of production. High scale enabled them to reduce prices - which in turn increased volume further - and this permitted more price cuts thereby creating a virtuous feedback loop that produced monopolies - hence Porter`s monopolistic rents as the source of competitive advantage.

In supply-side economies, firms achieve market power by controlling resources, increasing efficiency and fighting off challenges from the Five Forces. The goal, according to Van Altsyne *et al.,* (2016) was to build a “moat” around the business that protected it from rivals and channelled the competition towards other firms. However, the driving force behind the Internet economy is different. This is based upon demand-side-economies of scale that are also referred to as network effects (Van Alstyne *et al.,* 2016: 58).

Van Alstyne, Parker and Choudary (2016: 58) also stated that these network effects were enhanced by technologies that created efficiencies in social networking, demand aggregation, app development and other phenomena that helped networks to expand. Therefore, in the Internet economy, companies that achieved higher “volume” than competitors (attracted more platform participants) and offered a higher average value per transaction. Due to their larger networks, these firms were able to provide a closer match between supply and demand from the different sides of the platform (owing to their possession of larger and “richer” troves of data). Subsequently, greater scale generated more value, which attracted more participants, which created even more value. This created another virtuous feedback loop that also produced monopolies. Van Alstyne *et al*., (2016: 58) suggested that network effects created Alibaba, which now accounts for 80% of Chinese e-commerce transactions; Google, which now accounts for 82% of mobile operating systems and 94% of mobile search and Facebook, the world`s most dominant social media platform which now has 1.6 billion users.

A key weakness of the Five Forces model is that it doesn`t factor in network effects and the value that this creates. Porter`s (1979) model views external forces as “depletive” or “extracting” value from a firm (Van Alstyne et al., 2016: 58) and therefore proposes building barriers against them (barriers to entry). However, in demand-side economies, external forces are normally “accretive” and add value to the platform business. Consequently, the power of suppliers and customers that are considered threatening in a supply-side world become an asset in a platform world. Therefore, understanding when external forces may add or extract value in an ecosystem is a key aspect of platform strategy which also has to contend with competition from other platform ecosystems.

Moreover, in traditional businesses, the five forces are clearly defined and stable. For a steel manufacturer or an airline, the customers and competitors are well understood and the boundaries separating the suppliers, customers and competitors are clearly delineated. However, in platform-ecosystems the various boundaries can shift very rapidly and also converge.

We will now consider the relevance of the resource-based view (RBV) of strategy and its appropriateness for the analysis of platform-based ecosystems. According to Van Alstyne, Parker and Choudary (2016: 56-57), the emergence of platform-ecosystems has seen three types of shift occurring relating to traditional business models. These include a shift from resource control to resource orchestration; a shift from internal optimisation to external interaction and a shift from a focus on customer value to a focus on ecosystem value. We will now consider each of these in more detail.

The shift from resource control to resource orchestration is very important. According to the resource-based view (RBV) of strategy an organisation gains an advantage by controlling valuable, rare and inimitable (VRIO) resources (Barney, 1991) that are difficult to copy or to replicate. In one-sided firms, these resources would include tangible assets such as plant, equipment and raw materials and intangible resources such as brands and intellectual property. With platforms, the resources that are difficult to copy or replicate are the external community and the capabilities that its members own and contribute. These may include cars (transportation capabilities), rooms (accommodation capabilities) or ideas and information (innovation capabilities). Therefore, the network of external producers and consumers becomes the main resource and capability.

The second important shift has been from internal optimisation to external interaction. Firms in the `old` economy organise internal labour and resources to create value by optimizing a linear chain of product activities from material sourcing to sales and service. Platform ecosystems, on the other hand, create value by facilitating interactions between external producers and consumers. This external orientation means that the platform firms also divest themselves of the variable costs of production. The emphasis also shifts from controlling and dictating processes to persuading participants to join and contribute to the platform. Ecosystem governance therefore becomes an essential strategic skill.

Finally, Van Alstyne *et al.,* (2016) identified a shift from focusing on customer value to a focus on ecosystem value. Traditional one-sided businesses featured in established strategic models always sought to maximise the lifetime value of individual customers of products and services. These customers always appeared at the end of the linear process illustrated in Figure 2.3. Platforms, on the other hand, seek to maximise the total value of a growing ecosystem in a feedback-driven process that is typically circular and iterative.

2.7 Conclusion

These three shifts in emphasis illustrate that competition is more complicated and dynamic in a platform world. In platform ecosystems, competitive forces behave differently and due to the high levels of business model innovation, new factors come into play that are not embraced in traditional strategic models and approaches.

A much broader perspective of the ecosystem and platform concepts is therefore needed if we are to completely understand and appreciate the full extent of the creative destruction (Schumpeter: 1942) being caused by these platforms both within traditional industries and the technology sector as well. Choudary`s (2015) Platform Stack architectural model provides a very useful high level framework for the analysis of platform dynamics. However, this model still fails to highlight the true role of data, information, knowledge and innovation (wisdom) in driving platform-ecosystem dynamics (Ackoff, 1989). As data has become the new form of capital

(MIT-Oracle: 2016), the next chapter of the dissertation will consider the role of data, information and innovation as the new source of competitive advantage that is replacing capital in the post-industrial technology era. The resource-based view (RBV) of strategy will be used to explore the extent to which data-rich two-sided businesses have an innovation and competitive advantage over traditional one-sided firms.

Chapter 3.0 - Literature Review

A Resource-Based View (RBV) of the Innovation Advantage of a Two-Sided Business Model over a One-Sided Business Model & the Role of Data

3.0 Introduction

Chapter 3 will apply the resourced-based view (RBV) of strategy to the analysis of the two-sided platform ecosystem model and the single-sided business model in order to understand the extent to which a two-sided strategic approach is able to leverage data to achieve a competitive advantage over traditional one-sided businesses.

The analysis will incorporate a broad range of RBV theories (Grant: 1991; Barney: 1991) including dynamic capabilities (Teece *et al*., 1997), Danneels (2008; 2012) second order competencies, Prahalad and Hamel`s (1990) core competencies and Grant`s (1996) knowledge-based view. The importance of value networks (Peppard and Rylander: 2006) as a substitute for Porter`s (1990) traditional value chain will also be considered as well as the RCOV (Demil and Lecoq: 2010) and the Wheel of Business Model Reinvention frameworks (Voelpel *et al.,* 2004).

The chapter will conclude with a discussion of the research gap and how this will be tested using an innovation audit methodology.

3.1 The Origins and Relevance of the Resource-Based View in the Knowledge Economy

The origins of the resource-based view (RBV) can be traced back over 60 years to the work of Joseph Schumpeter and Edith Penrose. It was Joseph Schumpeter who laid the foundations for a resource-based theory in his *History of Economics Analysis* (1954), which highlighted the importance of resource differences in generating innovation, entrepreneurship and economic growth. In her work, *The Theory of the Growth of the Firm* (1959), Penrose applied Schumpeter`s theory to the industrial organisation. Schumpeter also made a distinction between innovation and discovery on the one-hand and innovation and commercialisation on the other. This reflected the nineteenth-century model of innovation where independent inventors offered their inventions to entrepreneurs for commercialisation.

Penrose (1959) reinterpreted Schumpeter`s theory of the modern firm and noted the necessity for innovation, discovery commercialisation and entrepreneurship all taking place *within* the firm`s boundaries. Penrose therefore highlighted the importance of in-house research and development and anticipated the growing importance of organisational learning, technological change, flexibility, diversification, collaboration, networks, shared capabilities and internationalisation.

Penrose (1959) started the shift in thinking away from firms obtaining profits through the exploitation of market power (Porter: 1979, 1980) towards the creation of profits through new capabilities. Penrose (1959) also anticipated the increasing relevance of Schumpeter`s ideas and her own interpretation of them in today`s business context. This view is reinforced in the work of Hitt *et al.,* (2003) who confirmed that nowadays it is more difficult to establish and sustain positions of market power due to globalisation and technological drivers. As discussed at the end of Chapter 2, the importance of the economies of scale and scope are reduced because of increasing market sophistication and diversification, forcing one-sided firms to specialise in more narrowly defined product markets. These require significant investment and therefore one-sided industrial era firms cannot compete as easily across a portfolio of products and markets.

In her discussion of resource-based heterogeneity among firms, Penrose therefore made a significant contribution to the development of the RBV. Yet Penrose also sought to emphasise the radical nature of Schumpeter`s original theory on innovation. This is evident in the development of dynamic capabilities which are discussed later in the chapter.

3.2 The RBV Approach - Its Strengths and Limitations Relating to One-Sided and Two-Sided Businesses

In order to critique the resource-based view of strategy and its relevance to the one-sided and two-sided business models it is important to provide a brief overview of the approach based on work by Barney (1991) and Grant (1991). It is generally agreed that an organisation's resources are the productive `assets` that it owns and controls and which the firm uses to make a product or deliver a service. These resources are normally classified as tangible resources (such as cash, equipment or land), intangible resources (such as patents, reputation and culture) and human resources (such as skills and motivation).

According to Grant (1991), however, on their own resources are not productive and if any competitive advantage is to be achieved the resources have to be combined to form capabilities. Capabilities emerge from the cooperation and coordination of a team of resources within a firm and therefore a capability is the capacity of a team of resources to perform some task or activity. The simple possession of resources is therefore not enough. The strategic assets of a firm also represent another important RBV concept. Strategic assets are another way of describing those resources, capabilities or competencies that are particularly valuable to the firm and are critical to its strategic objectives and its ability to sustain competitive advantage.

Moreover, resources and capabilities will only have value if they permit an organisation to satisfy the industry key success factors (KSFs). Grant (2008) also suggested that an industry`s KSFs were the factors within its market environment that determined its ability to survive and prosper. Therefore, according to the RBV approach, understanding these factors and being able to respond to them was a prerequisite for success in an industry. KSFs are understood in terms of answers to two questions. What do the customers want and what does the firm need to do to survive the effects of competition? The issue of competition is also complex and requires a firm to understand several key variables such as:

- What drives competition?
- What are the main dimensions of competition?
- How intense is the competition?

- How can an appreciation of these aspects of competition enable a firm to develop a superior competitive position?

The resource-based view (RBV) works well for traditional one-sided businesses because it enables these firms to identify and evaluate their resources and capabilities in a structured and linear manner. The traditional industrial era firms possess resources or assets that are highly tangible or physical (airlines, oil companies, steel mills and car firms) with high levels of internal ownership and/or control. The industries that they operate in are also relatively easy to define with high levels of specialisation.

However, Barney and Grant`s original work (1991) precedes the roll out of the worldwide web and the foundation and growth of the modern two-sided technology companies. The RBV audit frameworks of Grant and Barney (1991) do nevertheless include intangible resources such as technology, reputation (brand) and the capacity for communication which are very relevant to the industry platform companies and two-sided firms (Gawer: 2009). However, the RBV mapping tools are very generic and have a high level of abstraction (Timmers: 1998; Linder and Cantrell: 2000). For example, although both Barney and Grant (1991) include resources such as technology, information, knowledge and human capital they don`t refer to data or innovation.

Moreover, as discussed at the end of Chapter 2, the RBV approach is focused at the firm level and adopts an in internal perspective with the resources and capabilities being owned and/or controlled by the firm. This is a perfectly acceptable approach when analysing one-sided businesses that have traditionally adopted relatively high levels of vertical integration. However, with the modern industry platform and two-sided firms there has been a shift from resource control to resource orchestration and a shift from internal optimisation to external interaction (Parker *et al.,* 2016). In effect, the resource-based models have been inverted since most of the value is created externally within the ecosystem community defined by Moore (1993; 1996) in Chapter 2, rather than inside the firm itself. Ownership of these resources has also passed from the firm to the companies that comprise the ecosystem i.e. suppliers and customers etc. (Van Alstyne, Parker and Choudary 2016: 56-57). Successful, modern two-sided ecosystem companies therefore create huge value not through their access to physical resources but through leveraging data to coordinate physical and digital resources across an ecosystem.

This also has implications when applying the industry key success factor (KSF) model and defining who the industry and competition are. Two-sided platform companies are industry agnostic and cut across industry and technology boundaries. These companies have redefined the dimensions and drivers of competition. Since most companies primarily process information and customers and since many products have now been dematerialised into digital formats; two-sided platform companies are able to target a broad range of industries and markets and service customers at a significantly lower transaction cost to traditional one-sided businesses (Williamson: 1985; Van Alstyne et al., 2016) thereby transforming the economics of a wide variety of industries and markets including media, travel, health, banking, insurance, hotels and the automotive sectors etc. The blurring of industry and product boundaries through technology has therefore made it very difficult to identify who the competitors really are.

In addition to changing the rules of engagement in many markets and industries, the two-sided firms, due to their Big Data capabilities, are able to identify customer needs and wants in advance using micro-targeting and predictive analytics which the one-sided firms are not able to do. Amazon, for example, is able to undertake dynamic pricing in real time in response to customer demand on its website.

3.3 Value Networks Not Value Chains

None of these characteristics are identified in the traditional RBV models. These models also tend to be linear and static in nature. For example, Porter`s Value Chain (1985) has been a popular model for identifying and evaluating resources. Porter`s original value chain template is not unsurprisingly that of a manufacturing firm since this was formulated in 1985 and was heavily influenced by the capitalist industrial era in which the research was undertaken. Therefore, the primary activities revolve around making something. Although the value chain has been a very useful mechanism for portraying the sequence of linked activities that exist in the physical world within traditional industries (particularly manufacturing) and one-sided firms, the model has very little relevance when applied to two-sided platform companies. As products and services have become dematerialised and as the value chain itself no longer has any physical dimension, the concept is now seen as being an inappropriate (Norman and Ramirez: 1994).

The focal point of the value chain is the end product and the chain is designed around the activities required to produce it. The underlying logic is that every company occupies a position in the chain: upstream suppliers provide inputs before passing them downstream to the next link in the chain who is the customer. This suggests a single linear process that does not adequately capture the close symbiotic relationships (Fransman: 2010) between a company and its customers, suppliers and partners (Gossain and Kandiah, 1998). The model also lends itself to mechanistic linear thinking involving static rather than dynamic processes (Gossain and Kandiah: 1998; Rainbird: 2004).

However, adopting a network perspective provides an alternative approach that is more suited to `New Economy` organisations particularly where both the product and supply and demand chain have been digitized (Peppard and Rylander: 2006). Hearn and Pace (2006), devised a `Value Ecology` model as a substitute for the value chain based on new conceptualisations of how value creation has changed in the digital era. They identified a number of key paradigm shifts including a shift in thinking about consumers to thinking about co-creators of value (Moore: 1993; 1996); a shift from thinking about value chains to thinking about value networks; and a shift from thinking about product value to network value etc. The leading industry sectors in which these shifts were occurring included TV, computer games, e-business, mobile phones and `everything that was digital` (Hearn and Pace, 2006).

Unlike the value chain (Porter, 1985), Hearn and Pace`s (2006) value ecology model maintained that value creation was not a simple one-way linear process but involved processes of reiteration and feedback. Vargo and Lusch (2004:1) also stated that in the knowledge-based economy the notion of value was inherently different. The customer had become a co-producer or co-creator rather than a target and could be involved in the same value chain. Prior to this, the dominant logic was based on the economic model of there being an exchange of goods usually based on manufactured outputs. However, new perspectives have now emerged where the dominant logic focuses on intangible resources, the co-creation of value and relationships. The computer games sector (Humphreys *et al.,* 2005) provides a good example of this whilst user-generated content on Wikipedia, Facebook, You Tube, Instagram and Snapchat are all testimony to this shift in attitude. Therefore, companies can no longer act autonomously in the value creation process (Prahalad and Ramaswarmy, 2004) since the co-creation experience itself and not the product have become the basis of value.

The idea of moving from a value chain to a network approach is more appropriate from an information science perspective for two key reasons. First, networks are ideal information allocation and information flow mechanisms. Meanwhile, networks structurally facilitate rapid information transfer by providing horizontal links cutting across institutional boundaries to put people in direct contact with one-another. Networks also help to create information as well as transmit it (Barbasi: 2002). As each person in the network receives information, it is synthesised and new ideas generated i.e. information builds on information. Networks share new ideas and help create them and they are an ideal learning organisation for acquiring relevant, effective information (Bengtsson and Kock: 1999). Open innovation and crowdsourcing are also examples of how the Internet can act as source of free R&D (Chesbrough: 2003; Von Hippel: 2005).

Second, new value creation is achieved through the manipulation of information whilst the characteristics of information are very different from ordinary goods. One of the economic characteristics of information is that the cost of information production is independent of its scale of use and this implies increasing returns to the use of information (Rifkin: 2014). For example, a digital product can be replicated an infinite number of times at almost zero marginal cost unlike a physical product. This factor has conferred benefits to firms such as Google, Facebook and Netflix and Internet and app-based firms in general.

Hearn and Pace (2006) also identified a shift from product value to network value which differentiated the value ecology model from the value chain. An important dimension of network value were the information and market externalities (Watts: 2003). Externalities are what economists use to describe situations where the value of a product is derived from anything outside the product itself. A simple example is the telephone which increased in value after inception following increases in the number of connections. Information externalities occur when products or service choices are affected substantially by information outside the product such as the `buzz` on social networks and virality. Market externalities operate when the value of a product increases in proportion to the number of people who use it i.e. the diffusion of the original iPhone. This is also known as network economics (Arthur: 1996). This implies that value lies in the ability of the product or service to connect to others. When connection happens early through various externalities an increasing returns effect is often generated. A network effect will often lead to customer lock-in. Arthur (1996: 100) argued that as the shift towards the `new economy` occurred, the underlying mechanisms that determined economic behaviour also shifted from one of diminishing returns to increasing returns. Arthur (1996) gave a number of reasons why increasing returns occurred:

- Up-front costs (unit costs fell as sales increased)
- Network effects (the more a product or service gained prevalence, the more likely it would emerge as a standard)
- Customer groove (as more market share is captured it becomes easier to capture future markets)

The growth of Amazon and Alibaba as the leading e-commerce platforms in the USA and China and the diffusion of Apple`s ecosystem of mobile products provide good supporting examples of Arthur`s (1996) theory of increasing returns.

Hearn and Pace (2006) also stated that by adopting a network rather than a value chain approach organisations focused not on the company or the industry but the value creating system itself within which different economic actors (suppliers, partners, allies and customers) worked together to co-produce value. This viewed strategy from an ecosystem perspective (Moore: 1993; 1996; 2014). Whereas in a value chain context individual firm`s competed against each other, today competition is between networks (or even ecosystems) of interconnected organisations. Keystone players (Iansiti and Levien: 2004) and/or platform leaders (Gawer and Cusumano: 2002) need to view the health and wellbeing of their respective networks (and the individual partners that comprise the networks) and to prioritise this as being as important as their own company`s interests.

Transaction cost analysis (Williamson: 1985) also provides a way of understanding the impact of new information and communication technologies and why transformations take place within industries. According to this theory, an organisation can organise its activities either as an internal hierarchical structure or through a market relationship with external firms (Ouchi: 1980). Digitisation is significantly altering the cost structure of firms so that the cost of transactions both within and between organisations is dramatically declining (Malone *et al.,* 1988; Butler *et al.,* 1997). Therefore, many benefits associated with integrated firms (i.e. hierarchy), which primarily arise from their lower transaction costs, are eliminated. This can be seen across traditional industries with the fragmentation of traditional value chains from retail (banking) to manufacturing (automotive). This has also resulted in the emergence of the virtual organisation which is far removed from the physical value chain (Davidow and Malone: 1992).

As firms move towards a virtual marketplace (Rayport and Sviokla: 1994) in the networked economy traditional analytical tools such as the value chain fail to identify the true sources of value. The key to value creation in the networked economy lies in the understanding of how value is created in relationships (Blankenburg *et al.,* 1999).

From a network perspective relationships are viewed as part of a larger whole i.e. a network of inter-dependent relationships (Andersson *et al.,* 1994). These relationships are therefore `connected` because what happens in one relationship affects the others (positively or negatively). Any analysis undertaken must therefore view value creation based on how the organisation creates value within the network and not from the perspective of the organisation as an isolated unit. A good example is provided by Intel when it develops a new microprocessor. The success of the microprocessor chip is dependent on software developers writing applications that leverage the new processing capability; hardware manufacturers must build systems that can accommodate the new chip, including any additional cooling requirements; and new bus architectures may also need to be designed. This is an ecosystem that needs to be cultivated (Gawer and Cusumano: 2002).

One of the most important aspects of the networked economy is its dynamic nature (Levy: 1994). An action by one participant in the network can influence other network members. Moreover, an action by one participant may require further actions by other participants to be effective. This can have broad implications since it is no longer sufficient to think of a firm as a member of a closed system subject to uncontrollable outside shocks (Mareels *et al.,* 1996). It is actually part of a network that produces its own change. Finally, as an alternative to the value chain model, Peppard and Rylander (2006) developed a Network Value Analysis (NVA) tool. This technique was designed to generate a comprehensive description of where value lies in a network and how value is created.

3.4 Dynamic Capabilities

Another criticism of the resource models and the RBV approach is its static nature and the problems of applying the concepts in fast moving Schumpeterian markets. Although the approach was adequate in more stable environmental conditions in the industrial era, things have changed as a new competitive landscape has emerged (Hitt *et al.,* 2003).

Once an organisation develops an appropriate set of resources and capabilities and achieves a good `strategic fit` with its external environment, problems often occur when the environment changes but the firm isn`t able to change its resource configuration in response to these changes resulting in strategic drift (Johnson *et al.,* 2011). This is what Leonard Barton (1992) referred to as a `core rigidity`. This is the opposite of a core competency (which will be discussed later in the chapter) where there is an over-reliance by the firm on resource-based competitive advantage and the organisation fails to upgrade its resources and capabilities quickly enough. This has been a problem facing many single-sided firms in the era of hyper-competition (D`Aveni: 1994) including famous examples such as Kodak.

The problems facing traditional one-sided businesses is that the high fixed costs and physical infrastructures that they own and control make it difficult for them to respond to environmental change in an agile manner due to the high exit costs from the industry or market and the embedded paradigms that exist. In Chapter 1, Chesbrough (2010) highlighted a number of key barriers to business model innovation. These barriers included conflicts with existing assets and business models as well as an inability of the incumbent management to understand the new environment due to entrenched `dominant logic`. Alternatively, the `new economy` (Voelpel *et al.,* 2004) two-sided firms are asset light and process digital products (data) rather than physical products using external communities as an asset base. This subsequently results in high levels of agility and flexibility.

In order to avoid the threat of core rigidities (Leonard-Barton: 1992) occurring, firms need to develop dynamic capabilities (Teece *et al.,* 1997). Dynamic capabilities are not, in and of themselves, dynamic. They are routines which are designed to encourage or impose order. A dynamic capability is therefore a class of capability that enables a firm to respond dynamically to changes in its operating context by reconfiguring its resources and capabilities in such a way to transform itself to match the new industry key success factors (KSFs) which determine success or failure in the marketplace.

According to Eisenhardt and Martin (2000), dynamic capabilities included specific processes such as product development, strategic decision making and alliancing. They also stated that these dynamic capabilities were cross-functional and integrated various capabilities in different places and at different times across the organisation. They were therefore high-order capabilities.

There are subsequently subtle differences between the RBV approach to strategy and the concept of dynamic capabilities. The resource-based view of the firm emphasised sustainable competitive advantage whereas the dynamic capabilities focused on the issue of competitive survival in response to rapidly changing contemporary business conditions (Ludwig and Pemberton: 2011).

Dynamic capabilities theory is therefore concerned with the development of strategies for senior managers of successful companies to adapt to radical discontinuous change, while maintaining minimum capability standards to ensure competitive survival. For example, industries which have traditionally relied on a specific manufacturing process can't always change this process at short notice when a new technology arrives. When this happens, managers need to adapt their own routines to make the most of their existing resources while simultaneously planning for future process changes as the resources depreciate (Ludwig and Pemberton: 2011).

The New Dynamic Capabilities framework, of Amy Shuen (2009) is also very relevant in relation to two-sided firms and markets. In her analysis of Web 2.0, Shuen (2008) focused on the firm's ability to quickly orchestrate and reconfigure externally sourced competences. Her research included Apple, Google Android, IBM Linux developer ecosystems as well as crowdsourced, crowdfunded open innovations such as the Obama08 mobile app. This comprised the leveraging of resources such as platforms, know-how, user communities and digital, social and mobile networks. Shuen`s (2009) New Dynamic Capabilities framework took into account digital, information and network economics and the fall of the transaction costs of involved in using specialized services (Williamson: 1985).

Teece, Pisano and Shuen (1997) also proposed three dynamic capabilities (which concurred with Eisenhardt and Martin`s later research in 2000) as necessary for an organization to meet new challenges. These included the ability of employees to learn quickly and to build new strategic assets; the integration of these new strategic assets, including capability, technology and customer feedback, into company processes; and lastly the transformation or reuse of existing assets which had depreciated (Eisenhardt and Martin: 2000). Teece referred to successful implementation of these three stages as developing "corporate agility" (Teece: 2007). Successful execution and implementation of these dynamic capabilities was dependent upon the firm having a flat responsive structure (often project team-based), being a learning organisation (Pedler *et al.,* 1991; Senge: 1990; Senge *et al.,*1994) and having a change culture not restricted by an entrenched paradigm or dominant logic.

The concept of the learning organisation is an important driver of dynamic capabilities and the concept was popularized by Peter Senge in his book `The Fifth Discipline`. Senge (1990) proposed five important characteristics which included systems thinking, personal mastery, mental models, shared vision and team learning.

The idea of the learning organization developed from a body of work called systems thinking (Argyris: 1999). Learning organizations use this method of thinking when assessing their company and have information systems that measure the performance of the organization as a whole and of its various components. Systems thinking states that all the characteristics must be apparent at once in an organization for it to be a learning organization. If some of these characteristics are missing then the organization will fall short of its goal.

The commitment by an individual to the process of learning is known as personal mastery. There is a competitive advantage for an organization whose workforce can learn more quickly than the workforce of other organizations (Wang and Ahmed: 2003). Individual learning is acquired through staff training, development and continuous self-improvement. However, learning cannot be forced upon an individual who is not receptive to learning (Senge: 1990). A learning organization has been described as the sum of individual learning, but there must be mechanisms for individual learning to be transferred into organizational learning (Wang and Ahmed: 2003).

The assumptions held by individuals and organizations are called mental models (Senge: 1990). To become a learning organization, these models must be challenged. Organizations also tend to have 'memories' which preserve certain behaviours, norms and values (Easterby-Smith *et al.,* 2000). In creating a learning environment it is important to replace confrontational attitudes with an open culture that promotes inquiry and trust (McHugh *et al.,* 1998). Unwanted values also need to be discarded in a process called 'unlearning' (Easterby-Smith *et al.,* 2000). Wang and Ahmed (2003) refer to this as 'triple loop learning'.

The development of a shared vision is important in motivating the staff to learn, as it creates a common identity that provides focus and energy for learning (Senge: 1990). The most successful visions build on the individual visions of the employees at all levels of the organization (McHugh *et al.,* 1998), thus the creation of a shared vision can be hindered by traditional structures where the company vision is imposed from above. Therefore, learning organizations tend to have flat, decentralized organizational structures (Argyris, 1999). However, Senge (1990) stated that visions were transitory goals and suggested that there should also be long-term goals that were intrinsic within the company.

Finally, the accumulation of individual learning constitutes team learning (O`Keeffe: 2002). The benefit of team or shared learning is that staff knowledge grows more quickly and the problem solving capacity of the organization is improved through better access to knowledge and expertise (McHugh *et al.,* 1998). Learning organizations have structures that facilitate team learning with features such as boundary crossing and openness (Argyris: 1997). Team learning requires individuals to engage in dialogue and discussion therefore team members must develop open communication, shared meaning and shared understanding (O`Keeffe: 2002). Learning organizations typically have excellent knowledge management structures, allowing creation, acquisition, dissemination, and implementation of this knowledge in the organization (Wang *et al.,* 2003).

This combination of characteristics encourages organizations to shift to a more interconnected way of thinking (Chawla *et al.,* 1995). This approach is also essential for organisations that need to continuously innovate in order to remain relevant in a constantly changing environment. Senge`s (1990) seminal work and his five characteristics (explained above) also form an integral part of the innovation audit questionnaire which is used to test the levels of innovation within one-sided and two-sided businesses in the latter part of the dissertation. This will be explained in more detail in the methodology section in Chapter 4 and the data analysis in Chapter 5.

Nevertheless, there is evidence that the two-sided platform model complies more closely with Senge`s (1990) five disciplines when compared to the single-sided businesses. For example, since two-sided firms are digital platforms whose core business is data and information processing this means that they are systems-based. Second, two-sided firms have an advantage over single-sided businesses because they are data and information rich which means that the workforce can learn more quickly than the employees in other organizations due to the higher levels of knowledge. Third, since the two-sided platform companies are disrupting the `old economy` firms and markets their mental models challenge and question existing paradigms and rules of combat. Therefore `unlearning` isn`t necessary (Easterby-Smith: 2000) unlike the industrial era firms facing disruption.

Fourth, the modern industry ecosystem and two-sided platform businesses have very strong and long-term vision statements. These are what Collins and Porras (1994) referred to as BHAGS (Big Hairy Audacious Goals) and what Ismail *et al.*, (2014) referred to as the firm`s multi-transformative purpose (MTP). A good example of this is Google`s original vision statement which was to: *`organise the world's information and make it universally accessible and useful`.* Fifth, two-sided data rich companies typically have excellent knowledge management structures, allowing creation, acquisition, dissemination and implementation of this knowledge in the organization due to the nature of the work that they perform which is data-based.

Flat structures that are project based are also commonplace in such firms i.e. adhocracies (Mintzberg: 1979).

Finally, this work on dynamic capabilities has been followed by more recent research undertaken by Danneels *et al* (2008) who formulated the concept of second-order competences. According to Danneels *et al.,* (2008), some firms were more capable than others at altering their resource base by adding, reconfiguring and deleting resources or competences.

Danneels described two types of competences: customer competence, which was the ability of the firm to serve a particular group of customers and technological competence or the ability to use a particular technology to produce output. These "first-order competences," as Danneels called them, were needed to keep a company's current business competitive. However, there were also what Danneels called "second-order competences" in both technology (R&D) and marketing. These second-order competences consisted of the ability to add new technological or customer competences. These, second-order competences therefore affected the company's ability to renew itself beyond its current business. According to Danneels (2008) although a company may have been good at serving an existing market this didn`t make it skilled at learning how to serve a new market. Similarly, a firm may have known a particular technology really well but this didn`t make it skilled at learning and using new technologies.

Danneels also explored how companies could learn how to learn. In particular, he looked at how respondents rated their organizations in terms of five variables: constructive conflict, willingness to cannibalize, tolerance for failure, environmental scanning and slack resources. The first variable, constructive conflict involved creating a climate of open debate plus the honest and frank exchange of ideas. This is where the high-technology platform companies such as Google, Amazon, Apple and Alibaba excel.

The second variable, willingness to cannibalize meant that companies needed to be willing to sacrifice some of their current business in order to develop longer-term initiatives. Apple under Steve Jobs culled over 300 projects before launching a new mobile platform including the iPod, iPhone and iPad. However, Kodak refused to monetize the digital camera technology that it invented and continued with its established business model. Not surprisingly, Danneels found that the existence of slack resources — in other words, having the time and money to explore future-oriented projects with uncertain returns — also helped to build second-order competences. The platform technology companies are the five most valuable listed firms in the world i.e. Apple, Google (Alphabet), Amazon, Facebook and Microsoft (Forbes.Com: 2017). This provides them with the financial resources to experiment with new products and services and/or acquire firms that have developed new breakthrough technologies.

Environmental scanning and the extent to which the company kept its eye on technology and market trends through outside sources was also an important second-order competency. Since the information intensive platform companies have strong Big Data capabilities that can predict trends in real time they are well positioned to spot new developments quickly compared with the more traditional one-sided businesses.

A tolerance for failure was the final second order competency. In Chapter 1, the transformational view and business model innovation made frequent references to probing (Brown and Eisenhardt: 2008) and experimentation (Chesbrough: 2010; McGrath: 2010; Andries *et al.,* 2013). References were also made to discovery-driven planning (McGrath: 2010), dynamic consistency (Lecoq *et al.,* 2006) and effectuation (Sarasvathy: 2001). These are all techniques used to test product/service concepts in the marketplace prior to launch often resulting in failure. Due to the inability to forecast environmental change and consumer responses to technology driven products, these methods require a high tolerance for failure. The leading platform companies are all active in applying these methods in order to elicit market feedback. However, this is more difficult for one-sided companies that specialize in the production and marketing of hardware products and do not have access to a large ecosystem community.

Danneels (2008; 2012) second order competences also form an integral part of the innovation audit questionnaire which is used to test the levels of innovation within one-sided and two-sided businesses in the latter part of the dissertation. This will also be explained in more detail in the methodology section in Chapter 4 and the data analysis in Chapter 5.

3.5 Core Competences

In order to try to understand the reasons for the differences in performance between two-sided platform companies and single–sided businesses the dissertation will now consider the concept of core competencies and whether data and innovation have a significant role to play. Prahalad and Hamel (1990) defined core competencies as the "collective learning across the corporation". A core competency results from a specific set of skills that deliver additional value to the customer and these enable an organization to access a wide variety of markets. In fact, core competencies fulfil three criteria:

1) They provide potential access to a wide variety of markets.
2) They should normally make a significant contribution to the perceived customer benefits of the end product.
3) They are difficult to imitate by competitors.

The core competency of the two-sided platform companies is the ability to capture vast amounts of data and then to process this into information and to perform predictive and prescriptive analytics. This ultimately leads to high levels of organisational knowledge and innovation. This is normally referred to as Big Data analytics but this is now being extended into the areas of artificial intelligence (AI) and machine learning. The collective learning does not only extend across the organization but also externally to include suppliers and buyers that interact with the technology platform. It also includes structured data and unstructured/semi-structured data as well.

This also fulfils Prahalad and Hamel`s (1990) three core competency criteria outlined above. First, access to a wide variety of markets is achieved. Since the main processing activities of modern service companies consist of information and customers, the digital platform firms can enter a diverse range of markets by targeting customers using Big Data algorithms based on previous search histories and online profiles. The dematerialisation of products through digitisation (music, books, magazines newspapers, movies, finance and insurance etc.) has also meant that platform companies can sell to a broad range of industries. For example, Apple does not just sell computers and mobile hardware devices such as the iPhone but also distribute music, books, films and software apps as well. The same applies to Amazon and Alibaba with more than 400 million products (each) on their platforms including taxi hailing and financial services. Google Facebook and Microsoft are also more than just search engines, social media sites and/or software companies respectively. They sell media products, run cloud computing platforms as well as software applications and digital assistants all based on the leveraging of the vast troves of data that they have accumulated.

Second, they also make a significant contribution to the perceived customer benefits of the end product. Customers now receive products and services either free or at very low prices via the Internet often `on-demand` with minimal delays in waiting times. Amazon is now able to guarantee same day or next day delivery, a vast selection of products and services to choose from and very low prices. Spotify (and You Tube) offer free music or a low price subscription alternatives plus a massive range of songs that can be streamed instantly. Alibaba and other `Fintech` companies also offer loans and money transfers at very low rates of commission (with very short lead times) compared to the banks and other established one-sided financial institutions. Due to the data rich nature of the two-sided business model, these firms are able to deliver products and services at significantly lower transaction costs to one-side businesses.

Third, the core competency is difficult for competitors to imitate. In Chapter 2, when analysing the `platform stack` model, it was evident from Choudary`s (2015) research that single-sided business had so far failed to replicate the business models of the large platform companies by `building out the stack` and developing competencies in all three layers of the model including data, infrastructure and the external network community.

These traditional businesses, according to Choudary (2015), lacked a culture of data acquisition and data management. Choudary (2015: 321) recommended five key stages. The first stage for a traditional business, was to create a culture of data acquisition. The firm needed to understand that higher data acquisition meant greater monetisation opportunities. All digital services that were introduced to users should be integrated at the data layer and every service should seek to acquire data that could be monetised in some form in the business. A coherent data strategy was therefore required.

Once a strategy of data acquisition had been established, the second stage was to institute infrastructural change by integrating the internal organisation. The firm would need to integrate all processes, workflows and touchpoints at the data layer. The firms needed to restructure their internal systems to be more data-porous with internal application programming interfaces (APIs) and avoid silos that prevented cross-communication. The third stage involved leveraging the existing user base. Once users had been profiled on the database the business could start to target them with recommendations etc. Once the first three stages were complete, the firm could then start to build a community. There was a tendency (Choudary 2015: 324) for traditional firms to skip the first three steps and then fail because of the inability to leverage intelligence due to the lack of integration at the data layer. If the firm reached the final stage it would be able to operate as effectively as a modern platform company. Core rigidities (Leonard-Barton: 2002) and the absence of second order competencies (Danneels: 2008; 2012) have therefore prevented the single-sided firms from imitating their two-sided platform rivals.

Another perspective that can be used to analyse the core competences of the two-sided platform firms is Prahalad and Hamel`s (1990) `core competency tree` framework (see Figure 3.0 below). The routes of the tree consist of the competences which in this case are the `Big Data` (Simon: 2013) and `Datafication` (Normann: 2001; Lycett: 2013) capabilities that the two-sided platforms have. The `Big Data` competences comprise the ability to gather vast troves of data from both structured and unstructured sources (i.e. internally within an organisation as well as from the worldwide web) and to perform predictive and prescriptive analytics. Meanwhile, `Datafication` consists of three highly inter-linked stages: dematerialisation, liquification and density. Dematerialisation is the ability to reduce physical products down into a digital format. Liquification is the capability to manipulate and move/transfer the dematerialised information. Finally, density is the recombination of the dematerialised information as an end-user product or output (Normann: 2001; Lycett: 2013).

Meanwhile, the core product (the link between the core competencies and the end product) is the Internet platform infrastructure. Management of the data is performed by the actual businesses and this produces the end products which may include streamed media content, social media relationships, targeted advertisements, fulfilled e-commerce transactions, money transfers, room bookings, fast food deliveries or taxi rides etc.

The main difference between the one-sided and two-sided models is that the two-sided platforms view the firm as a portfolio of competences not as a portfolio of businesses. Competences (in this case datafication) are the routes of the tree (firm) so they are not visible and are difficult replicate. Moreover, single-sided firms do not generally have Big Data and datafication competences.

Finally, unlike physical assets, core competences do not deteriorate as they are applied and shared - they grow i.e. in this instance data generates more data. Therefore more data and better algorithms and machine learning (artificial intelligence) serves to enhance the innovation capabilities of the two sided-firms resulting in exponential revenue growth (Ismail *et al.,* 2014) based on the law of accelerating returns (Kurzweil: 2001). This has been driven by Moore`s Law and the doubling of computing power every 18-24 months (Moore: 1965). This is a further innovation advantage that the platform firms have over more traditional one-sided businesses with high physical fixed asset-based infrastructures.

Figure 3.0: Prahalad and Hamel (1990) `The Core Competency Tree`

3.5 The Knowledge-Based View (KBV) of the Firm

The chapter will now analyse the relevance of the knowledge-based view of the firm and how it relates to one-sided and two-sided firms. The knowledge-based theory of the firm considers knowledge as the most strategically significant resource that an organisation has. KBV proponents (Spender: 1996; Grant: 1996) argue that because knowledge-based resources are usually difficult to imitate and socially complex, heterogeneous knowledge bases and capabilities among firms are the major determinants of sustained competitive advantage and superior corporate performance.

However, although the resource-based view (RBV) of the firm recognizes the important role of knowledge in firms that achieve a competitive advantage, proponents of the knowledge-based view argue that the resource-based perspective does not go far enough. For example, the RBV treats knowledge as a generic resource, rather than having special characteristics. It therefore does not distinguish between different types of knowledge-based capabilities. Moreover, information technologies have the potential to play an important role in the knowledge-based view of the firm in that information systems can be used to synthesize, enhance and expedite large-scale intra- and inter-firm knowledge management (Alavi and Leidner 2001).

It is also important at this stage to clarify how knowledge is created and the processes involved before critiquing the relevance of the original knowledge-based theory in relation to one-sided and two-sided companies. A very simple formula often used in connection with the Knowledge Pyramid (Figure 3.1) is:

Data + Processing = Information + Experience = Knowledge.

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Figure 3.1: The Knowledge Pyramid (Debons *et al.,* 1988)

Meanwhile, using the Knowledge Pyramid (Debons *et al.,* 1988), data forms the basis of the structure, followed by information, knowledge and then wisdom or innovation. In both instances data is seen as the critical resource that underpins the whole knowledge process but on its own data has no value if it is simply stored in a database. It therefore has to be put to use through some form processing or activity. However, recent developments in technology have meant that the methods and processes used to create, acquire and share knowledge have changed significantly. This has seen a shift in competitive advantage away from the single-sided firms towards the two-sided platforms.

The knowledge-based view (KBV) of the firm emerged in 1996 following the publication of two papers by J. C. Spender and Robert Grant. According to Spender (1996: 46), competitive advantage was most likely to come from intangible firm-specific knowledge which enabled the organisation to add value to the incoming factors of production (land, labour and capital) in a unique manner. Spender was therefore arguing that the people within an organisation were the true source of value in the search for competitive advantage. This viewpoint was appropriate and relevant when analysing the single-sided business before the Internet gained traction and Web 2.0 emerged. However, it ignored the ecosystem perspective discussed in Chapter 2 (and the early part of Chapter 3) where the real value is created outside the firm within the ecosystem community. Moreover, the modern two-sided firms now gather most of the data that they develop into information and knowledge from external sources such as mobile phones and social media websites (Sharda *et al.,* 2014). The intangible knowledge which forms the basis of their competitive advantage is therefore no longer firm specific but available within the public domain.

Grant (1996), meanwhile, identified two types of knowledge based on two key distinctions: (1) *knowing how* and (2) *knowing about.* According to Grant, *know how* was primarily tacit in nature and involved skills that were expressed through their performance (i.e. welding or driving a lorry). On-the-other hand, *knowing about* was primarily explicit and comprised facts, theories and sets of instructions. Moreover, the main difference between the tacit and explicit knowledge was in their transferability. Explicit knowledge could be transferred across individuals, across space and across time. Once created it could be replicated among innumerable users at very low marginal cost. Alternatively, tacit knowledge could not be codified but only observed through practice hence its transferability between people was slow, costly and uncertain.

Since Grant`s (1996) original article was written, the volume, variety and velocity of the transfer of explicit data and knowledge has been exponential. This has been made possible due to the emergence of the industry platform and multi-sided/two-sided platform companies (Gawer: 2009). However, the single-sided businesses have not been able to develop the necessary second order competences (Danneels: 2008; 2012) to keep pace with this exponential growth trend.

Figure 3.2: Knowledge Types (Adapted from Nonaka *et al.,* 1995)

Moreover, the scope of the transfer of explicit knowledge was no longer confined to just individuals and organisations as illustrated in Figure 3.2 above. Knowledge could now be transferred globally across the Internet to anyone who had a connection to the web. In terms of the transfer of tacit knowledge, this has also begun to change. Algorithms that spot trends in behaviour, facial recognition software, sentiment analysis and behavioural analytics (i.e. online credit ratings) are just some of the methodologies that now enable platform companies to transfer what was previously considered to be tacit knowledge. This capability is also about to increase as artificial intelligence AI, machine learning, deep learning and voice recognition software functionality develops further. These competences in knowledge innovation are also confined to the industry platform companies because large amounts of data are required which single-sided companies do not possess.

This has given rise to new forms of analytics capabilities as illustrated in the `Analytics Value Chain` (Sharda *et al.,* 2014) in Figure 3.3 below.

Figure 3.3: The Analytics Value Chain (Sharda *et al.,* 2014)

According to Sharda *et al.,* (2014), leading firms are those that have moved up the analytics value chain such as Amazon who can perform a broad range of Big Data analytics that now includes prescriptive analytics i.e. the ability to diagnose solutions to problems, predict future behaviour and to provide advanced solutions. Amazon has now filed for a patent relating to pro-forma ordering where the company would be able to despatch goods to a customer before receiving an order based on earlier purchase behaviour. However, most companies are still at the descriptive analytics stage i.e. they can only (at best) report what has happened after the event.

In practice, knowledge generation and application are not distinct. For example, the application of existing knowledge creates opportunities for learning that increase the stock of new knowledge. This is a key driver of network effects on social media sites and Big Data. Nonaka`s (1995) theory of knowledge creation identifies the processes of knowledge conversion between tacit and explicit knowledge and between individual and organisational knowledge as central to the organisation`s building of its knowledge-base (see Figure 3.4 below). The conversion of knowledge between the different knowledge types (the epistemological dimension) and knowledge levels (the ontological dimension) formed a knowledge spiral in which the stock of knowledge broadened and deepened Thus, explicit knowledge is internalised into tacit knowledge in the form of intuition, know-how and routines, while the tacit knowledge is externalised into explicit knowledge through articulation and codification. However, Nonaka`s (1995) theory of knowledge creation also adopts a relatively internal perspective by focusing on `individual`, `organisation` and `inter-organization `sources. Owing to the time period during which the theory was written, it therefore ignores all the knowledge that now exists in external networks such as the world-wide web.

Figure 3.4: Nonaka`s (1995) Spiral of Knowledge Creation.

3.6 The Resource-Based View - A Transformational Perspective

When operating in fast moving Schumpeterian environments (Schumpeter: 1949; D`Aveni: 1994; Hitt et al., 2003), the need for organisations to adopt dual strategies focusing upon maintaining their existing business models and resource configurations but also developing new business models and competences has become critical to their survival. Exploiting new ways of creating and generating knowledge from new technologies is also essential as has already been discussed in the chapter so far.

In order to overcome the problems of the static, linear approaches to business model innovation and the drawbacks of the internal focus of the RBV and knowledge-based views, Demil and Le Coq (2010) adopted a transformational perspective to business model analysis (discussed in Chapter 1) which they referred to as `dynamic consistency`. This approach focused upon business model innovation and dynamic interactions between the business model components and also included innovation within the business model as well. Lecoq *et al`s*., (2006) research also viewed the organisation as being dependent upon its ability to anticipate and react to the consequences of evolution in any given business model component. This `dynamic consistency` enabled the firm to change whilst maintaining sustainable performance. In order to illustrate their viewpoint, Lecoq *et al.,* (2006) devised the RCOV model (see Figure 3.5 below).

Penrose (1959) also adopted a dynamic view of organisational growth and argued that growth of the firm resulted from the interaction between its *resources,* its *organization* and its capacity to propose new *value propositions* in markets. Using a business model perspective, Demil and Lecoq (2010) linked this to three core business model components consisting of resources and competences, organisation structure and the proposition for value delivery.

Figure 3.5: The RCOV model: the main Business Model Components and their relationships (Adapted from Lecoq, Demil and Warnier: 2006)

The *resources* could come from external markets or they could be developed internally, while the *competences* represented the ability and knowledge to improve or recombine the services that the resources could offer. The *organisation structure* incorporated the organisation`s activities and its relations with other organisations to combine and exploit its resources. This would include the value chain or value network of activities with external stakeholders. The business model also included the *value proposition* that the company delivered to customers such as products and services.

When analysing two-sided platform companies, the RCOV model provides a more flexible analytical framework compared with the concepts and theories discussed earlier. The fact that the resources can be sourced externally is very important since the platform ecosystem model inverts the original, internally-focused RBV. The reference to `competences that represented the ability and knowledge to improve or recombine the services the resources could offer` was also very relevant. Since data is at the core of everything that two-sided firms do, this can be recombined to produce a range of diverse products and services in a broad range of market sectors and industries. User data can be leveraged to market a broad range of products from media, health, financial services, transport, food and accommodation etc.

The data-rich nature of the platform companies has also influenced the type of organisation structure that two-sided firms operate. The structures are asset light and leverage external network effects. The two-sided firms operate across a value network not through a value chain. They leverage the benefits of market mechanisms by lowering transaction costs which is made possible through the utilisation of low cost cloud computing. This has led to the shrinkage of the core resource base and structure at the centre of the platform ecosystem and the expansion outwards towards the periphery (Van Alstyne *et al.,* 2017). This asset light organization structure has resulted in a very low cost base leading to a performance advantage over traditional brick and mortar companies such as banks, high street retailers, hotels and taxi companies etc. Since the marginal cost of scaling a digital platform is close to zero (Rifkin: 2014), the two-sided firms have also changed the economic models of many industries such as music and advertising etc. This has also impacted positively on the profit margins of the world`s leading technology platform-based firms.

The cost benefits and the ability of platforms to reduce transaction costs, has also resulted in new value propositions. Content is often given away free in order to gain traffic to a website or smart phone app so that advertising streams can be monetized (Google). The content on a vast proportion of social media sites is provided free-of charge enabling the social media firms to focus on enhancing user experiences. Two-sided markets therefore offer high levels of interactivity and engagement for large audiences that cannot be replicated by one-sided firms. Services can also be provided on-demand and in real-time 24/7. This has resulted in both new and higher value propositions that one-sided firms are not able to match due to their structure.

Finally, the ability to scale rapidly using the word-wide web as a global platform and the availability of cloud infrastructure (platform as a service, software as a service and infrastructure as service) plus an ecosystem of apps and smart phones, means that the two-sided platform companies can generate high revenues and a large number of users through network effects.

Voelpel *et al.,* (2004), also commented on how the competitive environment had undergone a fundamental change in their paper entitled, *`The Wheel of Business Model Reinvention: How to Reshape Your Business Model and Organizational Fitness to Leapfrog Competitors`.* Voelpel *et al.,* (2004), identified three major distinguishing features. These included how the environment had become more globalized and how it favoured intangible things such as ideas, information, relationships and knowledge. They also observed that it was intensely interlinked with ubiquitous networks. These three attributes had produced a new type of marketplace often termed the “new economy”, “knowledge economy” or “networked economy”.

There were, according to the authors important discontinuities that differentiated the “new economy” from the “old economy”. First, there was the emergence of digitization, virtualization and networking. Networks and digitized information made it possible for copious amounts of information to be compressed, stored, retrieved and transmitted instantly from around the world. This created the availability and easy accessibility of information across the world and gave everyone instant access to each other.

Second, the authors noted a shift from the former industrial based economy to a knowledge and information-based economy with organizations relying more on intellectual (intangible) assets and less on physical (tangible) assets that were important in the industrial age. Third, the economy was also characterized as an innovation-based economy with human imagination and ingenuity as a main source of value resulting in a need to constantly innovate to keep ahead of imitating competitors i.e. the `Red Queen Effect` (Whittington: 2001; 2002). Fourth, the emergence of the `prosumer` and `prosumption` where consumers were actively involved in the production process and co-created products and services was another important development (Toffler: 1980: Kotler: 1986).

According to Voelpel *et al.,* (2004), in such an environment, organizations needed to shift from traditional (existing industry-focused, mechanistic thinking) approaches of strategic management to ones that were systemic (holistic, new value configuration focused) in nature. This systemic thinking helped organizations in developing sense making capabilities and systemic frameworks for reinventing business models.

In response to this need, Voelpel *et al.,* devised the `Wheel of Business Model Reinvention` (Figure 3.6).

Figure 3.6: The Wheel of Business Model Reinvention (Voelpel *et al.,* 2004)

Traditionally the success or effectiveness of a business strategy was evaluated in terms of how well it achieved a fit with the external environment (STEP) and the industry in question (Porter`s Five forces framework). This approach, however, was very defensive and reactive (Brown and Eisenhardt: 1998) in that it assumed the organisation could only respond to environmental change instead of actually creating and shaping a new environment. The Five Forces model was also of limited use where industry convergence had occurred and platform ecosystem models were being deployed that cut across industry boundaries.

On the other hand, Voelpel *et al`s.,* (2004) four dimensional tool of business model reinvention attempted to make sense of environmental changes and their relevance in terms of shaping new business models. Their model is iterative and starts with `Customer Sensing`. This involves sensing the potential for change in customer/user behaviour and developing new customer value propositions. This is an area of business model reinvention where the two-sided firms are very adept due to the vast troves of data that they accumulate from the strong network relationships they have developed due to network effects.

Two-sided firms are able to use sentiment analysis (opinion mining) and behavioural analytics to great effect. Sentiment analysis aims to determine the attitude of consumers with respect to a topic, interaction or event. Amazon is a leader in using behavioural analytics to recommend additional products that customers are likely to buy based on their previous purchasing patterns on the site. Behavioural analytics is also used by Target to suggest products to customers in their retail stores, while political campaigns use it to determine how potential voters should be approached. In addition to retail and political applications, behavioural analytics is also used by firms to prioritize leads generated by their websites. Behavioural analytics also allows developers to manage users in online-gaming and web applications.

The second dimension of Voelpel *et al`s.,* (2004) model is technology sensing. This indicates the ability of the firm to sense the relative strength and impact of technology on new customer value and business networks. Since the large industry platform companies have been the pioneers of new technologies including the Web 1.0 and Web 2.0 infrastructure, they are always well-positioned as the innovators of new technologies. The fast growing two-sided platforms, meanwhile, were early adopters of cloud computing, apps and other key infrastructure upon which their business models were based.

The third dimension in the model is business system infrastructure. This involves sensing the potential for value system (re)configuration including organisational structures. The world`s leading industry platform companies (Apple, Amazon, Google, Facebook, Microsoft, Alibaba, Tencent and Baidu) are all platform leaders (Cusumano and Gawer: 2002; Gawer and Cusumano: 2008) or keystones (Iansiti and Levien: 2004) in their respective fields such as ecommerce, search, mobile and cloud computing and social media. These firms have developed and constantly reconfigured their ecosystems and platforms. Amazon has been a pioneer in cloud computing services followed by Microsoft, Google, Alibaba and Tencent. Amazon revolutionised ecommerce in the West and Alibaba in the East. Google has revolutionised search and Facebook and Tencent have revolutionised social media in North America/Europe and China respectively. New infrastructures are also evolving such as the Internet-of-Things, artificial intelligence (AI), smart homes and cars. Meanwhile, the new two-sided platform companies (many of which are classified as Unicorns) have leveraged the ecosystem infrastructures of the industry platform firms to create new value through business model innovation in traditional one-sided markets such as food, hotels, transport and health etc.

The fourth and final dimension is concerned with economics and profitability. This entails sensing the economic feasibility and profitability of the proposed business models being pursued. The leading two-sided ecosystem firms (Gawer: 2009) are the world`s most valuable and profitable companies occupying five of the top seven places in terms of their market capitalization with Apple, Alphabet (Google) and Microsoft holding the top three positions. (Forbes.com: 2017). Meanwhile, the two-sided `Unicorns` represent the world`s fastest growing private companies with valuations of over one billion US dollars qualifying them as `Unicorns` or `Decacorns`. Decacorns are worth over ten million US dollars and include firms such as Airbnb, Dropbox, Pinterest, Snapchat, Uber and Flipkart (CB Insights: 2017) etc.

Finally, the Wheel of Business Model Reinvention is iterative since organizations should continuously attempt to reinvent themselves. The model also illustrates the interactive (systemic) flow from all four dimensions in business model reinvention. Moreover, the data-rich industry platform and multi-sided (two-sided) firms would appear to have a significant advantage over the less data-rich one-sided companies based on the level of data-driven innovation that occurs throughout all stages of the model ultimately generating high economic rents (Grant: 2013) in stage four. This will be explored in more depth using the innovation audit questionnaire that will be explained in Chapter 4 (the methodology section of the dissertation) and the data analysis chapter (Chapter 5).

Statista.com (2017)

3.7 The Research Gap

Having reviewed the literature relating to business models in Chapter 1, ecosystems and platforms in Chapter 2 and the resource-based view (RBV) and related concepts in Chapter 3 of the dissertation; it would appear that the important role of data as a key resource in the innovation process and how the data-rich two-sided platform-ecosystem firms appear to have an innovation advantage over single-sided businesses has not yet been explored or addressed.

It is therefore the purpose of the dissertation to explore the role of data in business model innovation - and innovation in general - and the extent to which two-sided platform-ecosystem companies have an innovation advantage (due to their rich data resources) compared to established one-sided firms. A formal definition of the research gap is therefore outlined below:

The extent to which data-rich firms operating two-sided platform-ecosystem business models are able to use data to gain an innovation advantage over established one-sided companies.

This builds on academic literature reviewed in Chapter 2 relating to platform ecosystem models as defined in Annabelle Gawer`s (2009) four platform typologies. An innovation audit survey questionnaire will be used to evaluate and rank the innovation capabilities of one- sided businesses against the two-sided companies. The results of the primary research will then be analysed in Chapter 5 of the dissertation and final conclusions drawn regarding the robustness of the hypothesis in Chapter 6.

3.8 Conclusion

Chapter 3 has analysed the relevance and appropriateness of the resource-based view (RBV) in relation to both the one-sided and two-sided business models. It has also drawn upon a range of related concepts including the value chain and value network approaches, dynamic capabilities and second order competencies, core competencies and the knowledge-based view (KBV) before considering more contemporary and transformational models such as the RCOV and the Wheel of Business Model Reinvention frameworks. The dissertation will now provide a detailed analysis of the methodological approach adopted in order to test the research gap in Chapter 4.

Chapter 4.0 – Methodology

4.0 Introduction

It is the purpose of this chapter to clarify the research objective of the dissertation and to explain the nature and structure of the research methodology that has been adopted. The research gap that was identified from the literature review at the end of Chapter 3 was:

The extent to which data-rich firms operating two-sided platform-ecosystem business models are able to use data to gain an innovation advantage over established one-sided companies.

In order to test this hypothesis, the dissertation has undertaken secondary research and critically analysed academic literature relating to business models, platforms, ecosystems and the resource-based view (RBV) of strategy in Chapters 1 to 3. Primary research in the form of an innovation audit survey questionnaire was also used to evaluate and rank the innovation capabilities of one-sided businesses compared to the two-sided firms.

The chapter will now analyse the research design in more depth starting with the research philosophy, the ontology, the epistemology and the research paradigms before explaining the primary research techniques in greater detail and how the innovation audit was designed and formulated. A full breakdown of the chapter content is provided in Figure 4.0 below:

4.1	Research Philosophy
4.2	Primary Research Techniques
4.3	What is an Innovation Audit and How Has it Evolved?
4.4	Measuring Innovation Performance Using an Innovation Audit
4.5	Application of an Innovation Audit & Its Relevance as an Analytical Tool
4.6	Formulating the Innovation Audit Questionnaire
4.7	Selecting Appropriate Dimensions & Questions for the Innovation Audit
4.8	Selecting the Likert Scale & the Limitations of the Innovation Audit Methodology

Figure 4.0: The Different Stages of the Methodology Chapter

4.1 The Research Philosophy

In order to understand the purpose of the literature review and the primary research, it is important to consider the four different ontologies, namely: realism, internal realism, relativism and nominalism.

The classical approach to strategy is based upon the realism and internal realism ontologies as opposed to relativism and nominalism. Realism assumes that there is a single reality or a single truth and that once scientific laws are discovered they are absolute and independent of further observations (Puttnam: 1988). A realist therefore concentrates on aspects of performance that can be measured (see Table 4.0).

With the classical rational approach to strategy a universal law or `one size fits all` approach is adopted (Mc Millan: 2003; 2008). The Newtonian scientific approach and the successful development of science in western countries during the seventeenth and eighteenth centuries was dependent upon the emergence of empirical methods and a new philosophy of thought coupled with an application of classical scientific principles of rational reasoning, logic, analysis and measurement to the solution of problems. The existence of a single truth and the availability of concrete measurable facts reinforces this.

However, since the dissertation is testing the level of innovation advantage between two-sided and one-sided firms, the realism and internal realism approaches are no longer appropriate. Therefore, the relativism and nominalism ontologies have been adopted instead. These ontologies are not concerned with tangible fact but intangibles such as innovation. These two ontologies are consistent with the literature review in Chapters 1 to 3 of the dissertation relating to transformative business models (business model innovation), complexity science, chaos theory, ecosystems and platforms, intangible resources and capabilities and second order competencies. This is where high levels of instability and high innovation result in there being many truths or no truths and where new innovations make existing knowledge obsolete.

Table 4.0: Four Different Ontologies (Easterby-Smith *et al.,* 2015: 50).

In terms of the epistemology, both positivism and social constructionism are relevant to the thesis but for different reasons. With positivism the social world exists externally and its properties can be measured through objective methods rather than being inferred subjectively through intuition. Auguste Comte (1853: 3) once famously said: `All good intellects have repeated, since Bacon`s time, that there can be no real knowledge but that which is based on observed facts`. This statement is important because it comprises two assumptions. First, it views reality as external and objective and second that knowledge is of significance only if it is based on the observation of external reality and it is the result of empirical verification. Reductionism is also an important aspect of positivism. Wittgenstein (1953) argued that all factual propositions could be reduced to elementary propositions.

Both Comte (1853) and Wittgenstein`s (1953) views and the positivist epistemology therefore concur with the `Newtonian-Cartesian` paradigm and the rational approach to strategy. This involves an evaluation of the external environment and then the development of capabilities to meet the external observations based on scientific principles of rational reasoning, logic and measurement. Strategic options are then reduced so that the most viable option is selected based on tangible measurable facts.

However, the alternative paradigm that evolved fifty years ago stemmed from the view that `reality` was not objective and exterior but was socially constructed and given meaning by people in their daily interactions with others. This was popularised by Berger and Luckmann (1966), Watzlawick (1984) and Shotter (1993). This means that there are problems when trying to apply the positive epistemology to the dissertation research since innovation is highly intangible and difficult to evaluate using scientific verification based on narrow `true`, `false` or `meaningless` criteria. Positivism therefore fails to acknowledge the cultural, political, and psychological factors that get in between the observer and the truth. Since innovation involves high levels of interaction between individuals and their environment social constructivism is deemed to be more relevant. Moreover, the literature review revealed the critical role of knowledge and learning and dynamic capabilities as key components of the innovation process.

According to Berger *et al* (1991), social constructivism is a sociological theory of knowledge according to which human development is socially situated and knowledge is constructed through interaction with others. Social constructivism states that people work together to construct artefacts (in this case product/service and process innovations). While social constructionism focuses on the artefacts that are created through the social interactions of a group, social constructivism focuses on an individual's learning that takes place because of his or her interactions in a group.

It is also important to observe the linkages between the epistemology and ontology (see Table 4.1 below), with positivism (outcomes are true, false or meaningless) fitting with realist ontologies (a single truth) and constructionism (knowledge emerges from interactions) fitting with relativism (knowledge and truth exist in relation to culture and society and are not absolute) and nominalism (the non-existence of `universals`).

Table 4.1 The Juxtaposition of Different Ontologies and Epistemologies (Adapted from Easterby-Smith *et al.,* 2015: 54).

This perspective concurs with the literature review and the innovation audit survey adopted as the secondary and primary research methods for the dissertation. The linking of business model components and the role of data in enhancing relationships and knowledge sharing are crucial to innovation and were a core theme within the literature review. Meanwhile, the innovation audit questionnaire tests the levels of integration between internal and external stakeholders based on key dimensions such as organizational structure, organizational processes, organizational culture and organizational learning etc.

Table 4.1 therefore clearly illustrates how realism and positivism are juxtaposed with the classical approach to strategy (i.e. classical science) and how the relativism/nominalism approaches belong to business model innovation, complexity science and the platform-ecosystem approaches to strategy. The dissertation therefore used a mixture of quantitative and qualitative methods including secondary research and primary techniques.

The secondary research explored a wide range of peer reviewed academic journal articles and book publications in Chapters 1 to 3 of the literature review. Meanwhile, an innovation audit survey was used to collect quantitative data (this is explained in more depth in sections 4.2 and 4.3). Although the hypothesis being tested (levels of innovation) fits with the social positivism and relativism epistemology and ontology, the innovation audit attempts to quantitatively evaluate the levels of innovation based on a sample of 100 hundred firms using a Likert scale of 1 to 5. Although there is no `single truth` in terms of `true` or `false` statements, conclusions can still be drawn from the analysis. In order to overcome the problems of there being `many truths`, the audit questionnaire seeks to extract a truth although this is often obscure but does exist. There is subsequently an element of internal realism (Putnam: 1988) relating to the quantitative survey method adopted.

Having reviewed the fundamental philosophical positions underpinning the dissertation with particular emphasis on the epistemological dimension, the chapter will now consider the various paradigms. The full range of paradigms are listed in Table 4.2. However, only the paradigms relevant to the study will be analysed in detail and include the scientific paradigm, postmodernism and systems theory.

Table 4.2: Alternative Paradigms (Easterby-Smith *et al.,* 2015: 59).

The scientific method is positivist and based on large samples. It is also used in most disciplines including strategy. Roughly 80% of papers published in the leading US-based journals are positivist against around 25% in the leading Europe-based journals (Easterby-Smith, Li and Bartunek: 2009). The scientific paradigm and classical approach to strategy also focused on cause and effect relationships which are critiqued as being too linear within the literature review.

Orthodox strategic management theory is also inspired and derived from economics and tends to ignore the presence of people. Strategy has up until recently been viewed as an abstract concept based on a North American economic tradition. This has discouraged more qualitative/constructionist approaches. However, recent research by Jarzabkowski *et al.,* (2007) used a more European sociological perspective. This consisted of a 3Ps (praxis, practices and practitioners) framework where. According to Jarzabkowski et al., (2007), strategy was conceptualised as being a:

`…….situated, socially accomplished activity`.

The word `situated` meant that strategy was something that was done in a specific situation, suggesting that location or context was important and that where and when the strategy was enacted influenced how it was accomplished. Meanwhile, `socially accomplished` meant that strategy was carried out by people in a social setting such as an organisation involving more than one person and the need for people to work together (to be `engaged`) in order to enact their ideas. This characteristic also applies to innovation. The scientific paradigm is therefore not considered to be relevant.

Post-modernism is, however, considered to be a relevant paradigm. Lyotard (1984) and Chia (2008) highlighted three key areas relating to post-modernism. First, it provided a critique of scientific progress which was viewed as being discontinuous and contested rather than linear and continuous. Lyotard (1984) examined the impact of computerisation on the control of knowledge and how technology enabled many corporations to be more powerful than states. This perspective concurs with the hypothesis that a key source of competitive advantage is data, information and knowledge leading to high innovation. This is tested further in the Chapter 5 (data analysis) where the two-sided firms are evaluated on the basis of their ability to monetise the knowledge they have developed.

Post-modernism`s ontological position was also seen as being opposed to realism but some commentators saw it as being nihilistic rather than supporting relativism. This also concurs with complexity science (McMillan and Carlisle: 2007) which is analysed in Chapter 2 where systems move from mechanistic/hierarchical states into complexity/chaos and sometimes randomness where there are no controlling mechanisms and there is the potential for disintegration.

Post-modernism also has implications for management research. The post-modernists did not see organisations as static and monolithic which makes their perspective particularly appropriate for studying dynamics and change. This is a core theme and thread running through the literature review and dissertation. The dynamics and change being generated by the Internet as a macro-innovation platform requires new perspectives and theories to replace the scientific paradigm and the classical school i.e. the transformative business model perspective as discussed in Chapter 1.

A second element of the post-modernist perspective was the opposition to realism which placed an emphasis on the invisible elements and processes of organisations. This includes tacit knowledge and the informal processes of decision making. In terms of tacit knowledge, the literature review discusses this in Chapter 3. Moreover, the analysis of innovation in Chapter 3 and the innovation audit also explore intangible assets including brands and intellectual property.

Finally, post-modernism was critical and sceptical of the role and motivation of large industrial organisations and questioned whether they were of lasting value. The dissertation focuses on the new two-sided Internet-based platform ecosystem companies and how, through data and business model innovation, the traditional one-sided firms are being out-innovated. This is a core component of the dissertation hypothesis.

Systems theory is another paradigm that has relevance to the dissertation. Systems theory was first developed in the nineteen fifties (Von Bertalanffy: 1962) as an inter-disciplinary methodology for studying systems (living and inanimate). Systems theory has a number of basic assumptions that relate to the dissertation. First, systems theory states that complex systems should be studied as a whole and rather than breaking them down into their constituent parts. Second, there is the belief that when studying systems, it is the relationship between the members that provides the most information. Third, there is the belief that there are common properties in all systems which therefore provide the potential for methodological unification across the social sciences.

In Chapter 2, a systems approach (Pascale: 1999) to analysing strategy is introduced and linked to platform (Gawer: 2009a; Choudary: 2015) and ecosystem models (Moore: 1996; Fransman: 2010) to provide a holistic perspective. Relationships between the different members of the ecosystem (business community) are also highlighted in the discussion of value networks in Chapter 2 of the dissertation and how data/information form the basis of these relationships. Finally, Value Network Analysis (VNA) and co-production and co-evolution are discussed in Chapters 2 and 3.

4.2 Primary Research Techniques

The primary research method used to test the hypothesis was the innovation audit technique. However, despite pioneering work undertaken by Majaro (1988) and Voss *et al.,* (1991) in the 1980s and 1990s, the technique of innovation auditing has been largely under-represented in mainstream research (Goffin and Mitchell: 2010: 367). The chapter will now provide an explanation of what an innovation audit is and how the research method has evolved. It will then explain how and why the innovation audit questions were selected and the reasoning behind the choice of the ranking scale used and the limitations of the audit approach.

A deductive approach was taken to test the theory that two-sided ecosystem platform companies have an innovation advantage compared to established one-sided firms due to their rich data resources. A survey questionnaire was formulated consisting of 6 sections (incorporating 12 questions each) and a total of 72 questions in all (Dillman *et al.,* 2009). Each question was ranked using a Likert scale (Derrick and White: 2017) of 1 to 5 (see Appendix 4). The survey measured six components of organizational innovation including organizational strategy, organizational processes, organizational structure, organizational culture, organizational learning and organizational idea generation.

A sample of one hundred companies was used for the survey analysis (using Bristol Online Survey software) from a population of 43 traditional one-sided companies and 57 two-sided technology firms (see Appendix 15). The respondents who were targeted within the respective firms were senior managers with responsibility for strategy who had a holistic view of the organisation and how it was managed. The purposive sampling technique was used to ensure eligibility criteria was complied with on a consistent basis (Easterby-Smith *et al.,* 2015: 82). The questionnaire was also pilot tested targeting six respondents before general distribution.

The results of the survey were analysed using SPSS and the full range of statistical methodologies included Cronbach`s Alpha (Cronbach: 1951), which was be used to measure the scale of reliability and the internal consistency of the questions. This was followed by a correlation matrix based on Spearman`s rank correlation (Spearman: 1904) before undertaking a cluster analysis (Bailey: 1994; Everitt: 2011) using scatter plots to illustrate the grouping of the of the surveyed firms. A Mann-Whitney *U* test (Mann-Whitney: 1947) was then applied in order to determine whether the two independent samples (the one-sided and two-sided firms) had been selected from populations that had the same distribution. A Factor Analysis (Child: 2006) was also used to determine which were the most important variables in the innovation process. Finally, scatter plots and box plots were utilised in order to illustrate the differences between the two-sided and one-sided firms from an innovation perspective.

4.3 What is an Innovation Audit and how has it Evolved?

An innovation audit looks at a number of issues to see what is working well and what is impeding innovation within a company. It asks a range of analytical questions and by examining key indicators it determines strengths and weaknesses and ways of improving innovation throughout an organisation. The principle is therefore simple, by using a checklist of questions it is possible to score innovation performance against a model of `best practice` and therefore identify areas where competitive advantage can be enhanced (Tidd and Bessant: 2009; 2013).

This auditing approach has significant relevance for the practice of innovation management and a number of frameworks have been developed over the years to support it. For example, in the 1980s the UK National Economic Development Office developed an `innovation management tool kit` which was updated and used as part of a European programme aimed at developing better innovation management amongst small and medium enterprises – SMEs (Majaro: 1988; Chiesa *et al.,* 1996). Another framework that was originally developed at London Business School (Voss: 1999), was promoted by the UK Department of Trade and Industry. Other former examples include the `living innovation` model that was jointly promoted with the Design Council (Design Council: 2002). There were also various innovation frameworks promoted by trade and business associations (Francis: 2001). This trend has been continued as a result of the work of NESTA in the UK which has commissioned a variety of studies for the development of an `Innovation Index` that offers a measurement framework for both practice and performance in innovation (NESTA: 2009).

Additional frameworks that have been developed also cover particular aspects of innovation management such as creative climate, continuous improvement and product development (Ekvall: 1991; Amabile: 1998; Bessant: 2003). Moreover, with the increasing use of the Internet there has been a number of web sites which offer interactive frameworks for assessing innovation management performance as an initial step towards improving competitive advantage.

4.4 Measuring Innovation Performance Using an Innovation Audit Framework

The full range of measures that can be used to evaluate innovation are illustrated in Figure 4.0 (below). This covers both the inputs and the outputs of the process and how the process itself is organized and managed (Adams: 2006). The *inputs* to the innovation process are very important and traditionally have been confined to criteria such as skilled staff (scientists and engineers), further training and development programmes, the amount of resource expended on `blue sky` exploration and the number of new ideas generated. The amount of spending on R&D or market research and the number of patent applications were also considered to be important indicators. These measures of innovative performance are therefore classified as both leading and intangible indicators.

The reference to `blue sky` exploration is significant because this is what Sarasvathy (2001), McGrath (2010), Chesbrough (2010) and Brown and Eisenhardt (1998) referred to in Chapter 1 as effectuation, evolutionary learning, experimentation and

Figure 4.1: A Framework for Innovation Measurement (Adapted from Tidd & Bessant: 2013: 631)

However, what hasn`t been considered as an input to the innovation audit process models so far has been data as a source of new ideas, particularly unstructured data from the Internet.

In terms of *outputs* as measures of innovative performance, there are a number of lagging, tangible indicators which include the range of patents granted and scientific papers published as an indication of knowledge. Other important indicators include the number of new products introduced or new businesses set-up and the percentage of sales and profits derived from these as indicators of product innovation and success (Tidd: 2000). Traditionally, customer satisfaction surveys have been used to measure improvements in quality or flexibility from operational or process perspectives (Luchs: 1990; Zairi: 1996). Attempts to measure the strategic impact of innovation also include improvements in overall business performance where benefits can be directly attributed to the innovation concerned. This might include growth in firm revenues or market share, improved profitability and higher value added i.e. higher market capitalisation and enterprise values (Kay: 1993; NESTA: 2007; Stoneman: 2010). An intangible measure, the brand strength of the company and/or its products (Danneels: 2008; 2012) was also recently added.

In between the inputs and the outputs is the innovation *process* itself. Traditional one-sided manufacturing firms have been known to use a number of specific measures for evaluating the internal workings of the innovation process in former years. This has included the monitoring of the number of new ideas generated (product/services/process) at the start of the innovation system and the failure rates in the development process, in the marketplace or the number of percentage overruns on development time and cost budgets. In process innovation, the traditional manufacturing firms would generally look at the average lead time for the introduction or use of continuous improvement measures including suggestions per employee, the number of problem solving teams, savings accruing per worker and cumulative savings etc.

However, these highly formalized accounting-oriented processes were criticised for potentially stifling innovation since failure was seen as a negative outcome. This was not the case in high innovation firms where failure was frequently considered to be an essential element of the innovation learning process (Senge: 1990; 1994; Davenport *et al*. 2006). Therefore, a high tolerance for failure and viewing this phenomenon as an investment in learning rather than a financial loss was essential.

Nowadays the main inputs into the innovation system are ideas in the form of unstructured digital data. Moreover, the ability of modern two-sided firms to undertake real-time, stream analytics and implement changes to digital products and services on their platforms in milliseconds (thousandth of a second) has changed the competitive landscape. Since these technologies and capabilities did not exist in the early days when innovation audits were being pioneered in single-sided manufacturing companies, it is therefore important to adopt a more up-to-date perspective of the innovation process and how it is organized and managed.

According to Tidd and Bessant (2013), the modern innovation audit process model needs to consider a range of core questions when analysing high technology firms in the twentieth century. These might include:

- How well does the organisation search for opportunities?
- How well does the organisation implement innovation projects from inception to launch and beyond?
- Is the organization supportive of innovation?
- Is there a clear and communicated innovation strategy?
- Has the firm built and maintained rich and diverse external linkages?
- How does the firm capture learning from the innovation process?

This checklist of questions also needs to be linked to the concept of innovation-friendly environments or creative climates (Simpson: 2017) and an organisation architecture (Burns: 2013) that comprises an appropriate culture, structure and systems for nurturing innovation and dynamic capabilities (Teece *et al.,* 1997) as discussed in Chapter 3.

4.5 Application of the Innovation Audit and Its Relevance as an Analytical Framework

There is a shortage of effective tools and frameworks for the analysis of innovation. A major obstacle is the intangible nature of innovation and the broad, complex and uncertain characteristics of the subject area. Innovation is not an exact or predictable science but a reflective practice in which organisations need to review, configure and develop dynamic capabilities in order to survive and compete. The most commonly used alternatives to the innovation audit methodology that organisations sometimes use include post-project reviews (PPRs) and benchmarking.

Both approaches have inherent flaws. Post-project reviews are structured attempts to capture learning at the end of an innovation project (Rush *et al.,* 1997). Most organizations fail to carry out such reviews particularly if the project has run poorly and has not achieved its stated objectives which is quite normal in high innovation environments (Swan: 2003). Another weakness of PPRs is that they are best suited to distinct, bespoke projects with a narrow focus that doesn`t embrace the organisation holistically (Bessant and Francis: 1999).

Meanwhile, benchmarking consists of a range of techniques involving comparisons between two variants of the same process (internal, competitive or industry) or two similar products in order to provide opportunities for learning (Camp: 1989; Rush: 1995; Stapenhurst: 2012). However, benchmarking in the `new economy` (Voelpel *et al.,* 2004) is now considered to be a form of imitation or replication rather than a form of innovation. According to Tom Peters (Peters: 2013), in order to grow, companies need to escape the cycle of competitive benchmarking, replication and imitation. Peters believed that a company couldn`t achieve success simply by following another business but would need to innovate itself.

The advantages of using an innovation audit framework (such as the one illustrated in Figure 4.0), is that it incorporates the full range of activities undertaken by a firm incorporating inputs, processes and outputs. It also captures both the tangible and intangible aspects of innovation as well as the leading and lagging indicators. Meanwhile, it also allows the researcher to adapt and customise the model to suit the organisational environment that is being analysed through the compilation of tailored survey questionnaires.

The purpose of an innovation audit is predicated on two basic assumptions. For example, an organisation with no clear innovation strategy, with limited technological resources (and no plans for acquiring these), with weak project management capabilities, poor external links and a rigid and unsupportive organization would be unlikely to succeed in innovation. By contrast, an organisation with clear strategic goals, with long-term links to support technological developments, a clear project management process that is well supported by senior management and which operates in an innovative organisational climate would have a better chance of success (Tidd and Bessant 2013: 632).

However, the reason for applying the innovation audit framework is to test the extent to which the data-rich two-sided platform ecosystem firms are able to use their superior data to gain an innovation advantage over the traditional one-sided firms. The next section of the methodology chapter will explain how the innovation audit was formulated and the academic concepts and theories underpinning the chosen structure. With regards to the innovation audit framework illustrated in Figure 4.0 (above), the innovation audit questionnaire that has been formulated for this area of primary research will focus on the *process* of innovation and it will attempt to measure the extent to which the various companies surveyed have innovation-friendly environments and creative climates for nurturing knowledge and innovation i.e. dynamic capabilities and appropriate organisation architectures. These are the intangible aspects of innovation that are `hidden` and difficult to quantify and measure, unlike the inputs and outputs to the innovation process. However, the questionnaire still includes some references to levels of R&D and new product development.

Information relating to *Inputs* such as R&D spend and patent applications and *outputs* such as financial performance, patent portfolios and brand strength, is available within the public domain for the publicly listed companies. However, a large proportion of the companies surveyed are either still private (and don`t publicly release revenue figures and other financial data) or they have only operated as public companies for a short period of time. This means that it has not been possible to undertake any regression analysis using the financial data available hence the decision to use the innovation audit framework to evaluate the actual innovation processes of the surveyed companies.

Nevertheless, from the information that is publicly available, it is evident that the data-rich platform ecosystem companies meet all the high innovation output criteria (stated above) in terms of high sales revenues, high market capitalisation and enterprise values and strong distinctive brands. The number of new products and businesses that they have spawned and the size of their patent portfolios are also very extensive. Where the firms are not making large profits (i.e. Amazon and the private Unicorn companies), these organisations are still generating high cash flows, high revenues and high levels of funding as well as scaling exponentially by increasing the number of users on their respective platforms.

The leading platform companies dominate the top ten rankings in the world`s most valuable companies league table (Forbes: 2017) as well as dominating the *2017 Brand Z Top 100 Global Brands* classification (Kantar Millward Brown: 2017). The collective value of the 203 Unicorn companies is currently US$707 billion (CB Insights: 2017). This is in sharp contrast to the traditional single-sided firms whose financial performance, brand strength and intellectual property portfolios are much lower.

4.6 Formulating the Innovation Audit Questionnaire

When formulating an innovation audit questionnaire it is important to consider two key variables from the outset. The first consideration is what dimensions of the organisation are to be evaluated from an innovation perspective (i.e. what aspects of innovation need to be assessed). Second, what ranking scale is to be used and why.

In terms of dimensions, Tidd and Bessant (2013: 624) stated that innovation wasn`t a matter of doing one or two things well but about good all round performance. They identified four clusters which they considered to be important for successful innovation. These included the need for innovation to:

- Be strategy-based.
- Be dependent upon effective internal and external linkages for making change happen.
- Require effective enabling/implementation mechanisms for making change happen.
- Happen within a supporting organisational context.

According to Tidd and Bessant (2013), in the *strategy* domain there are no simple rules for success but a capacity to learn from experience and analysis. Moreover, within the area of *linkages,* developing close and rich interaction with markets and suppliers of technology and other organisational players was considered to be of critical importance. Linkages offered opportunities for learning from lead-users, customers, strategic alliances and alternative perspectives. The theme of `open innovation` was therefore relevant in an era in which networking and open collective innovation was becoming the dominant model. Tidd and Bessant (2013) also said that in order to succeed organizations needed *effective enabling/implementation mechanisms* to move innovations from idea or opportunity through to reality. This process involved systematic problem solving and worked best within a clear decision-making framework.

Finally, Tidd and Bessant (2013) stated that a *supporting organizational context* in which creative ideas could emerge and effectively be deployed was essential. There was a requirement to create a climate and conditions within which a learning organization could operate with shared problem identification and problem solving and the capability to capture and accumulate learning.

These four clusters of innovation are incorporated within the innovation audit questionnaire (see Appendix 4) through the formulation and application of six dimensions, namely: organizational strategy, organizational processes, organizational structure, organizational culture, organizational learning and organizational idea generation.

However, the perspective that has been adopted when formulating the audit framework has been to test the role of data in enhancing innovation performance. In Chapter 3 (Figure 3.1) the Knowledge Pyramid was used to demonstrate the role of data in the knowledge and innovation building process (i.e. providing the foundations). Big Data and `datafication` were also seen as the routes of the knowledge-based view of the firm (Figure 3.0 Core Competency Tree). The key question the audit is seeking to answer is the extent to which the data and the knowledge and innovation that emerges from it actually enhances innovation performance by comparing data rich two-sided platform companies with traditional one-sided businesses.

For example, if in the strategy domain there are no simple rules and future success is dependent upon a capacity to learn from experience and analysis, to what extent does the superior data of the two-sided firms result in better strategic decision making? Second, if within the area of *linkages,* developing close and rich interactions with markets and the suppliers of technology and other organisational players is of critical importance, then does the Big Data and `datafication` competencies of the two-sided firms result in higher audit scores?

Furthermore, do the linkages and open innovation capabilities provided by platform companies offer better opportunities for learning from lead-users, customers and strategic alliances and provide alternative perspectives thereby further enhancing their innovation advantage over one-sided businesses?

Finally, to what extent does the data-driven decision (DDD) making capabilities of the two-sided firms result in better and more effective enabling/implementation mechanisms compared to one-sided businesses. These are important components of the innovation audit.

In Chapter 3, the importance of dynamic capabilities and the need for firms to be learning organizations was also discussed in some depth and this was also a core feature of the dynamic business model perspective in Chapter 1. According to Tidd and Bessant (2013: 625), there were two important learning dimensions when it came to innovation. First, there was the *acquisition of knowledge* to add to the organisation`s existing stock of knowledge including competitor, market and technological know-how etc. Moreover, according to Teece *et al.,* (1997) and Voelpel *et al.,* (2004), innovation represented a key strategy for developing and sustaining competitiveness in the modern `knowledge economy` but being able to deploy the strategy depended upon the continuing accumulation, assimilation and deployment of new knowledge. Firms which exhibited competitive advantage demonstrated timely responsiveness and rapid product innovation coupled with the ability to effectively co-ordinate and redeploy internal and external competencies (Teece *et al.,* 1997: 509-533).

Tidd and Bessant`s (2013) second knowledge dimension concerned *the innovation process* itself and the existence of appropriate structures, cultures and processes. The ability of the two-sided businesses to accumulate more knowledge through their data rich platforms by leveraging their Big Data capabilities compared to one-sided businesses and the extent to which their structures, cultures and processes facilitated the sharing of data, information and knowledge across their platforms (avoiding the problems of core rigidities) are all considered as part of the innovation audit.

4.7 Selecting Appropriate Dimensions & Questions for the Innovation Audit

As mentioned earlier, when designing an innovation audit questionnaire, establishing the most appropriate dimensions is very important. A number of innovation audit templates were researched before formulating the audit questionnaire used for this analysis. A well-known example that was considered was the SPOTS framework. SPOTS stands for the five dimensions selected for the innovation audit, namely: Strategy, Process, Organization, Tools/Technology and Systems. The audit template was designed for the purpose of analyzing the organization and the management of service development and delivery based on a sample of 100 firms in the USA and the UK (Tidd and Hull: 2003).

Each of the five factors played a different role in evaluating the level of service innovation within the respective firms. Strategy provided focus, process provided control, organization provided the coordination of people, tools and technologies provided transformation/transaction capabilities and system provided integration. Performance was analysed as a total index and as three sub-scales: (1) innovation and quality, (2) time compression in development and cost reduction in development/delivery and (3) service delivery. The first two factors corresponded to generic strategic alternatives i.e. differentiation vs. cost. The third factor distinguished the service process from the product features. The scores and comparisons with those of other companies in the database allowed the company to identify its strengths and weaknesses.

A generic template more suited to a holistic analysis of an organisation`s ability to innovate was designed by Tidd *et al.,* (2005; 2009; 2013). This was based on five dimensions including: strategy, processes, organization, linkages and learning. They chose to use a ranking scale ranging from 1 to 7. A sample of the full innovation audit questionnaire and the five dimensions relating to each question can be found in Appendix 1.

Goffin and Mitchell (2010: 320-321) also stated that the scope of the audit needed to be decided in advance in terms of the number of dimensions and the breadth of questions to be asked. Goffin and Mitchell (2010) said that there were two levels of audit: a simple, fast version to obtain an initial idea of strengths and weaknesses and a version that probed more deeply. A sample of a fast innovation audit questionnaire is provided in Appendix 2 (Goffin and Pfeiiffer: 1999). This consists of five dimensions (Innovation Strategy, Ideas, Prioritization, Implementation, People and Organization). The audit also used a set of `Yes-No` questions and answers without any ranking scale that enhanced speed. Such an approach might be used to provide an initial overview of the organisation before undertaking more in-depth interview-based research. However, a representative survey should use a more comprehensive set of questions than the fast version. A widely used audit was created by a team from London Business School (LBS) and is referred to as a `technical innovation audit` (a sample is provided in Appendix 3). It includes questions covering both innovation processes (for example, concept generation; NPD; process innovation and technology acquisition) and their `enablers` such as human resource practices from top management (Chiesa *et al.,* 1996). Managers were also required to rate their company`s performance on a scale of 1 (`poor`) to 5 (`world class`).

Meanwhile Tidd and Bessant`s (2013) innovation audit framework/questionnaire (Appendix 1) is a hybrid example that sits somewhere between Goffin and Mitchell`s (2010) fast version (Appendix 2) and a comprehensive version such as the LBS `technical innovation audit` explained above. It therefore comprises more questions and incorporates a rating scale (not just `Yes-No` questions and answers).

For the purpose of this dissertation, a comprehensive innovation audit has been formulated (see Appendix 4). This consists of six dimensions each comprising twelve questions (totalling 72 in all). The dimensions include organizational strategy, organisational processes, organizational structure, organizational culture, organizational learning and organizational ideas generation. The questionnaire has been formulated using a select number of questions from the Tidd and Bessant (2013) innovation audit (Appendix 1) and the `technical innovation audit` (Appendix 3). There are 28 questions sourced from the Tidd and Bessant (2013) audit questionnaire and 33 questions used form the `technical innovation audit`. The remaining 11 questions were formulated by the author based on theories relating to high-involvement in innovation (HII) firms (Tidd and Bessant: 2013: 129). The innovation audit questionnaire also uses a ranking system (a Likert scale from 1 to 5) instead of simple `Yes/No` questions and answers.

The chapter will now analyse the structure of the innovation audit questionnaire and critique the reasoning behind the choice of dimensions and the selection of the questions concerned. Strategy is a very important dimension and was a feature of all the innovation audits surveyed. Therefore *organisational strategy* was introduced because of the need for focus and direction. The full range of questions are listed below and comprise 8 questions from the `technical innovation audit` (TIA) and 4 questions from the Tidd & Bessant (T&A) audit. These sources have been highlighted in brackets as (TIA) and (T&B).

1) A technology strategy exists (i.e. an explicit policy for sourcing technologies) and there are mechanisms for understanding the current and future technology needs of the organization. (TIA)
2) Competitors' innovation rates are known/monitored. (TIA)
3) Performance measures are in place for innovation including goals for new products, services and processes. (TIA)
4) Risk taking is encouraged rather than penalized by management. (TIA)
5) There is a formalized innovation programme in the organization. (TIA)
6) The organization's innovation strategy/policy is promoted throughout the organization. (T&B).
7) There is top management commitment and support for innovation. (T&B).
8) The organization looks ahead in a structured way (using forecasting tools and techniques) to try and imagine future threats and opportunities. (T&B).
9) The top team have a shared vision of how the company will develop through innovation. (T&B).
10) The percentage of revenue from products/services introduced in the last 3 years is high compared to competitors. (TIA)

11) Market share has increased as a result of new products/services introduced in the last 3 years. (TIA)
12) The number of new products/services in the portfolio has been increasing over the last 3 years. (TIA)

A key theme underpinning the choice of questions in the strategy dimension was the role of data in enabling firms to quantify and measure innovation. Half the questions make reference to forms of measurement including questions 2, 3, 8, 10, 11 and 12. For example, the extent to which `competitors' innovation rates are known/monitored` (Q2); whether `performance measures are in place for innovation including goals for new products, services and processes` (Q3); whether `the organization looks ahead in a structured way (using forecasting tools and techniques)…….` (Q8); is ` the percentage of revenue from products/services introduced in the last 3 years high compared to competitors` (Q9); has `market share increased as a result of new products/services introduced in the last 3 years` (Q11) and has `the number of new products/services in the portfolio been increasing over the last 3 years` (Q12).

The remaining six questions were also selected for important reasons. Questions 1, 5 and 9 indicate the extent to which the organization is focused on innovation and has a sense of direction. Question 1 refers to `an explicit policy for sourcing technologies`. Question 5 asks about the existence of a `formalized innovation programme` and Question 9 refers to having a `shared vision` for the development of innovation. The final three questions are important because they question the paradigm or dominant logic of the firm. Question 4 explores the firm`s attitude to risk, whereas Question 6 considers the extent to which the innovation strategy/policy is promoted throughout the organization and whether there is top management support for innovation in Question 7. According to Choudary (2015: 321), successful platform companies have to have a data acquisition mind-set so these points are very important. Meanwhile, awareness of the need to change and awareness of how to change are important innovation management capabilities (Tidd and Bessant: 2013: 633) which are normally enhanced in firms that have a high-involvement in innovation (Tidd and Bessant: 124-132) resulting from large amounts of data, information and knowledge.

The formulation of a strategy relies heavily on new ideas. In the *Organizational Idea Generation* section of the questionnaire nine questions were sourced from the `technical innovation audit` (TIA), one question from Tidd and Bessant`s (T&A) audit and two questions were developed by the author based on high-involvement in innovation (HII) theories. (HII) will therefore appear against the questions that were formulated in this way. The full range of questions are listed below:

1) The organization systematically searches for new product/service ideas. (T&B)
2) Creative ideas are collected on a regular basis from all employees. (TIA)
3) The number of ideas for new products, services and processes developed in the last 12 months is comparable to the best in class. (TIA)
4) Ideas originate from all departments, often from contacts with customers. (TIA)

5) Competitors are monitored regularly. There is a consistent approach to customer surveys and market trend analysis. (TIA)
6) The company sources for ideas externally e.g. from suppliers. (TIA)
7) The company belongs to a network i.e. it has close relationships with suppliers and customers and ongoing contacts with universities, government agencies, industry consortia etc. (TIA)
8) There is extensive networking internal and external. (TIA)
9) People in the organization know where to take their ideas. (TIA)
10) Ideas are quickly developed into new product/service concepts. (TIA)
11) Creativity techniques and workshops are effectively used. (TIA)
12) There is a positive approach to creative ideas, supported by relevant motivation systems. (HII)

The *Organizational Idea Generation* dimension was included because it provided a key measure of innovation. As discussed in Chapter 3, data and ideas form the basis of the `Knowledge Pyramid` (Debons *et al.,* 1988) from which information, knowledge, wisdom and innovation evolve. The first eight questions focus on the ability of the firm to search, source, collect and develop ideas and the role of internal and external networks. This is something the data-rich platform companies are very good at.

For example, `the organization systematically searches for new product/service ideas` (Q1); `creative ideas are collected on a regular basis from all employees` (Q2); ` the number of ideas for new products, services and processes developed in the last 12 months is comparable to the best in class` (Q3); `ideas originate from all departments, often from contacts with customers` (Q4); `competitors are monitored regularly [and]…..there is a consistent approach to customer surveys and market trend analysis` (Q5); `the company sources for ideas externally e.g. from suppliers` (Q6); `the company belongs to a network…….` (Q7) and `there is extensive networking internal and external` (Q8). According to Choudary (2015: 324) firms needed to be data-porous as well as avoiding silos that prevented the cross-communication of ideas and information. Internal and external networks (mentioned above) and the systems and mechanisms featured in Questions 9 to 12 are therefore very relevant.

Question 9 considers the existence of informal structures/systems that allow people to share their ideas while Question 10 refers to the ability to quickly transform ideas into new product/service concepts. Meanwhile, Question 11 and Question 12 highlight the importance of workshops and motivation systems. This can help to generate internal data-driven network effects that are essential for innovation.

The third dimension chosen for the innovation audit was *Organizational Learning.* Nine of the questions in this section were sourced from the `technical innovation` audit (TIA) and three questions were sourced by the author from high-involvement in innovation theory (HII). The full range of questions are listed below:

1) The organization is good at understanding the needs of customers/end-users. (TIA)
2) There is a strong commitment to training and development of people. (TIA)

3) Time is taken to review projects to improve performance next time around. (TIA)
4) The organization learns from its mistakes. (TIA)
5) The organization systematically compares its products and processes with other firms. (TIA)
6) The organization meets and shares experiences with other firms to help it learn. (TIA)
7) The organization is good at capturing what it has learned so that others in the organization can make use of it. (TIA)
8) The firm is good at learning from other organizations. (TIA)
9) The organization uses measurement to help identify where and when it can improve its innovation management. (TIA)
10) The organization design enables creativity, learning and interaction. (HII)
11) There is a continuing commitment to education and training. (HII)
12) There are high levels of proactive experimentation such as finding and solving problems, communication and sharing of experiences and knowledge capture and dissemination. (HII)

Organizational Learning was included as an innovation audit dimension because it was a key component of the dynamic capabilities concept (Teece *et al.,* 1997) and it is also necessary to avoid strategic drift (Johnson *et al.,* 2011) and core rigidities (Leonard-Barton: 1992) from becoming embedded within the firm. This was also a core component of the transformational view of business model innovation discussed in Chapter 1. The extent to which organizational learning was enhanced by the continuous generation of new data and ideas by platform companies was also very important when selecting and formulating the questions.

Explicit questions are asked relating directly to the provision of education and training i.e. Question 2: `there is a strong commitment to training and development of people` and Question 11: ` there is a continuing commitment to education and training`, which seeks to explore if the firm is dynamic and knowledge-based (Grant: 2008). Other key questions that were selected included the need to determine the levels of benchmarking, measurement and comparative behavior within the firm. Questions 5, 6 and 8 all refer to various forms of organizational benchmarking (internal and external) including products, processes and experiences. In Questions 4 and 7, the need to learn from mistakes and share and capture learning are important. Question 12 also takes this a stage further: `there are high levels of proactive experimentation such as finding and solving problems, communication and sharing of experiences and knowledge capture and dissemination`.

This emphasizes the need to not only share captured knowledge but questions the extent to which the firm carries out pro-active experimentation. This is also related to the discussion in Chapter 1 and dynamic business model innovation driven by probing, experimentation, effectuation and the need for `dynamic consistency` (Brown and Eisenhardt: 1998; Sarasvathy: 2001; McGrath: 2010; Chesbrough: 2010; Penrose: 1959; Lecoq *et al.,* 2006). Creativity is also considered in Question 10 whilst the need to measure innovation is included in Question 3: `time is taken to review projects to improve performance next time around` and Question 9: `the organization uses measurement to help identify where and when it can improve its innovation management`. In two-sided firms, the audit trails created by data have now made it possible to measure performance more effectively based on data-driven decision making (DDD) and monitoring (Brynjolfsson *et al.* (2011).

The next three dimensions in the innovation audit, organizational processes, structure and culture are important insofar as they can either help or hinder the innovation performance of the firm. We will first look at *Organizational Processes.* In this section, seven questions were sourced from the `technical innovation audit` (TIA), four from the Tidd and Bessant (T&B) audit and one was sourced from the author based on high-involvement in innovation theory (HII). The full range of questions are listed below:

1) There are processes in place to help manage new product development effectively from idea to launch. (T&B)
2) There are effective mechanisms for managing process change from idea through to successful implementation. (T&B)
3) There are mechanisms in place to ensure early involvement of all departments in developing new products/processes. (T&B)
4) There is a clear system for choosing innovation projects. (T&B)
5) Processes are constantly reviewed to identify areas for improvement. (TIA)
6) There is a focus on process improvement rather than on maintenance of processes. (TIA)
7) If it isn't broken, leave it alone is NOT an accepted philosophy in the organisation (TIA)
8) There is a strong link between product innovation and process improvement to support the product. (TIA)
9) The organisation is at the leading edge of technology in our industry. (TIA)
10) There is participation in organization-wide continuous improvement activity. (HII)
11) The time-to-market of new products is very short compared to our competitors. (TIA)
12) The organization is constantly developing and introducing new products/services. (TIA)

Seven of the organizational process questions specifically refer to process change and innovation (Questions 2, 3, 5, 6, 7, 8 and 10). Key words and statements include `process change` (Q. 2), `developing new products/processes` (Q. 3),`processes are constantly reviewed to identify areas for improvement` (Q. 5), `a focus on process improvement rather than on the maintenance of processes` (Q. 6), `if it isn't broken, leave it alone is NOT an accepted philosophy` (Q. 7), `a strong link between product innovation and process improvement to support the product` (Q. 8) and `organization-wide continuous improvement` (Question 10).

This complies with the dynamic business model perspective (Casadesus-Masanell and Ricart: 2010; Cavalcante *et al,* 2011; Demil and Lecoq: 2011, Van Puten and Schief: 2012) discussed in Chapter 1 where firms need to continuously re-invent through experimentation. In many instances the actual process and product are the same thing where data-based platform firms such as Facebook, Google, Netflix, Spotify, Airbnb and Uber are concerned. The dematerialization of physical products into digital files such as music, movies, news and books means that platform firms are constantly innovating in terms of both product and process since data is their core competency (Prahalad and Hamel: 1990). This enables the two-sided firms to produce new `Value propositions` which was a feature of the RCOV model in Chapter 1 (Lecoq, Demil and Warnier: 2006). This is explored in Question 1: ` there are processes in place to help manage new product development effectively from idea to launch` and Question 12: `the organization is constantly developing and introducing new products/services`.

Finally, key performance advantages such as speed to market (Question 11) and technology leadership (Question 9) are considered since Big Data technology operates in real time using sophisticated hardware and software platforms so analytics and new business models can be delivered and executed very quickly i.e. dynamic pricing and matching buyers and sellers and user interests.

When compiling the questions for *Organizational Structure,* seven of these were taken from the Tidd and Bessant (T&B) innovation audit questionnaire and five were sourced from the author based on high-involvement in innovation theory (HII). The full range of questions are listed below:

1) The organization structures are flexible and facilitate innovation to happen. (HII)
2) People work well together across departmental boundaries. (T&B)
3) People are involved in suggesting ideas for improvements to products or processes. (T&B)
4) The structure facilitates rapid decision making. (T&B)
5) Communication is effective and works top-down, bottom-up and across the organization. (T&B)
6) The reward and recognition system supports innovation. (T&B)
7) There is a supportive climate for new ideas - people don't have to leave the organization to make them happen. (T&B)
8) The employees work well in teams. (T&B)
9) Individuals and teams have space and autonomy for idea generation and creative problem solving. (HII)
10) Teams are diverse and heterogeneous in structure i.e. diverse educational, functional and industrial backgrounds. (HII)
11) There is an appropriate use of teams to solve problems (at local, cross-functional and inter-organizational level). (HII)
12) There are key individuals who energize and facilitate innovation within the organization i.e. promoters, sponsors and champions. (HII)

Alfred Chandler (1962) once famously said that structure should follow strategy. Inappropriate structures can create core rigidities (Leonard-Barton: 1994) if the environment changes and the strategy and structure remain the same which is aligned with the static business model perspective in Chapter 1 (Lindner *et al.,* 2010; Van Putten and Schief: 2012). The questions in this section therefore explore whether there are systemic barriers to innovation and the sharing of data, information and knowledge. The most appropriate structure for innovation according to Henry Mintzberg (1979) is an adhocracy which is flexible and team-based and therefore an important dynamic capability (Teece *et al.,* 1997).

Four of the twelve questions (Questions 8, 9, 10 and 11) therefore explore the role of teams in the organization. Key considerations are the extent to which `employees work well in teams` (Q. 8) and the extent to which they are diverse, cross-disciplinary, cross-functional and are creative. Since innovation relies on the sharing of data, ideas, information and knowledge the structures also needs to be `flexible` (Q. 1), cut across `departmental boundaries` (Q. 2) and `top-down, bottom-up and across the organization` (Q. 5).

The role of employees was also considered since the value in high-involvement in innovation (HII) companies is in the intangible resources such as human capital and ideas. This is highlighted in Question 3: `people are involved in suggesting ideas for improvements to products or processes` and Question 12: `there are key individuals who energize and facilitate innovation within the organization i.e. promoters, sponsors and champions`. Finally, since innovation is influenced by environmental factors, Questions 4, 6 and 7 explore whether `the structure facilitates rapid decision making` (Q. 4), whether there are `reward and recognition systems` in place to support innovation (Q. 6) and if `there is a supportive climate for new ideas` (Q. 7).

When analyzing the *Organizational Culture,* nine questions were sourced from the `technical innovation audit` (TIA) and three from the Tidd and Bessant (T&B) questionnaire. The full range of questions are listed below:

1) There is collaboration with other firms to develop new products or processes. (T&B)
2) The organization develops external networks with people who can provide specialist knowledge. (T&B)
3) The organization works closely with 'lead users' and customers to develop innovative new products and services. (T&B)
4) Human resource policies support a culture of innovation through stimulating a creative, problem-solving working environment. (TIA)
5) The skills required for innovation are identified and they are fully resourced through recruitment and training. (TIA)
6) Career structures support innovation through development of people across different functions. (TIA)
7) Innovation is covered by employees' appraisals and employees are rewarded for innovation activities. (TIA)
8) Innovation strategies are deployed to the employee level. (TIA)
9) Staff can approach top management with ideas and get a fair hearing. (TIA)
10) Clear innovation targets are set and known by all employees. (TIA)
11) There is a system for screening and evaluating ideas in the organization. (TIA)
12) The responsibility for screening decisions doesn't lie too high in the company hierarchy. (TIA)

One of the main differences between the two-sided platform companies and the one-sided firms is their approach to managing resources such as people. Two-sided platform companies have co-evolved their capabilities through co-creation with an external ecosystem or economic community of firms and individuals (Moore: 1996). Therefore questions 1, 2 and 3 refer to: `….collaboration with other firms to develop new products or processes` (Q. 1); developing `….external networks with people who can provide specialist knowledge` (Q. 2) and `….working closely with 'lead users' and customers to develop innovative new products and services` (Q. 3).

Low power distance (Hofstede: 1984) is also essential within an organization that seeks to be a successful innovator (Burns: 2013). Therefore, Questions 8, 9, 10, 11 and 12 all consider the egalitarian culture and mechanisms for generating, screening, evaluating and sharing ideas. There are references to `innovation strategies [being] deployed to the employee level` (Q. 8), `…approaching managers with ideas and getting a fair hearing` (Q. 9), `clear innovation targets are set and known by all employees` (Q. 10), `there is a system for screening and evaluating ideas in the organization` (Q. 11) and the extent to which `…..responsibility for screening decisions doesn`t lie too high in the company hierarchy` (Q. 12). Finally, the extent to which innovation is embedded within the HR fabric of the organization is also explored in Questions 4, 5 and 6.

4.8 Selecting the Likert Scale and the Limitations of the Innovation Audit Methodology

The chapter will now consider how the Likert scale was chosen for the scoring of the innovation audit questions before analyzing some of the drawbacks and limitations of the innovation audit research approach.

A range of 1 to 5 was selected for the Likert scale based on research undertaken by John Bessant (2003) in which he drew up a high involvement in innovation (HII) model which was used to rank firms based on a set of core characteristics. Two further dimensions from Tidd and Bessant`s (2013: 633) innovation management capability model have also been included. According to Bessant (2003), there are five stages that an organization progresses through in terms of their ability to innovate (see Figure 4.1 below).

Figure 4.2: The five stage high-involvement innovation (HII) model (Bessant: 2003)

Each of the stages takes time to move through and there is no guarantee that organisations will progress to the next level. Moving on means having to find ways to overcome particular obstacles with different stages.

The first stage – Level 1 – is what Bessant (2003) referred to as `unconscious HII`. There was little if any high involvement in innovation (HII) activity going on and when it did happen it was random in nature and occasional in frequency. Employees would help to solve problems from time to time but there was no formal attempt to mobilize or build on the activity. This is also what Tidd and Bessant (2013), in their `developing innovation management capability model`, referred to as a low awareness of the need to change and a low awareness of how to change. Innovation was therefore not even thought of and rarely happened.

Level 2, represented an organisation`s first attempt to mobilize higher involvement in innovation (HII). According to Bessant (2003) this involved setting up a formal process for finding and solving problems in a structured and systematic way and training and encouraging people to use it. Supporting this would be some form of reward/recognition arrangement to motivate and encourage continued participation. There would be an underpinning infrastructure of teams, task forces, facilitators and some form of steering group to monitor and adjust the operations over time. Meanwhile, the awareness of the need to change and the awareness of how to change (Tidd and Bessant: 2013) would be low to moderate. Therefore there was an awareness of innovation but responses would be random and occasional based on internal systems.

However, in order to maintain progress the firm would need to move to the next level of HII and to adopt a strategic focus and systematic improvement. Level 3 involved coupling the HII initiatives to the strategic goals of the organisation so that the fragmented improvement activities could be aligned. Two key behaviours were involved which included strategy deployment (communicating the overall strategy of the organisation) and monitoring and measuring of performance to create a continuous improvement cycle. This starts to have a positive impact on margins and profitability i.e. the final stage of the RCOV model (Lecoq, Demil and Warnier: 2006) in Chapter 1. The awareness of the need to change and the awareness of how to change would therefore be ranked as moderate (Tidd and Bessant: 2013) with systems in place but room for improvement.

According to Bessant (2003), key limitations of Level 3 HII were that the direction of activity was set by management within prescribed limits and the focus was internal. Therefore, the move to Level 4 introduced the element of empowerment of individuals and groups to experiment and innovate on their own initiative. This means that the firm had a high awareness of the need to change and a high awareness of how to change. Highly developed and effective systems for innovation therefore existed including provisions for improvement and development (Bessant: 2003; Tidd and Bessant: 2013).

At Level 5, the firm becomes a learning organisation where everyone is fully involved in experimentation, improvement and knowledge sharing. High involvement in innovation (HII) is the dominant way of life within the organisation and innovation is both incremental and radical. Awareness of the need to change and awareness of how to change are extremely high since this is embedded in the corporate culture with disruption serving as a key driver of growth. These organisations create and shape new environments and business models.

However, when applying innovation audits there are certain limitations and drawbacks. Where questions in innovation audits are designed to be answered on a numeric scale, it needs to be remembered that the answers are quantitative and they are only based on managers` opinions. Goffin and Mitchell (2009: 366) warned that comparing innovation audit results between companies was difficult because the scales were not absolute. Many aspects of innovation management were too complex to allow all of the inputs, processes and innovation outputs to be represented by a single number. Goffin and Mitchell (2009) also stated that it was difficult to `benchmark` more than a few aspects of innovation performance such as the revenues generated by new products or the percentage of revenues invested in R&D. Time-to-market figures were also difficult to compare reliably. Finally, the intangible nature of innovation has made its evaluation increasingly difficult.

4.9 Conclusion

Chapter 4 has explained the choice of research design adopted by the dissertation including the research philosophy, the research approach, the research methods and the data analysis techniques that have been utilised. It also explained the reasons for the adoption of the innovation audit technique and how it has evolved as a research tool. Linkages to the research gap identified in the literature review in Chapters 1 to 3 were also analysed. There was a detailed explanation of how and why the six innovation audit dimensions were selected and the reasons underpinning the choice of questions. The chapter also explained how the five point Likert scale was arrived at.

The data gathered from the innovation audit survey will now be analysed in some depth in Chapter 5 of the dissertation to identify the extent to which two-sided ecosystem platform companies have an innovation advantage over established one-sided firms due to their substantial data resources.

Chapter 5.0 – Data Analysis

5.0 Introduction

It is the purpose of this chapter to analyse the data collected from a sample of one hundred (100) companies. Fifty seven (57) of these companies are classified as two-sided or industry platform firms and the remaining 43 companies are classified as traditional single-single sided firms (see Appendix 15).

The 57 two-sided/industry platform firms are based in the technology sector and include large Internet firms, financial technology companies (Fintech) as well as firms responsible for building and running the Internet infrastructure including microchip firms, cloud companies, telecoms operators, handset producers and new media firms such as Netflix plus a select number of Unicorns that operate two-sided business models such as Uber, Airbnb and Deliveroo. The 43 traditional one-sided firms are from a range of sectors including high street banking, manufacturing, utilities, transport and logistics and high street retail services etc. (see Appendix 15).

The research data was collected using an Innovation Audit questionnaire divided into 6 sections consisting of twelve questions each, resulting in a total of 72 questions. The six categories include: organisational strategy, organisational processes, organisational structure, organisational culture, organisational learning and organisational idea generation (see Appendix 4). Each question was ranked using a Likert Scale ranging from 1 to 5 (strongly disagree, disagree, partially agree, agree and strongly agree). The analysis is also univariate (the dependent variable being innovation) and it utilises ordinal and binary data incorporating. The statistical methods used are also non-parametric since the data is not normally distributed (Easterby-Smith *et al.,* 2015).

The innovation audit questionnaire survey was selected as the most appropriate method for gathering data because it closely met the research philosophy, ontology, epistemology and the research paradigms discussed in Chapter 4 (the methodology chapter).

The innovation audit approach was seen to be consistent with the relativism and nominalism ontologies which relate to intangible variables such as innovation. In terms of the epistemology, both positivism and social constructionism were seen to be relevant to the audit questionnaire because innovation is a process where `reality` is socially constructed and given meaning by people in their daily interactions with others. Therefore, since innovation is dependent upon high levels of interaction and knowledge and learning between individuals and their environment, social constructivism was considered to be well-suited to the innovation audit approach which explored the levels of interaction within the sample of 100 firms.

In terms of paradigm, post-modernism and systems theory were also closely aligned with the purpose and design of the innovation audit tool. Post-modernism placed an emphasis on the invisible elements and processes of organisations which the audit questionnaire sought to make explicit. This included characteristics such as tacit knowledge and the informal processes of decision making in high interest in innovation (HII) firms (Tidd and Bessant: 2013). Meanwhile, systems theory stated that complex systems should be studied as a whole, rather than breaking them down into their constituent parts. The comprehensive nature of the innovation audit which analyses innovation across six dimensions is therefore consistent with the systems paradigm.

The data analysis seeks to test the following research hypothesis:

The extent to which data-rich firms operating two-sided platform-ecosystem business models are able to use data to gain an innovation advantage over established one-sided companies.

The chapter will now seek to identify and analyse patterns in the collected data using SPSS and a number of statistical methodologies in order to draw conclusions relating to the research hypothesis (Hinton and McMurray: 2017). This will lead to a broader discussion of the inferences of the data in Chapter 6 where the strategic implications of the statistical analysis will be explored in more depth.

5.1 Data Analysis – An Overview

The first part of Chapter 5 will focus on an analysis of the differences between the two-sided and one sided firms and the extent to which the data-rich two-sided firms have an innovation advantage over the less information-intensive single-side firms. The second part of the chapter will analyse the differences between the two sided firms and industry platform companies that comprise the sample of 57 technology firms that were surveyed. In Annabelle Gawer`s (2009) Typology of Platforms framework in Chapter 2, the author stated that there was some doubt as to whether two-sided (multi-sided) firms were innovative to the same extent as industry platform firms:

> *The key distinction I make is whether the multi-sided market facilitates or not innovation in new products, technologies or services. All industry platforms do – but some multi-sided platforms don`t seem to* (Gawer 2009: 58).

Sections 5.6 and 5.7 of the chapter will explore this statement further by analysing the survey results for the 29 two-sided companies before comparing them with the scores for the 28 industry platform firms.

Meanwhile, a range of statistical methodologies will be used to analyse the data gathered from the innovation audit survey questionnaires relating to the one-sided and two-sided firms. These will include Cronbach`s Alpha (Cronbach: 1951) which will be used to measure the scale of reliability and the internal consistency of the questions. This will be followed by a correlation matrix based on Spearman`s rank correlation (Spearman: 1904) before undertaking a cluster analysis (Bailey: 1994; Everitt: 2011) using scatter plots to illustrate the grouping of the of the surveyed firms. A Mann-Whitney *U* test (Mann-Whitney: 1947) is then used to determine whether the two independent samples (the one-sided and two-sided firms) have been selected from populations that have the same distribution. A Factor Analysis (Child: 2006) will also be used to determine which are the most important variables in the innovation process. Box plots are also used to illustrate the differences between two-sided and one-sided firms from an innovation perspective.

An analysis is then undertaken of the differences between the two-sided and industry platform firms using the Mann-Whitney *U* test, cluster analysis and graphic illustrations in the form of scatter plots and box plots (as discussed earlier).

5.2 Cronbach`s Alpha

Cronbach's Alpha is a measure of internal consistency or how closely related a set of items are as a group. It is an important measure of scale reliability. Technically speaking, Cronbach's alpha is not actually a statistical test but a coefficient of reliability or consistency of the answers given (Cortina: 1993).

A commonly accepted rule for describing and evaluating internal consistency using Cronbach's alpha is outlined in Table 5.0 below:

Table 5.0: Cronbach`s Alpha Reliability Scale (Dunn *et al.,* 2013)

If we apply this to the data collected from the innovation audit survey questionnaires it can be seen that the answers are located in the `Excellent` category as far as consistency and reliability are concerned with an score of 0.997 based on the full set of answers to Questions 1 to 72. Table 5.1 (below) provides an overview and a breakdown of the scores which have been divided into six separate components of innovation based on the questionnaire structure. Each individual component is in the `Excellent` category as is the overall ranking. No rating is lower than 0.979. The full range of supporting data for each individual question broken down into the six categories as well as including the full ratings for all 72 questions as a holistic table can be found in Appendix 5.

Table 5.1: Cronbach`s Alpha Reliability Statistics – An Innovation Audit Summary.

5.3 An Overview – Two Sided and One-Sided Firms

The chapter will now consider differences between the data-rich two-sided companies and the less data-intensive one-sided firms based on their ability to innovate. A full summary of the Bristol Online Survey (BOS) innovation audit questionnaire results can also be found in Appendix 6 and Appendix 7 as supporting evidence. These are divided into two sections with one set of data for the one-sided firms (Appendix 6) and another separate set of results for the two-sided companies (Appendix 7). Full BOS audit results for all one hundred (100) firms combined can be found in Appendix 13.

Spearman`s rank correlation was chosen as the method to use for the development of the correlation matrix because, unlike the Pearson`s coefficient, it is better suited for the analysis of ordinal data and rank order correlation coefficients (Hollander and Wolfe: 1973). The correlation coefficient measures the strength and direction of a linear relationship between two variables. The value is always between +1 and –1. A guideline is provided in the list below.

- **Exactly** –**1.** A perfect downhill (negative) linear relationship
- –**0.70.** A strong downhill (negative) linear relationship
- –**0.50.** A moderate downhill (negative) relationship
- –**0.30.** A weak downhill (negative) linear relationship
- **0.** No linear relationship
- **+0.30.** A weak uphill (positive) linear relationship
- **+0.50.** A moderate uphill (positive) relationship
- **+0.70.** A strong uphill (positive) linear relationship
- **Exactly +1.** A perfect uphill (positive) linear relationship

The Spearman correlation coefficients for all 72 questions in the innovation audit questionnaire are listed in Appendix 8. This shows quite unequivocally that there is a `strong` to near `perfect` uphill positive linear relationship of almost +1. Virtually all the questions in all six categories are in the +0.80 and +9.0 categories with the lowest score for just one question being +0.75. The organizational strategy, organizational structure and organizational learning dimensions of the innovation audit were particularly strong in this respect.

The strength of the linear relationships between the two groups (two-sided and one-sided firms) are clearly illustrated in the scatter plot in Figure 5.0 below which represents all 72 questions.

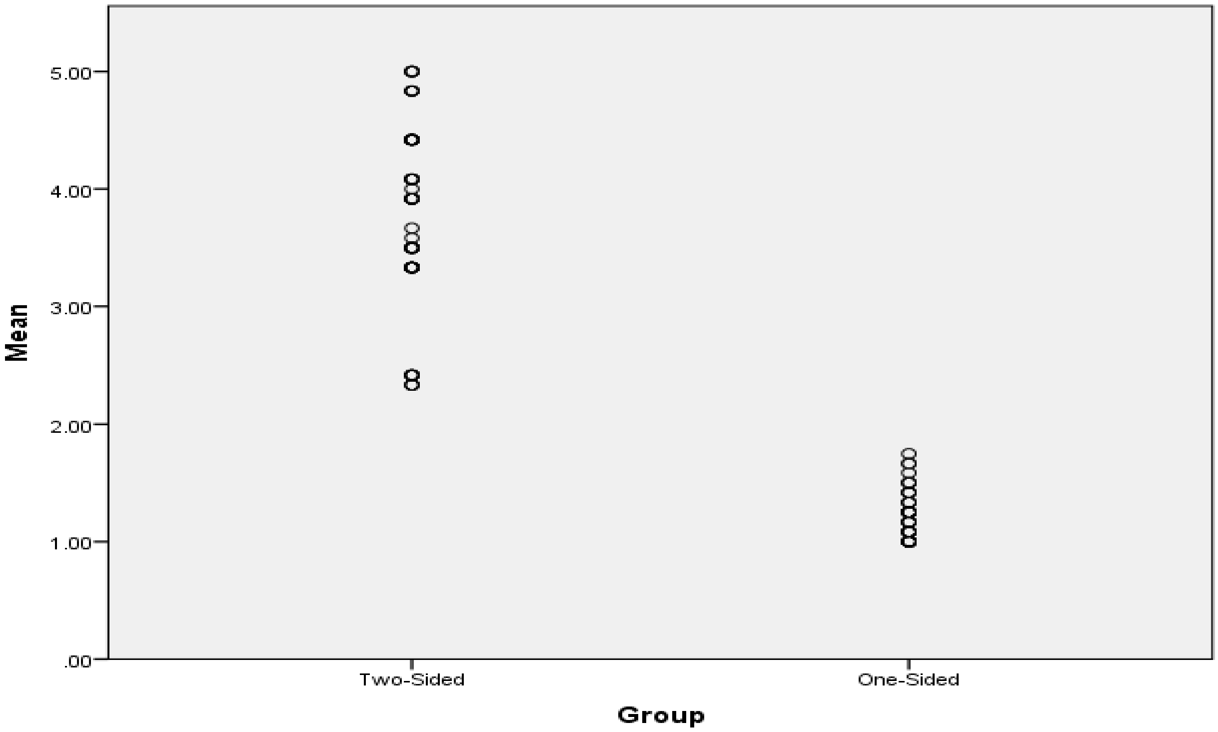

Figure 5.0: Scatter Plot – Innovation Audit Questionnaire – Questions 1 – 72.

The Scatter Plot in Figure 5.0 not only illustrates the linearity of the relationships but it also highlights the broad spread and wide range of responses (scores) between the two-sided and one-sided firms. The two-sided firms are firmly located in the upper half of the Likert scale (3 to 5) with the one sided-firms being located in the lower half (1 to 2).

Figure 5.0 represents the responses for all seventy two (72) questions in the innovation audit questionnaire. This shows that 42% of the sample of two-sided firms were located in category 4 to 5 of the Likert scale meaning that the respondents either agreed or strongly agreed that their companies were highly innovative. The remaining 42% partially agreed and 16% of the two-sided sample disagreed that their firms were highly innovative (position 2). At the other end of the scale, the respondents from the one-sided firms consistently disagreed that their firms were highly innovative (located in categories 1 to 2 in the Likert scale).

If we undertake a cluster analysis based on all six categories of the innovation audit it can be seen that this trend is reinforced rather than reversed. In the scatter plots for all six categories of the audit (see Appendix 9), all the one-sided firms remain routed in the lower half of the Likert scale (positions 1 to 2). Nevertheless, when analysing the two-sided firms there remains a strong presence in the top three positions in the Likert scale although on some dimensions lower scores are recorded for some of the two-sided companies. The scatter plot for `Organizational Strategy` (Appendix 9) is more-or-less a carbon copy of the scatter plot for all 72 questions illustrated in Figure 5.0. Meanwhile, when analysing the remaining five dimensions there is still a cluster of high innovation companies that remain in positions 4 to 5 but there is also an increase in the number of two-sided companies being ranked in positions 3 and even position 2 in some cases. For example, in terms of `Organizational Processes` (Questions 13-24), the ratio of two sided-firms in positions 4 to 5 is marginally higher at 43% but the ratio of firms in position 3 decreases from 42% to 21% and the figure for positions 2 to 3 increases to 36% from 16% (see Figure 5.1).

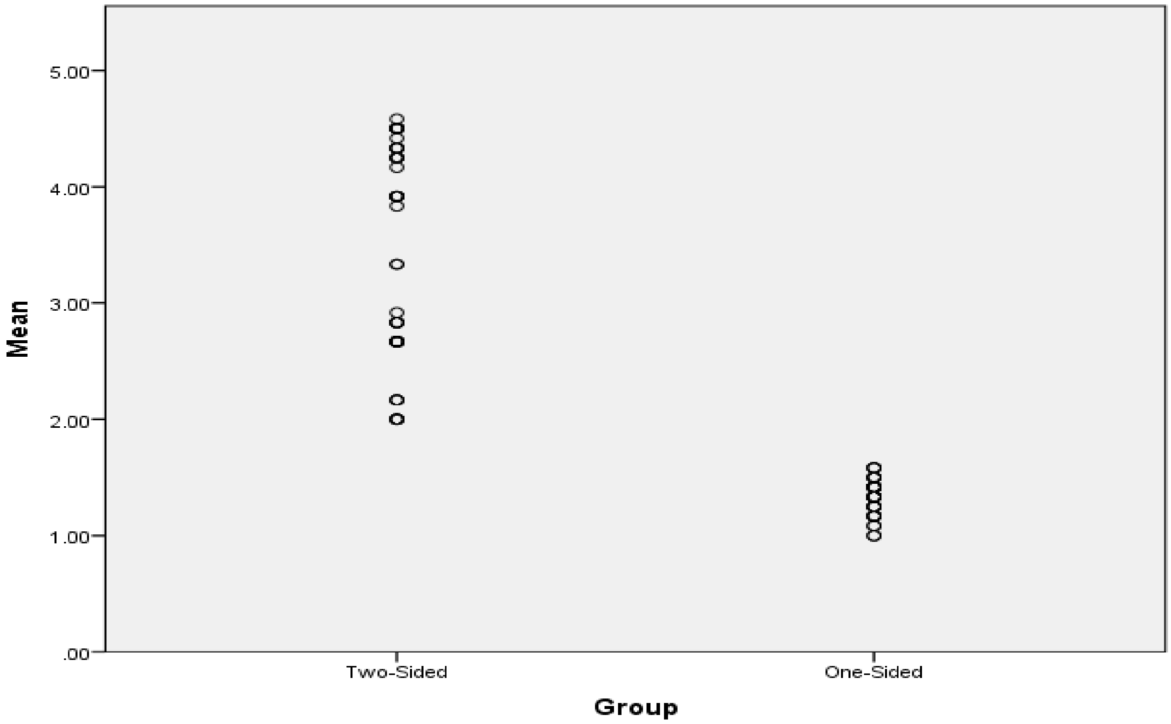

Figure 5.1: Scatter Plot – Organizational Processes (Questions 13 - 24).

When analysing `Organisational Structure` (see Appendix 9: Questions 25 -36), a similar spread of marks can be seen to those in Figure 5.1 for `Organizational Processes` with an approximate two thirds and one thirds split between positions 3 to 5 (at 67%) in the Likert scale and position 2 at 33%. Nevertheless, 40% of the respondents still agreed or strongly agreed with their firm`s innovation capabilities and were positioned in positions 4 to 5.

However, the most noticeable spread of marks appear in the three categories of the innovation audit entitled organisational culture, organizational learning and idea generation. If we look at the scatter plot in Figure 5.2 (below and Appendix 9), where there is almost a 50-50 split between positions 3 to 5 at 54% and positions 2 to 3 at 46%.

This spread of responses amongst the two-sided firms is even more pronounced if one considers the dimensions of organisational learning (Questions 49 – 60) and idea generation in Figure 5.3 and Figure 5.4 below (plus Appendix 9). Although nearly two thirds of the two-sided companies are in positions 3 to 5 (65%), the remaining one third are located in positions 2 with 21% of the sample respondents saying that they disagreed that the firm was a learning organisation and 14% strongly disagreeing with this viewpoint.

Finally, it is in the category of idea generation (Questions 61 – 72) that the widest spread of responses within the two-sided sample occurs. Only half of the sample (50%) is located in positions 3 to 5 (primarily position 4 to 5 i.e. 42%) whereas a third of respondents disagreed that their firm was good at idea generation and 17% strongly disagreed with this perspective.

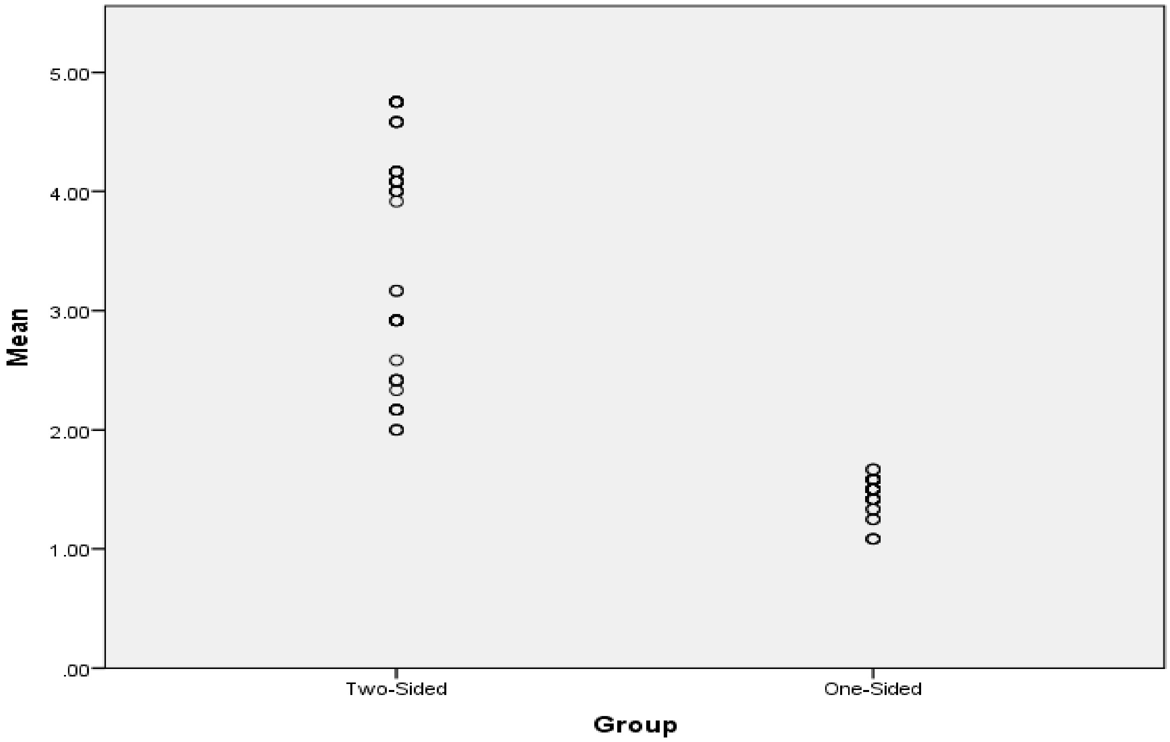

Figure 5.2: Scatter Plot – Organizational Culture (Questions 37 - 48).

A more in-depth analysis of the range of responses within the two-sided cluster will be undertaken in the second part of Chapter 5 (Sections 5.6 and 5.7). However, there are a number of inferences that are briefly worth mentioning. First, there is a cluster of firms that continuously appear in the upper positions (4 and 5) of the Likert scale throughout the entire innovation audit (i.e. across all six dimensions). Recent journal articles (Rotman: 2017) and management consultancy reports (*Financial Times*: 2015c) have referred to these as the `Superstar` firms. These are the new Internet-based firms that have grown exponentially on the back of open-source software, the switch to “cloud” computing and the move to huge data centres and Big Data analytics. These relatively new two-sided firms have replaced the systems, hardware and semi-conductor firms (i.e. the industry ecosystem companies) as the keystone players in the technology sector.

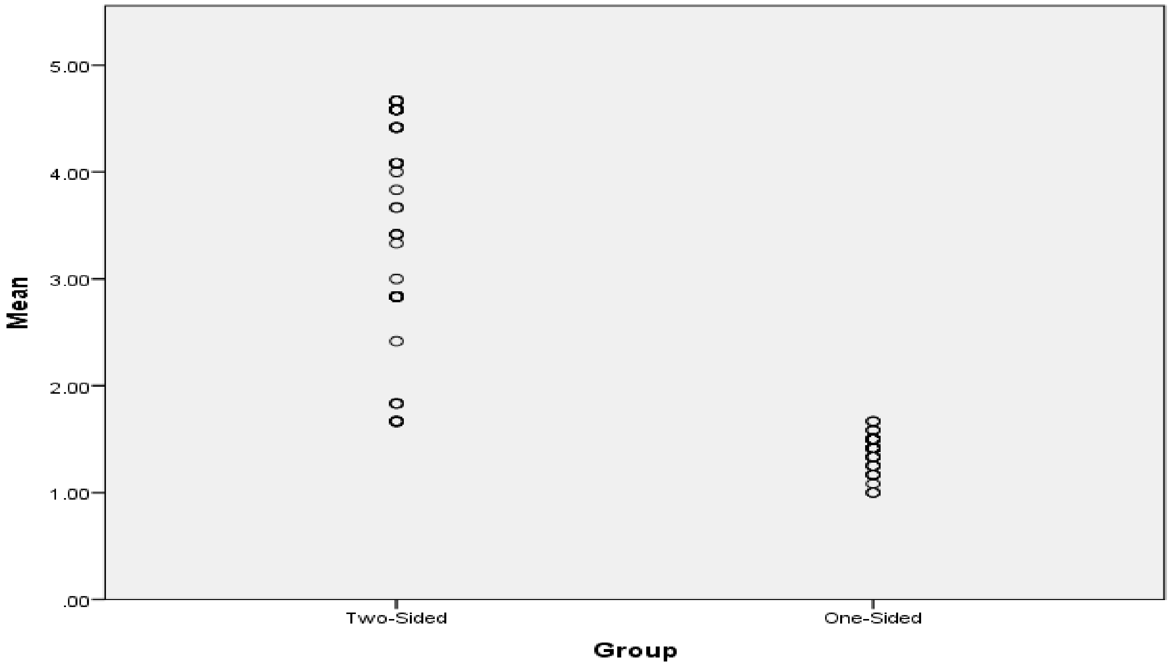

Figure 5.3: Scatter Plot – Organizational Learning (Questions 49 - 60).

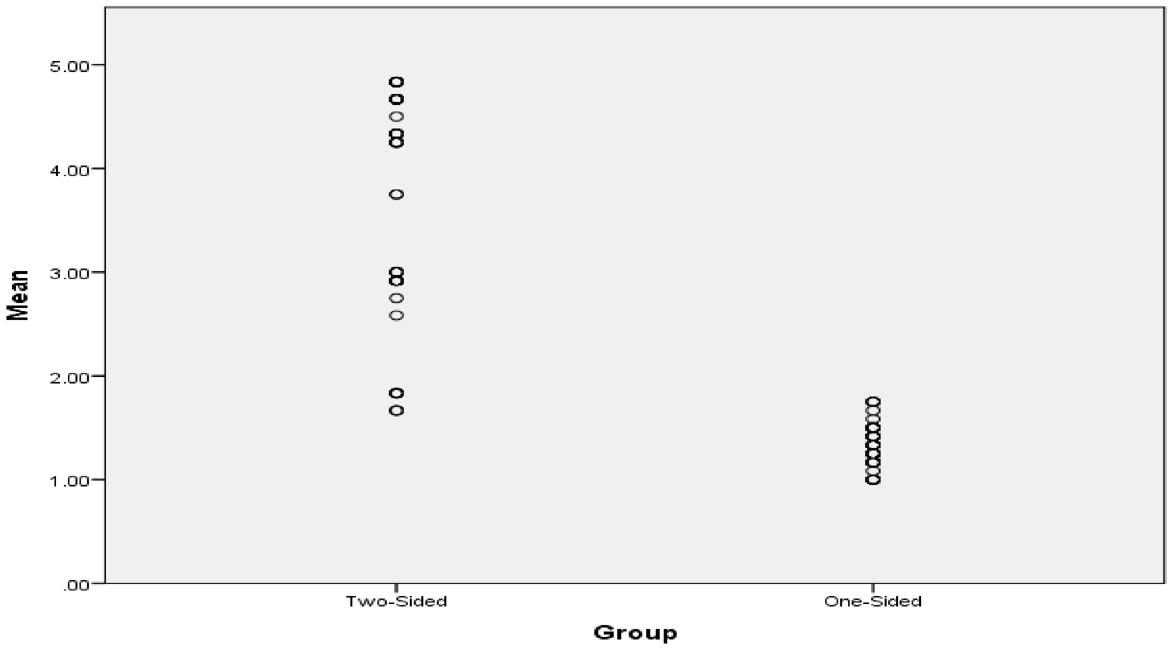

Figure 5.4: Scatter Plot – Organizational Idea Generation (Questions 61 - 72).

This will be explored in more detail at the end of the chapter in sections 5.6 and 5.7. Meanwhile, a more rigorous analysis of the differences between the two-sided and one-sided firms will now be undertaken (since this is the main research gap) using additional statistical methods including the Mann Whitney *U* test and Factor Analysis (Thompson: 2004) with supporting illustrations using box plots.

5.4 Two-Sided Firms and One-Sided Firms – An In-Depth Analysis

When testing the differences between groups, the Mann-Whitney *U* test was selected in preference over other methodologies such as the t-test because the data generated by the innovation audit survey is not normally distributed being ordinal (binomial distribution) and non-parametric (Faye and Proschan: 2010). The ordinal scale is distinguished from the nominal scale by having ordered categories in the form of the Likert scale (1 to 5). The Mann–Whitney *U* test not only remains the logical choice when the data is ordinal but all the observations from both groups are independent of each other.

The full results of the Mann-Whitney *U* test can be found in Appendix 10. The results are broken down into six sections based on the six categories of the innovation audit: organisational strategy, organisational processes, organisational structure, organisational learning and organisational idea generation.

Mann-Whitney U Test			
	Innovation Audit Category	Average Mean Rank - Two-Sided Firms	Average Mean Rank - One-Sided Firms
1	Organizational Strategy	71.55	22.59
2	Organizational Processes	70.10	24.51
3	Organizational Structure	70.75	23.65
4	Organizational Culture	69.33	25.20
5	Organizational Learning	69.48	25.33
6	Organizational Idea Generation	69.49	25.31
Total Mean Average Scores		70.10	24.43

Table 5.2 Mann-Whitney *U* Test: The Average Mean Rank Scores for the Two-Sided and One-Sided Firms (based on the six categories of the innovation audit).

For the purpose and convenience of the analysis, a mean average score for each of the six categories has been presented in Table 5.2. This illustrates very clearly the wide range between the mean rank scores for the two-sided firms compared to the one-sided companies. The total mean average for the two-sided firms was 70.10 and 24.43 for the one-sided firms. This symmetry of the data also reinforces the results of the cluster analysis as evidenced in the scatter plot in Figure 5.0 above. Not only is the split between the two types of firm emphasised but the lower mean rank scores for the two sided firms in the organisational culture, organizational learning and organizational idea generation categories of the audit are also highlighted.

A factor analysis (Child: 2006) was also undertaken to describe the variability between the two groups based on the six components of the innovation audit. The full results can be found in Appendix 11. These are broken down on the basis of the six audit categories and there is also a full factor analysis results table based on all 72 questions combined. A summary of the mean average variances is provided in Table 5.3. The total mean average variance is 86.06% which reinforces the results of the earlier analysis.

Factor Analysis - A Summary of the Six Innovation Audit Categories		
Innovation Audit Category		% of Variance
1	Organizational Strategy	87.516
2	Organizational Processes	81.723
3	Organizational Structure	86.826
4	Organizational Culture	84.746
5	Organizational Learning	88.545
6	Organizational Idea Generation	87.032

Table 5.3 Factor Analysis: The Percentage Variance for the Six Categories of the Innovation Audit for the Two-Sided and One-Sided Firms.

When undertaking the factor analysis, it is important to note that data and innovation are highly intangible and can therefore be classed as having a high order of latency i.e. they are unobserved underlying factors. Although, under normal conditions, it is difficult to measure the process elements of innovation directly; by linking the variables to specific measures within the audit questionnaire it has been possible to identify `shared variance` (Child: 2006) where the variables have become clustered illustrating a high variance between the two-sided firms with high data levels and high innovation and the one-sided companies with low data levels and low innovation.

So far the analysis has taken a high level view of the innovation audit results. The chapter will now explore each of the six individual categories of the innovation audit in more depth using the audit results to establish why there is such a wide range between the scores for the two-sided and one sided firms. This will consider the mean rankings, standard deviations and variances for each category using box plots to illustrate the differences. The results for the whole sample of 100 firms combined can be found in Appendix 12. A summary of the average mean rankings, average standard deviations and average variances for all six categories is illustrated in Table 5.4 (below).

Innovation Audit Results				
	Innovation Audit Category	Average Mean Rank	Average Standard Deviation	Average Variance
1	Organizational Strategy	2.68	1.62	2.24
2	Organizational Processes	2.24	1.52	2.11
3	Organizational Structure	2.54	1.49	2.07
4	Organizational Culture	2.84	1.48	2.01
5	Organizational Learning	2.86	1.55	2.25
6	Organizational Idea Generation	2.87	1.64	2.52
Total Average Figures		2.67	1.55	2.2

Table 5.4: The Average Mean Rank Scores, Standards Deviations and Variances for the Two-Sided and One-Sided Firms Combined.

This shows that the total average mean rank for all the firms combined was 2.67 with an average standard deviation of 1.55 and an average variance of 2.2. However, since the research question is concerned with the actual differences between each type of firm, a second set of results have been produced presenting a separate set of figures for the two-sided and one-sided companies for benchmarking purposes. The full set of results can be found in Appendix 6 (one-sided forms) and Appendix 7 (two-sided firms). Summaries of the overall mean average scores are provided in Tables 5.5 and 5.6 below. Table 5.5 provides a breakdown of the average mean rank scores for the two types of firm, whereas table 5.6 is a breakdown of the scores for the average standard deviations and the average variances.

Innovation Audit Results			
	Innovation Audit Category	Average Mean Rank - Two-Sided Firms	Average Mean Rank - One-Sided Firms
1	Organizational Strategy	3.78	1.22
2	Organizational Processes	3.46	1.33
3	Organizational Structure	3.27	1.13
4	Organizational Culture	3.52	1.47
5	Organizational Learning	3.58	1.39
6	Organizational Idea Generation	3.65	1.33
Total Average Mean Rank		3.54	1.31

Table 5.5: The Average Mean Rank Scores for the Two-Sided and One-Sided Firms.

This shows that the average mean rank score for the two-sided firms is markedly higher when separated from the aggregated scores for both category of firm in Table 5.4. The average mean rank is higher in all six categories and the total score of 3.54 is higher than the aggregated score of 2.67. This compares with a much lower average mean rank score of 1.31 for the one-sided firms. This is illustrated diagrammatically in the box plot in Figure 5.5 below.

Unsurprisingly, the average standard deviations and variances are also lower. The average standard deviation for the two-sided firms was 1.15 compared to 1.55 for the aggregated results. The variance, meanwhile, was even lower at 1.29, not 2.2. When analysing the one-sided firms, the average standard deviation declined from 1.55 to 0.28 whereas the variance changed from 2.2 to 0.11 (see Table 5.5 and Table 5.6).

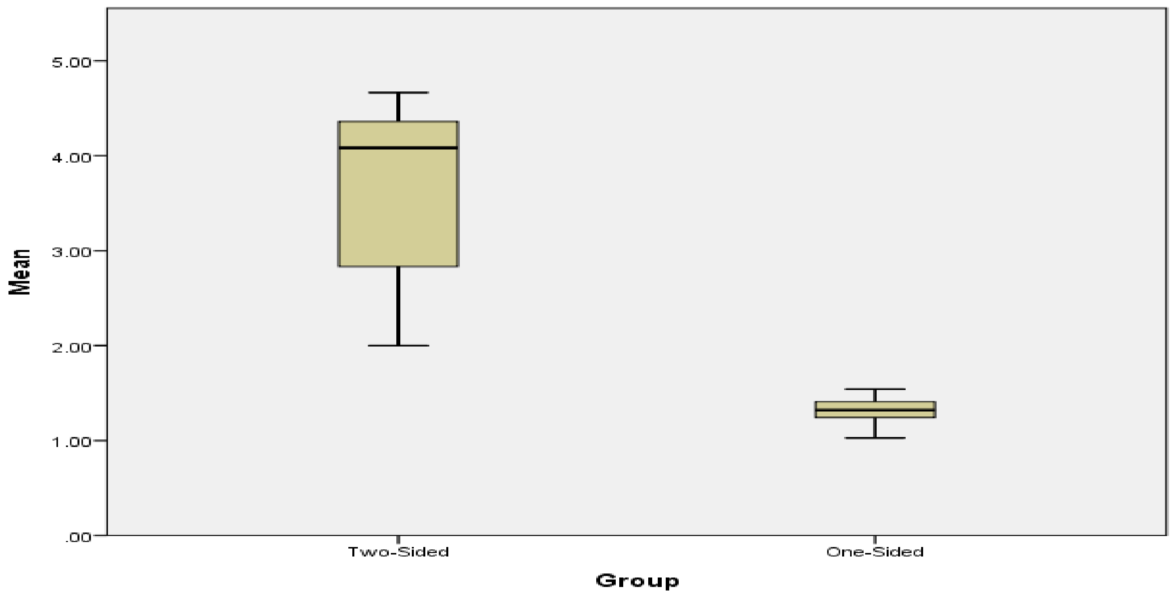

Figure 5.5: Box Plot – The Average Mean Rank for the Two-Sided and One-sided Firms (for all six categories of the innovation audit).

Innovation Audit Results					
	Innovation Audit Category	Average Standard Deviation - Two-Sided Firms	Average Variance - Two-Sided Firms	Average Standard Deviation - One-Sided Firms	Average Variance - One-Sided Firms
1	Organizational Strategy	0.99	0.98	0.18	0.12
2	Organizational Processes	1.13	1.30	0.36	0.14
3	Organizational Structure	1.14	1.31	0.25	0.09
4	Organizational Culture	1.14	1.31	0.29	0.11
5	Organizational Learning	1.16	1.35	0.29	0.10
6	Organizational Idea Generation	1.34	1.54	0.36	0.15
Total Mean Average Deviation & Variance		1.15	1.29	0.28	0.11

Table 5.6: The Average Standard Deviations and Variances for the Two-Sided and One-Sided Firms.

The standard deviations and variances within the two-sided cluster are significant (albeit small) and will be explored further in sections 5.6 and 5.7 when analysing the differences between the two-sided firms and the industry platforms. The chapter will now focus on the gap between the mean rank for the two-sided firms and the one-side companies and will explore why the one-sided firms` level of deviation and variance around the mean score is so low. This would indicate at first hand a consistently low level of innovation. In order to provide a deeper level of analysis of the differences between the two groups, all six categories of the innovation audit will be analysed starting with organizational strategy, followed by organizational processes, organizational structure, organizational culture, organizational learning and organizational idea generation.

5.5 An Analysis of the Two-Sided Firms and the One-Sided Firms based on the Six Categories of the Innovation Audit

The first category in the innovation audit is **`Organizational Strategy`** (Questions 1 – 12). The average mean rank score (Table 5.5) for the two-sided firms for this category was 3.78 and 1.22 for the one-sided firms. This is clearly illustrated in the scatter plot below (Figure 5.6) where the one-sided firms are firmly rooted in position 1 in the Likert scale with organizational strategy having the lowest average standard deviation of all six categories at 0.18 and a variance of just 0.12 (Table 5.6). This implies that the sample responses are consistent.

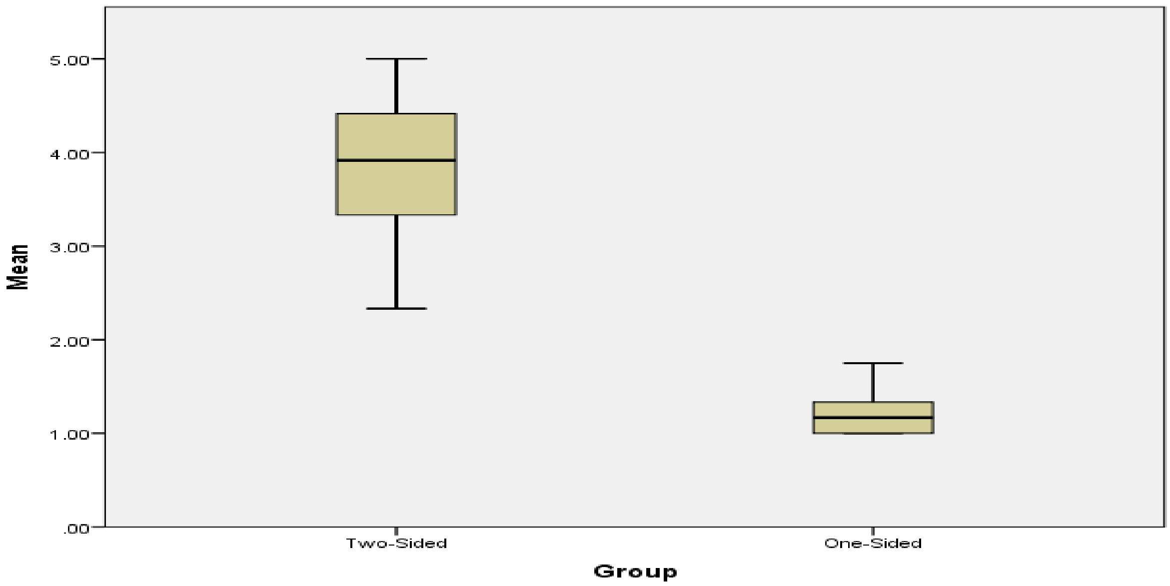

Figure 5.6: Box Plot – The Average Mean Rank for the Two-Sided and One-sided Firms -`Organizational Strategy`.

Six of the twelve questions in the `Organizational Strategy` category (Questions 1, 2, 3, 10, 11 and 12) are of an explicit and tangible nature and therefore the responses are not susceptible to any subjective bias. For example, Question 1 asks if there is `an explicit policy for sourcing technologies`. The mean rank of 1.14 is well below the average figure (see Appendix 6). This implies that the one-sided firms are not engaging with new digital technologies and platforms that are essential for the gathering and internalisation of data which forms the basis of innovation.

Meanwhile, the remaining five questions mentioned above (Questions 2, 3, 8, 10, 11 and 12) indicate an absence of any data driven decision making (DDD) as well as an absence of an information mind set or what Choudary (2015) referred to in Chapter 2 as a `culture of data acquisition`. For example, Question 2 reveals no knowledge or attempts to monitor competitor innovation rates with a score of 1.14. Question 5 asks if there is a formalized innovation programme and Question 3 asks if there are performance measures and goals to monitor new products, services and processes. The respective mean rank scores of 0.21 and 1.05 imply that appropriate data and information systems do not exist to manage any innovation process (see Appendix 6). This means that the respondents would not have any knowledge of the percentage of revenues from new product/service development compared to competitors (Question10) nor would there be any information regarding market share from new products/services in the last 3 years (Question 11). This is borne out by the mean rankings of 1.16 and 1.14 for these questions. The answers to Question 8 also indicates that there was a lack of any forecasting tools being deployed and signal detection from the environment. This is an area in which the that data rich two-sided firms excel because they are capturing data continuously that enables them to undertake beta-testing, micro-targeting and dynamic pricing using algorithms to perform predictive analytics.

Although computing power has become commoditised it is still costly and this may be the reason for the lack of top management commitment in Question 7 (i.e. seeing ICT as a liability not an investment) with a score of 1.37 (see Appendix 6). This is reinforced by the top team`s lack of a shared vision for innovation (Question 9) and the failure to promote an innovation strategy (Question 6). These questions both received scores of 1.16.

The lack of any tangible outputs from innovation is also endorsed by the low score for Question 12 of 1.16 and the failure to increase the product portfolio over a 3 year period. Finally, an adversity to high risk was a feature of the answers to Question 4, which had a mean rank of 1.49 (see Appendix 6).

The second category in the innovation audit is **`Organizational Processes`** (Questions 13 – 24). The average mean rank score (Table 5.5) for the two-sided firms for this category was 3.46 and 1.33 for the one-sided firms. This is clearly illustrated in the box plot below (Figure 5.7). Yet again, the one-sided firms are firmly rooted in position 1 in the Likert scale with organizational processes having an average standard deviation of 0.36 and a variance of just 0.14 (Table 5.6).

A clear theme emerging from the responses to the twelve questions in the organizational processes category is that the one-sided forms have not developed any processes to nurture and develop innovation and hence there has not been many new processes, products and services. In order for innovation to occur there has to be an innovation-friendly environment that doesn`t seem to exist within the traditional organizations surveyed. Many of these companies appear to be pursuing cost leadership or cost focus strategies (Porter: 1985) where maximization of financial returns through operational efficiencies are prioritised.

Evidence to support this is provided in the answers to the twelve Questions. For example, Questions 13, 14 and 16 received scores of 1.49, 1.53 and 1.16 (see Appendix 6). This means that the respondents strongly disagreed that processes were in place to help new product development and process change and mechanisms for choosing innovation projects. There also appeared to be some systemic barriers (structural and cultural) since Question 15 received a score of only 1.05 when respondents were asked if mechanisms existed to ensure the early involvement of all departments in developing new products and services.

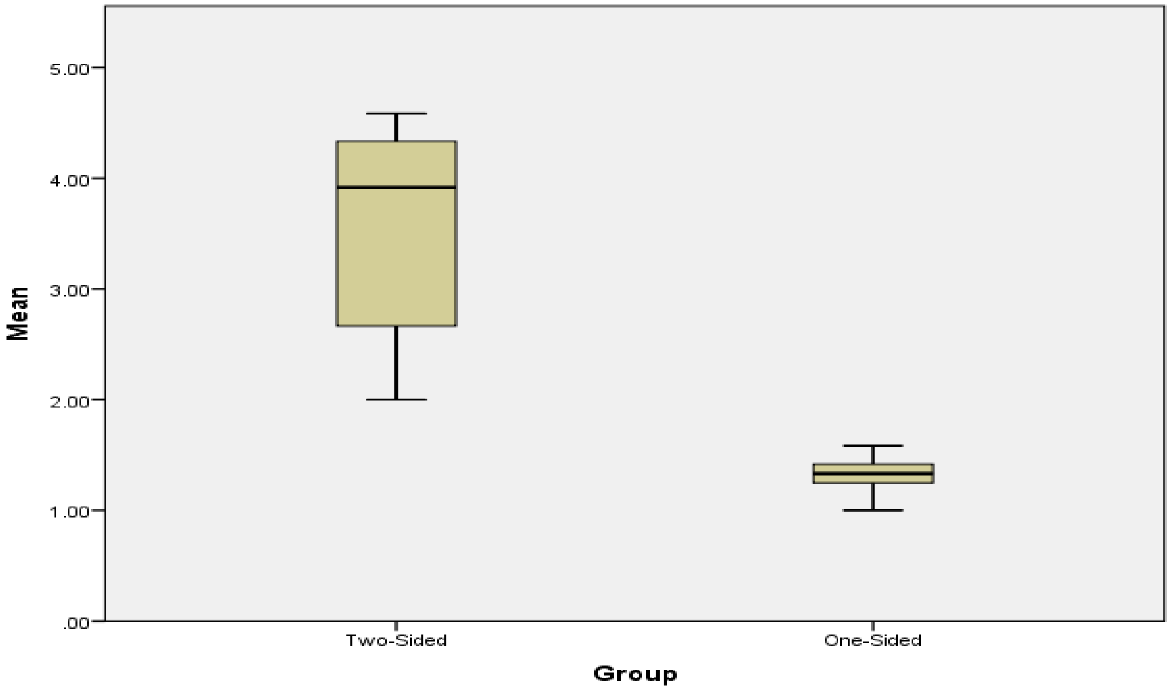

Figure 5.7: Box Plot – The Average Mean Rank for the Two-Sided and One-sided Firms -`Organizational Processes`.

The responses to Questions 17 to 22 reinforce this negative perspective. The respective scores for these six questions were: 1.49, 1.79, 1.79, 1.42 and 1.02 (see Appendix 6). There is no evidence from these responses of any continuous performance improvements reviews (Questions 17 and 22). Existing processes appear to be maintained (at best) rather than improved and developed (Questions 18, 19 and 20). In fact, the responses to Questions 19 and 21 are very significant. For example, Question 19 states that if it isn`t broken leave it alone and Question 21 asks if the organisation is at the leading edge of technology in its industry. This could be linked to a lack of investment in information technology systems by the sample companies (i.e. the high street banks, traditional manufacturing companies and retail shopping chains). These companies IT systems (legacy systems) are unable to capture, process and analyse unstructured (semi-structured) data from the Internet. These technologies are therefore seen as a cost overhead or liability and not as a potential source of competitive advantage.

Finally, the respondents also strongly disagreed with Questions 23 and 24. When asked if the time-to-market of new products was short compared to competitors or whether the organization was constantly developing new products/services, the mean rankings were 1.19 and 1.02 respectively (see Appendix 6). This is in stark contrast to the two-sided firms and industry ecosystem companies who are actively involved in `growth-hacking` (Ellis and Brown: 2017) and `time pacing` (Brown and Eisenhardt: 1998).

`Growth hacking` (Ellis: 2010) is a process of rapid experimentation across marketing channels and product development to identify the most effective, efficient ways to grow a business. Growth hackers, use their knowledge of product and distribution to find innovative, technology-based avenues for growth. This approach is a form of logical incrementalism (Quinn: 1980) executed at high speed by technology start-up companies. Airbnb and Uber are good examples of companies that have embodied growth hacking.

Time-Pacing strategy (Brown and Eisenhardt: 1998a) refers to creating/developing new products/services and entering new markets according to the calendar or at set times irrespective of competitor strategies and the overall external environment. The purpose of this approach is to create a `moving target` that is difficult to replicate. Moore`s Law (Moore: 1965) and the doubling of computing power every two years is an example of how Intel used time pacing. However, the one-sided firms appear to be pursuing event pacing strategies (Gersick: 1994) where change only happens in response to events such as competitor moves, shifts in technology, poor financial performance or new customer demands. Event pacing is about creating a new product or entering a new market only in response to a move by a competitor or by making an acquisition because an attractive target becomes available. It is therefore a highly reactive strategy that is only suitable for stable markets.

The third category in the innovation audit is **`Organizational Structure`** (Questions 25 – 36). The average mean rank score (Table 5.5) for the two-sided firms for this category was 3.27 and 1.13 for the one-sided firms. This is easily the lowest average mean rank score for all the six categories of the innovation audit by a very clear margin.

This is illustrated in the scatter plot below (Figure 5.8) where the one-sided firms are at the lowest position in the overall Likert scale with organizational structure having an average standard deviation of 0.25 and a variance of just 0.09 which is also the lowest variance for all six categories (Table 5.6). The first five questions in the organizational structure component of the innovation audit relate to the ability of the organisation to share data, information, ideas and knowledge. The responses to these questions indicate that this was not a strong characteristic of the one-sided firms featured in the sample with average man rankings of 1.0, 1.02. 1.37, 2.0 and 1.0 respectively (see Appendix 6). If innovation is to flourish within an organisation there has to be a free flow of data, information and knowledge (Rowley: 2007) which is not possible if there are structural barriers such as bureaucratic hierarchy with multiple levels and high functional specialisation.

In Chapter 2 of the dissertation, Choudary (2015) stated the need for traditional businesses to enable data porosity and integration which isn`t possible if systemic barriers such as hierarchy and functional silos exist. The one-sided firms therefore did not appear to have organizational structures that were flexible and facilitated innovation (Question 25). Meanwhile, communication was not multi-directional – top-down, bottom-up and across the organization (Question 29). The scores also indicated that there was an absence of communication across departmental boundaries (Question 26) which may also have influenced the failure to encourage ideas for product and process improvements (Question 27) and the lack of rapid decision making (Question 28).

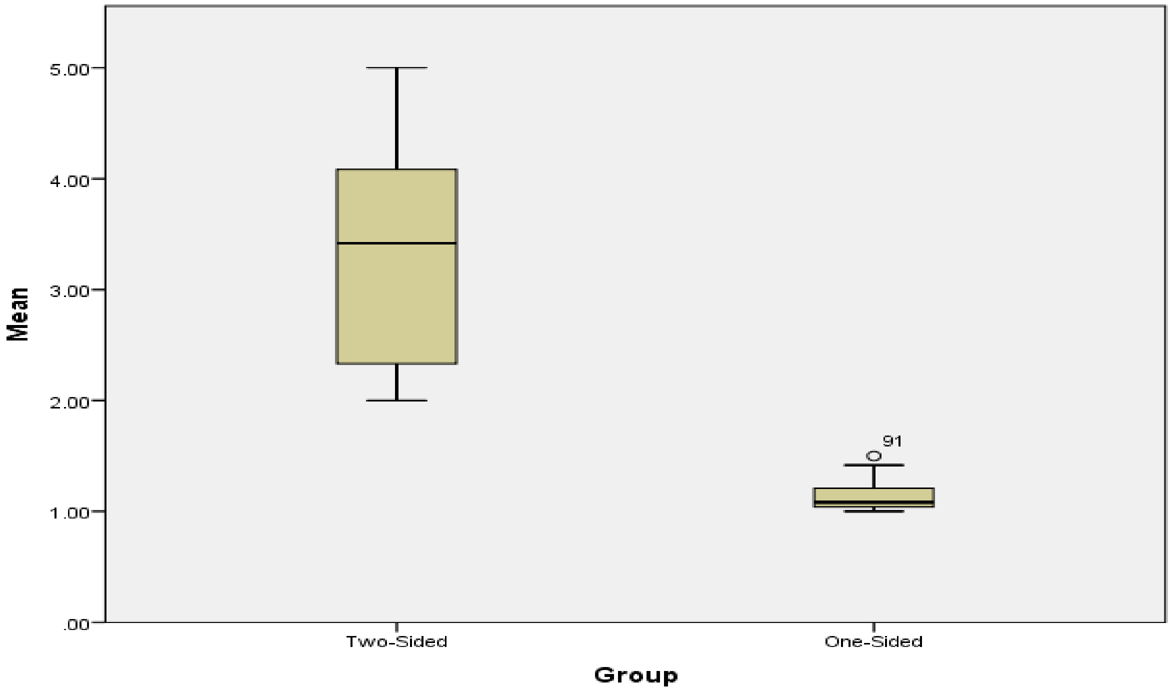

Figure 5.8: Box Plot – The Average Mean Rank for the Two-Sided and One-sided Firms -`Organizational Structure`.

One way of overcoming these systemic barriers to the flow of data, information and knowledge is to adopt a project team based structure which Mintzberg and Waters (1985) referred to as an adhocracy. However, based on the responses to Questions 32 to 35, this does not appear to have happened. The mean rankings for each of the five questions were 1.35, 1.02, 1.19 and 1.09 respectively (see Appendix 6). The employees did not work well in teams (Question 32), the teams did not have space and autonomy for idea generation (Question 33), there was an absence of diverse heterogeneous teams (Question 34) and there was no evidence to suggest that there was an appropriate use of teams to solve problems (Question 35). These team-based structures are an integral feature of the two-sided firms and industry platform companies. The two-sided firms also provide reward and recognition systems to support innovation (Question 30) and ensure there is a supportive climate for new ideas (Question 31). Meanwhile, 3M and Google offer 15% and 20% time to employees to work on their own projects. There are also key individuals who energize and facilitate innovation (Question 36) in the two sided firms. These characteristics do not exist if we compare the scores for the one-sided firms with the two sided firms for each of the questions. For example, in Question 30, the one-sided firms mean ranking was 1.21 compared to 3.21 for the two-sided/platform industry firms. In Question 31, the score was 1.05 compared to 3.26 for the two-sided/platform industry firms and in Question 36 it was 1.33 compared to 3.19 (see Appendix 6). It would therefore appear that the structures of the one-sided firms were still very mechanistic rather than organic (Burns and Stalker: 1966) making the transition towards digitization and an acceptable level of `data porosity` (Choudary: 2015) extremely difficult.

The fourth category in the innovation audit is **`Organizational Culture`** (Questions 37 – 48). The average mean rank score (Table 5.5) for the two-sided firms for this category was 3.52 and 1.47 for the one-sided firms. This is the highest average mean rank score for all six categories of the innovation audit for the one-sided firms but still well below that achieved by the two-sided companies.

This is illustrated in the box plot below (Figure 5.9) where the one-sided firms are at the lowest position in the overall Likert scale with organizational structure having an average standard deviation of 0.29 and a variance of 0.11 (Table 5.6).

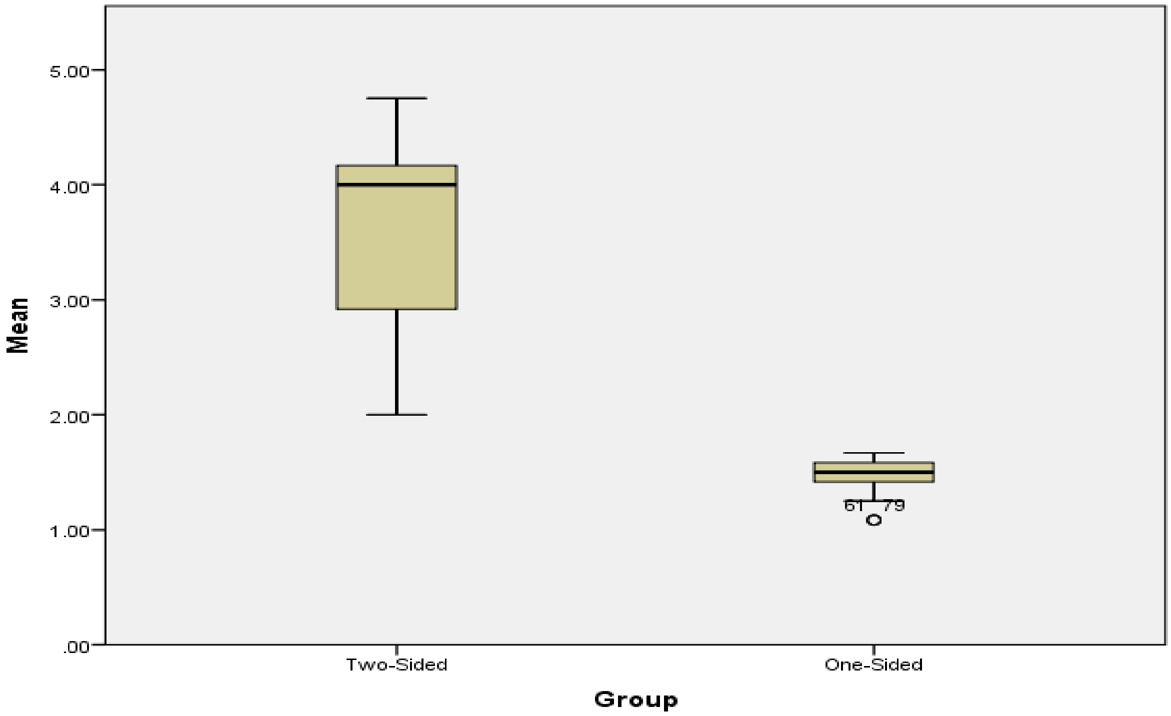

Figure 5.9: Box Plot – The Average Mean Rank for the Two-Sided and One-sided Firms -`Organizational Culture`.

The first three questions in the `organizational culture` component of the innovation audit (Questions 37, 38 and 39) refer to external collaboration between the one-sided firms and external networks and stakeholders. This is a key strength of the high innovation two-sided firms whose resources and capabilities are largely sourced from external ecosystems (Moore: 1993; 1996). However, judging from the responses, the one-sided firms did not appear to collaborate with other firms to develop new products (Question 37) with a mean rank: 1.6. There also appeared to be a largely internal focus since developing external networks to provide specialist knowledge (Question 38) received a response of 1.79. These two scores are nevertheless relatively high compared to other category responses for the one-sided firms. However, the one-sided firms did not appear to be undertaking any open-source innovation (which is a strong feature of modern platform companies) since the score for working closely with `lead-users` to develop new products and services (Question 39) was only 1.02. In Chapter 2 of the dissertation, Choudary (2015) stresses the need for traditional companies to leverage implicit data-driven network effects, to build explicit communities and to enable explicit exchange with the community members. This is something that the two-sided firms excel at but not the one-sided firms due, in part, to the process and structural issues discussed earlier.

The responses to Questions 44 to 48 also imply the existence of high power distance (Hofstede: 1980; 1984) within the one-sided firms that is likely to prevent the effective sharing of data, information and knowledge that is essential to innovation. The mean rankings for each question were: 1.0, 1.65, 1.0, 1.14 and 1.07 respectively (see Appendix 6). For example, the responsibility for screening decisions not lying to high in the organisation received a highly negative response (Question 48). Moreover, senior management didn`t appear to set innovation targets that were known to employees (Question 46) and there was no evidence of any system for screening end evaluating ideas in the organization (Question 47). Similar to Question 48, a low response score was received regarding the deployment of innovation strategies to the employee level (Question 44) and staff were not apparently able to approach top management with ideas to get a fair hearing (Question 45), which further amplifies the high power distance.

Some of the highest scores for the one-sided firms in the `organizational culture` component of the innovation audit were to be found in the responses to Questions 40 to 43. HR policies to support a culture of innovation (Question 40) received a mean rank score of 1.79. The resourcing of innovation skills through recruitment and training (Question 41) scored 1.88 whereas career structures to support innovation through people development (Question 42) also scored 1.88. Finally, employee appraisals to reward innovation (Question 43) scored 1.84. However, although these responses are comparatively higher for the one-sided firms than other questions within the innovation audit and the organizational culture category, they are still very low at position 1 in the Likert scale (strongly disagree) and significantly lower than the two-sided firms (see Appendix 6).

The fifth category in the innovation audit is **`Organizational Learning`** (Questions 49 – 60). The average mean rank score (Table 5.5) for the two-sided firms for this category was 3.58 and 1.39 for the one-sided firms. This is the second highest average mean rank score for all six categories of the innovation audit for both the two-sided and the one-sided firms.

This is illustrated in the scatter plot below (Figure 5.10) where the one-sided firms have an average standard deviation of 0.29 and a variance of 0.10 (Table 5.6).

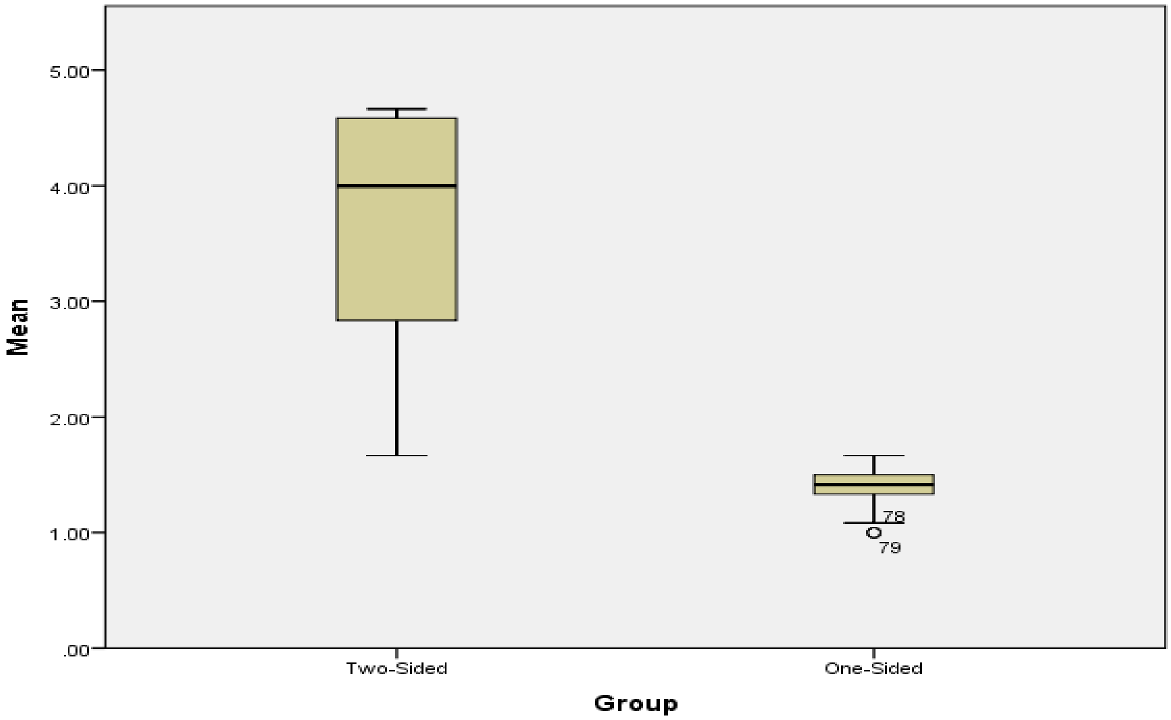

Figure 5.10: Box Plot – The Average Mean Rank for the Two-Sided and One-sided Firms -`Organizational Learning`.

The organizational learning capabilities of the one-sided firms appear to be affected by a tendency to be inwardly focused with an absence of feedback loops and mechanisms such as single-loop and double-loop learning (Argyris: 1991). The failure to develop feedback mechanisms that are vital for learning and innovation are highlighted in the responses to Questions 51, 52, 55, 57, 59 and 60. The mean rankings for these questions were: 1.42, 1.84, 1.02, 1.12, 1.02 and 1.0 respectively (see Appendix 6). The one-sided firms did not seem good at reviewing projects to improve performance next time around (Question 51) nor were they good at learning from their mistakes (Question 52). Moreover, the one-sided firms were not good at capturing what they had learned so that their employees could put the knowledge to practical use (Question 55) as well as there being an absence of knowledge capture reinforced by the communication and learning from experience (Question 60). These drawbacks are reinforced by the apparent lack of measurement for improving innovation management (Question 57) and the absence of proactive experimentation to generate new feedback and knowledge.

It is in these areas of the innovation audit where the two-sided firms are comparatively strong with median rankings in excess of 4 as illustrated in the box plot in Figure 5.10. As discussed in Chapter 3, unlike the one-sided firms the two-sided companies have core competencies (Prahalad and Hamel: 1990) in Big Data and `Datafication` (Figure 3.0) which enables them to capture vast amounts of data and to perform predictive and prescriptive analytics in real time thereby providing instant feedback (Sharda *et al.,* 2014). Alternatively, the one-sided firms are limited to descriptive and diagnostic analytics (Figure 3.3 Chapter 3).

Although competitive benchmarking isn`t considered to be a high innovation methodology it does provide an important foundation for learning and feedback. However, Questions 49, 53, 54 and 56 also receive low response scores with mean rankings of 1.81, 1.86, 1.09 and 1.67 respectively (see Appendix 6). The one-sided firms do not appear to systematically compare products and processes with other firms (Question 53), nor do they meet and share experiences with other firms to facilitate learning (Question 54). There also appears to be a need to enhance customer end/user engagement (Question 49). Lastly, they do not seem to be good at learning from other organizations (Question 56). Customer engagement (Question 49) and understanding customer needs is something that the two-sided Internet firms excel at with many of their customers also creating content i.e. prosumers (Kotler: 1986).

The ability to learn also appears to be negatively influenced by elements of structure and culture. For example, in Question 58, the one sided firms did not have appropriate organisational designs to enable creativity, learning and interaction (with a mean rank of 1.02). This implies the existence of functional silos and a lack of `data porosity` (Choudary: 2015). Finally, the lack of a continuing commitment to the training and development of people in Question 50 (with a mean rank of 1.8) was not a reflection of the overall HR training policies but only those relating to innovation.

The sixth and final category in the innovation audit is **<u>`Organizational Idea Generation`</u>** (Questions 61 – 72). The average mean rank score (Table 5.5) for the two-sided firms for this category was 3.65 and 1.33 for the one-sided firms. This was the second highest average mean rank score for all six categories of the innovation audit for the two-sided firms.

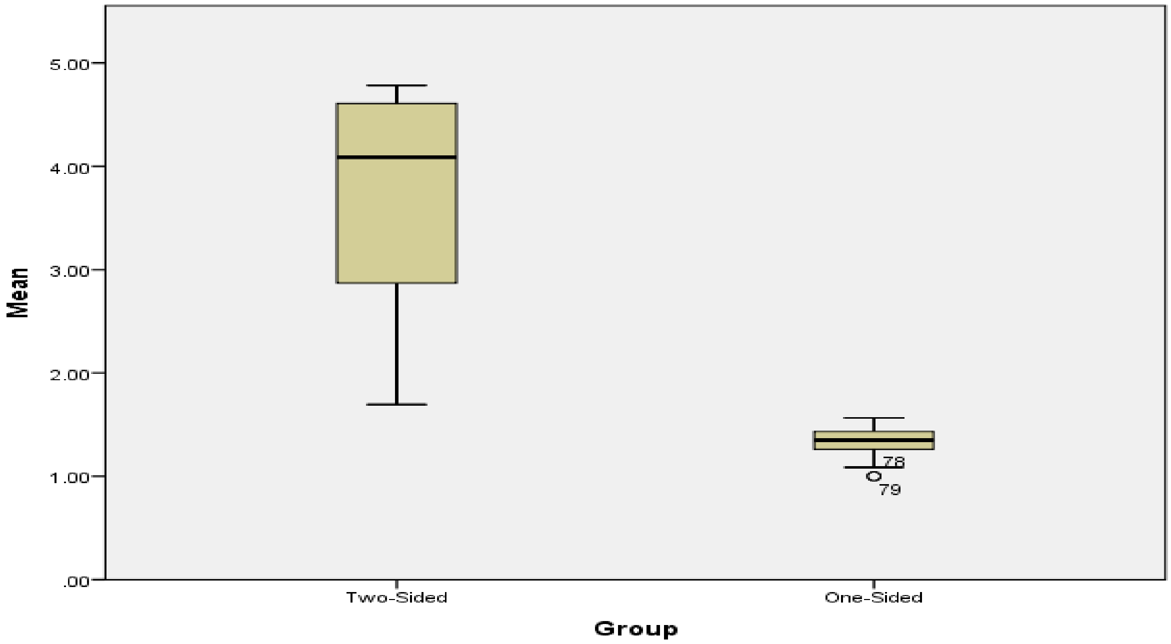

Figure 5.11: Box Plot – The Average Mean Rank for the Two-Sided and One-sided Firms -`Organizational Idea Generation`.

This is illustrated in the box plot (Figure 5.11) above where the one-sided firms had an average standard deviation of 0.36 and a variance of 0.15. These were the highest average scores for all six categories of the innovation audit for the one-sided firms (Table 5.6).

This component of the innovation audit focusses primarily on the mechanisms that exist for the internal and external generation of ideas based on eight questions. Questions 61, 62 and 64 were concerned with internal idea generation and the respective mean rankings were: 1.26, 1.35 and 1.02 (see Appendix 6). The respondents did not appear to believe that the one-sided firms systematically searched for new product service ideas (Question 61), nor that creative ideas were collected from all employees on a regular basis (Question 62). They also strongly disagreed that ideas originated form all departments (Question 64).

From an external perspective, idea generation was also considered to be low. This is reflected in the responses to Questions 63 and Questions 65 to 68. The mean rankings for these questions were: 1.0, 1.72, 1.72, 1.77 and 1.21 respectively (see Appendix 6). When benchmarking their firms against external players in the marketplace the respondents did not believe that the number of new product, service and process ideas were comparable to the best in class (Question 63) although this was not easy to evaluate because of its intangibility. There was also an absence of consistent scanning of customer surveys and market trend analysis (Question 65). This doesn`t mean it wasn`t undertaken but consistency was the key word in this instance. It also appears that sourcing ideas externally from suppliers and customers was not as thorough as it should have been (Question 66). Formal internal and external networking was also lacking (Questions 67 and 68).

As discussed in section 3.3 of Chapter 3, the two-sided firms were configured on the basis of value networks (Peppard and Rylander: 2006) not value chains which were far more efficient and effective in transmitting data and information than the linear value chains (Porter: 1985) which formed the basis of the one-sided firms. The ability of the Internet firms to crowd source ideas and perform live beta testing of products and to receive near real-time feedback was also a unique strength. This is reflected in the high median score (plus 4 in the Likert scale) for the two-sided firms in the box plot in Figure 5.11.

The value networks are therefore better at processing ideas than linear value chains and this is reflected in the responses to Questions 69, 70 and 71. These questions received mean rankings of: 1.51, 1.16 and 1.14 (see Appendix 6). Due to their linearity, people in the one-sided businesses did not have appropriate outlets for their ideas (Question 69). They were not able to develop their ideas into new products (Question 70) and there was an absence of creativity techniques and workshops that were commonplace in two-sided firms such as Google (Question 71). Finally, the respondents strongly disagreed that there was a positive approach to creative ideas with relevant motivation systems but that a fear of change and insecurity was a more realistic assumption.

5.6 Two-Sided Firms and Industry Platform Firms – An Overview

Chapter 5 has so far focused on testing the differences between the two-sided and one sided firms using the innovation audit questionnaire. This has revealed a consistently wide range of responses between the two groups with a large differential in the median and mean rankings for the two-sided firms compared to the one-sided companies.

However, further analysis of the data also revealed a differential relating to the median and mean innovation audit scores between what Gawer (2009) defined in her typology of platforms in Chapter 2 (Table 2.0) as the industry platform firms and the two-sided firms. When Gawer produced her typology in 2009, she said that the industry platforms were industry ecosystems where several firms or organisations functioned together as part of a technological system. The role of the platform owners of these industry ecosystems was to stimulate and capture value from external complementary innovation. Meanwhile, the role of complementors was to benefit from the installed base of the platform and from direct and indirect network effects and complementary innovation.

When defining two-sided firms, Gawer (2009) referred to these as multi-sided or double-sided markets or platforms. According to Gawer, these consisted of several firms or groups of firms who transacted with each other through the intermediary of a double-sided or multi-sided market. The role of these firms was to facilitate the transactions between different sides of the platform or market. However, at the time of writing, Gawer (2009: 58) questioned the extent to which the two-sided/multi-sided platforms were truly innovative compared to the industry platform (ecosystems).

Both of Gawer`s typologies have important commonalities. The two-sided (multi-sided) firms and the industry platform firms are both two-sided and have rich external ecosystems. They also both qualify as platforms since they co-evolve value through their ecosystems (Moore: 1993; 1996). Since 2009, the two-sided firms appear to have evolved from being purely transactional platforms to becoming disrupters of traditional industries through business model innovation. Amazon, Google, Facebook, Alibaba, Tencent, Netflix and the new Unicorn firms such as Uber, Airbnb and Spotify, are now transforming how products and services are delivered by redefining how value is created through business model innovation.

Meanwhile, some of the former industry platform companies that were instrumental in creating the PC infrastructure such as Apple and Microsoft have also reinvented themselves by migrating their platforms on to the Internet through the development of mobile computing and cloud technologies. These companies have become known as the high growth `superstar` technology firms (Rotman: 2017: *Financial Times:* 2017).

However, the industry platform firms responsible for the building of the Internet infrastructure (the systems, hardware and semi-conductor firms), including Intel, Cisco, Oracle, EMC/Dell, IBM and Hewlett Packard etc., have all declined in value. According to a survey conducted by the US private equity firm Francisco Partners, in the *Financial Times* (2015c: 13) entitled `The fall and rise of the technology juggernauts`: `*the fifteen technology companies with the largest market capitalisation in 2000 (before the dot-com crash) had by 2015 lost approximately $1.35 trillion dollars or 60% of their combined market value`.*

The article also revealed that the sharpest declines in value had been between the systems, hardware and semi-conductor firms. This was because of the continuing decline in the cost of computing, the rise of open-source software, the switch to the "cloud" and the move to huge data centres where companies such as Amazon, Google and Facebook were developing new business models. The survey and article also went on to say that `*the fifteen companies that had a combined value of less than $10 billion dollars in 2000 were now among the world`s top 50 technology companies as measured by market capitalization*` (*Financial Times:* 2015c: 13).

This data suggests that the fortunes and development of the two-sided firms and the industry platform companies have been inverted since Gawer published her article in 2009. The chapter will, therefore, analyze the extent to which there has been a reversal in the level of innovation between the data intensive, Internet-based, two-sided firms and the less data intensive industry platform firms using the innovation audit responses. The original sample of 57 two-sided technology companies is sub-divided into 29 Internet-based, two-sided firms and 28 industry platform (ecosystem) firms. The sample of 29 two-sided firms includes the world`s largest Internet companies as well as a range of Unicorns that are disrupting finance (Fintech), transportation (Uber), accommodation (Airbnb), media (Spotify) and food (Deliveroo) etc. The sample of 28 industry platform companies includes established technology firms such as IBM, Hewlett Packard, EMC/Dell, Intel and Sony etc. (see Appendix 15).

5.7 Two-Sided Firms and Industry Platform Firms – An In-Depth Analysis

The chapter will now analyze the differences between the two-sided Internet-based firms and the industry platform companies to establish the extent to which the increased data intensity of being Internet-based translates into a higher capacity for innovation. The chapter will analyze each of the six categories of the innovation audit using a Mann Whitney *U* test, a cluster analysis with scatter plots, box plots and data from the innovation audit.

A full Mann-Whitney *U* test was undertaken to test the differences between the two groups of companies. The full results can be found in Appendix 14. These are broken down into the six innovation audit categories consisting of: organizational strategy, organizational processes, organizational structure, organizational learning and organizational idea generation. The average mean rank scores for the two sided firms and the industry platform companies have been summarized in Table 5.7 (see below). This shows a marked difference between the two types of companies with the two-sided firms averaging significantly higher scores in all six categories of the innovation audit as evidenced by the total mean average score of 40.36 compared with 17.21 for the industry platform companies.

Mann-Whitney U Test			
	Innovation Audit Category	Average Mean Rank - Two-Sided Firms	Average Mean Rank - Industry Platform Firms
1	Organizational Strategy	38.61	19.04
2	Organizational Processes	39.81	17.75
3	Organizational Structure	40.85	16.72
4	Organizational Culture	40.89	16.67
5	Organizational Learning	41.21	16.35
6	Organizational Idea Generation	40.79	16.78
Total Mean Average Scores		40.36	17.21

Table 5.7: Mann-Whitney *U* Test: The Average Mean Rank Scores for the Two-Sided and Industry Platform Firms (based on the six categories of the innovation audit).

However, before analysing the six individual components of the innovation audit, the chapter will start by evaluating the full audit results for the two groups based on all 72 questions combined using a cluster analysis/scatter plot and a box plot diagram as illustrated in Figures 5.12 and 5.13 below.

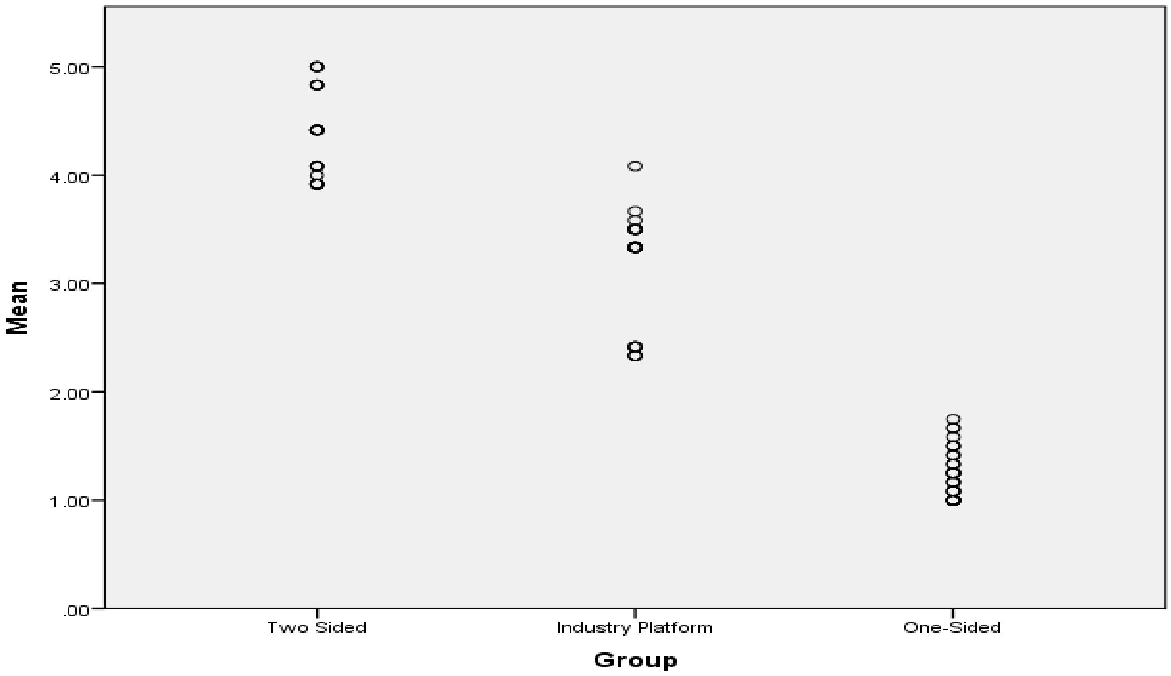

Figure 5.12: Scatter Plot – Innovation Audit Questionnaire – Questions 1 – 72 (Two-Sided & Industry Platform Companies).

Looking at the cluster analysis/scatter plot and the box plot it is easy to visualise the differences in the overall innovation audit scores achieved by the two-sided Internet firms compared to both the industry platform and the one-sided companies. The two-sided firms are firmly located in positions 4 to 5 in the Likert scale (agree/strongly agree that the firm is innovative) with a median score of just under 4.5.

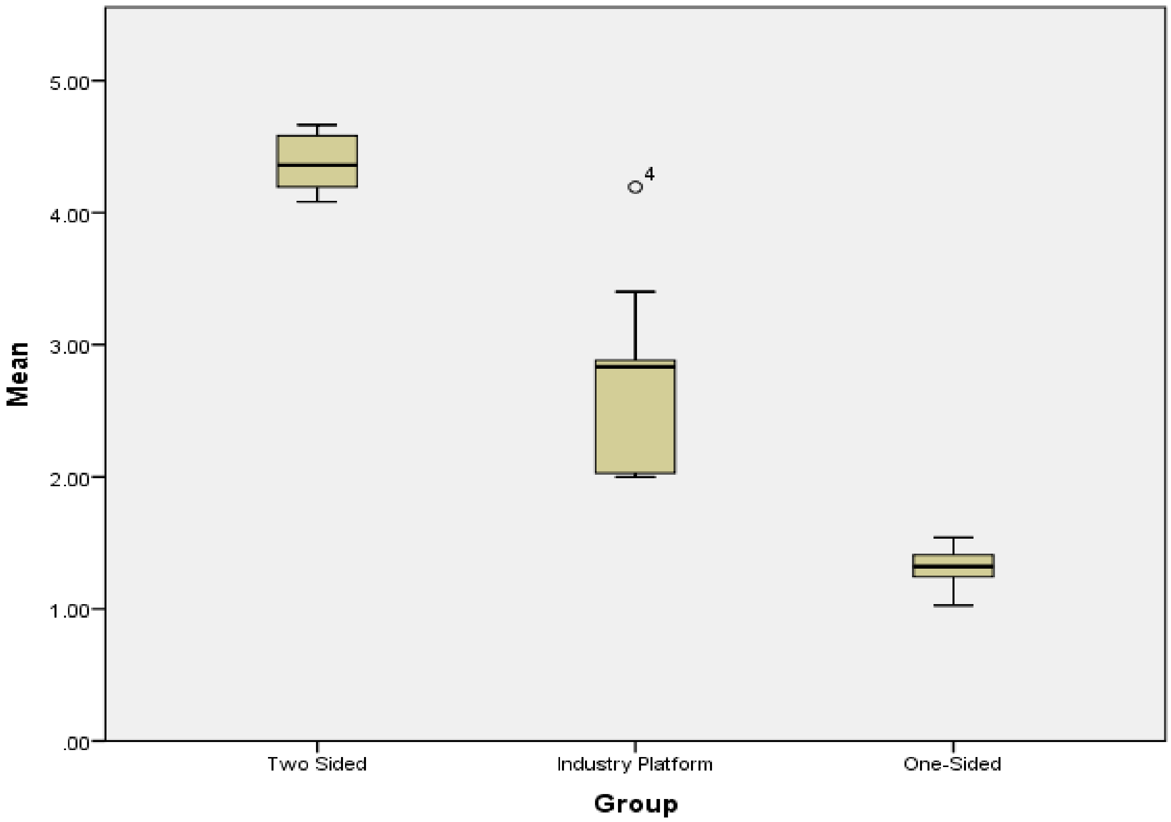

Figure 5.13: Box Plot – The Average Mean Rank for the Two-Sided and Industry Platform Firms (for all six categories of the innovation audit).

Meanwhile, the industry platform firms have a much wider spread and are firmly located in positions 2 to 3 in the Likert scale with a median score of just under 3 (partially agree that the firm is innovative). Some of the reasons for the wider range of responses by the industry platform respondents were discussed at the end of Section 5.3 above where it was suggested that core rigidities (Leonard-Barton: 1992) may have emerged whereby the environmental fit achieved by these established technology companies may have resulted in systemic barriers to innovation such as bureaucratic processes and rigid hierarchical structures and outmoded paradigms and dominant logics (Burns: 2013). This may also have stymied new forms of organizational learning and idea generation. These issues will now be considered in more detail as the chapter analyses each one of the six innovation audit categories in more depth starting with organizational strategy (Questions 1 – 12).

The two-sided firms demonstrate a strong capacity for innovation in the **`Organizational Strategy`** component of the innovation audit with a range of responses ranging from positions 4 to 5 and a median ranking of just under 4.5 (Figure 5.14 and Figure 5.15) similar to their median rank for the overall innovation audit. Compared to their overall audit ranking, the industry platform firms also received a wide range of responses from positions 2 to 4 on the Likert scale. Organizational strategy was also the industry platform firms` highest average mean rank of all six innovation audit categories in the Mann-Whitney *U* test at 19.04 (Table 5.7) as well as its highest median rank as featured in the box plot with a score in excess of 3.5 (Figure 5.15).

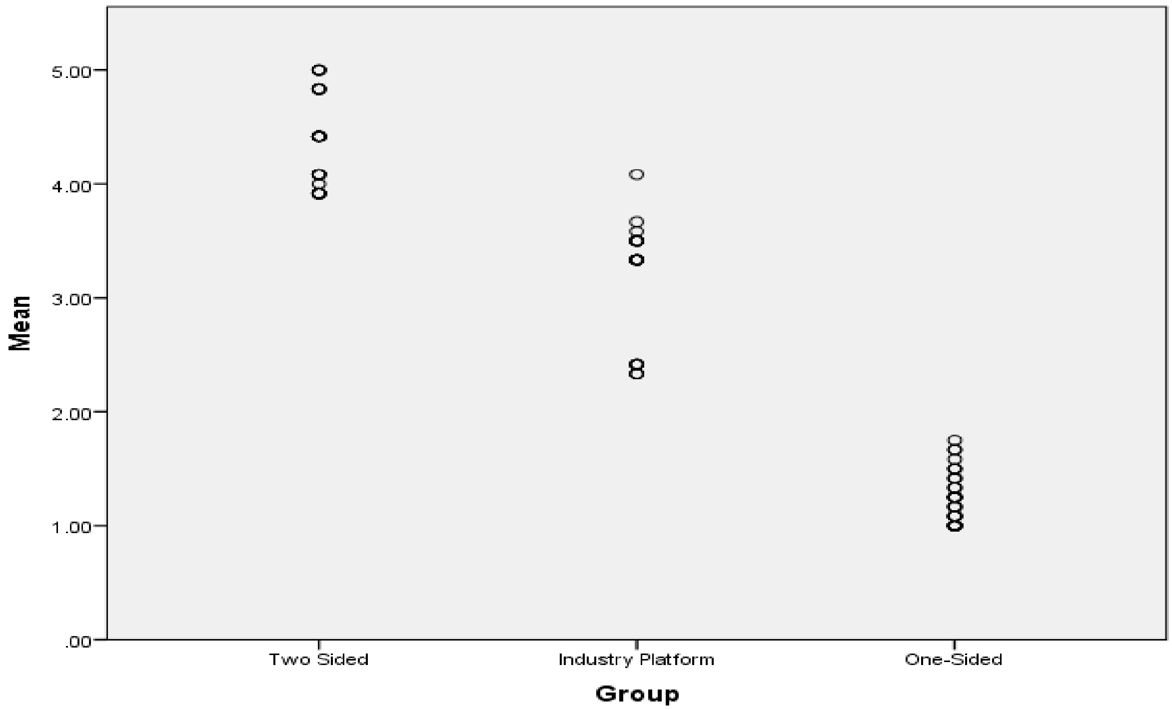

Figure 5.14: Scatter Plot – Organizational Strategy: Questions 1 – 12 (Two-Sided & Industry Platform Companies).

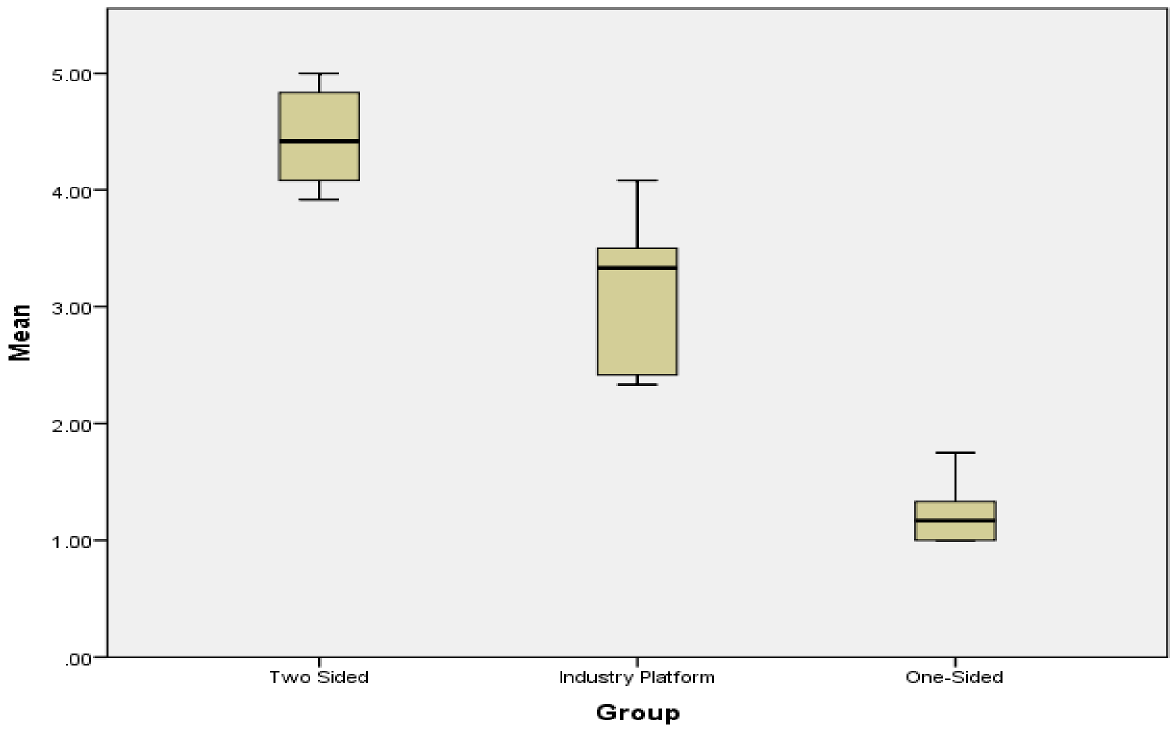

Figure 5.15: Box Plot – Organizational Strategy: Questions 1 – 12 (Two-Sided & Industry Platform Companies).

The two-sided firms scored highly compared to the industry platform firms in their responses to Questions 10 to 12. The two-sided firms` revenues and market share from products/services introduced in the last three years (Question 10 and Question 11) had been very high as well as there being an increase in the number of products/services in their portfolios (Question 12). As discussed in section 5.6 above, the financial performance of the Internet firms has increased exponentially over recent years whereas the performance of the industry platforms has been declining (*Financial Times:* 2015; 2017). The top five US Internet companies are currently worth US $2.95 trillion whilst `Unicorn` companies (or `Decacorns` worth more than 10 Billion) such as Uber and Airbnb have valuations of 60 billion and 31 billion US dollars respectively.

These firms also have high market share and broadening product/service portfolios compared to the industry platform firms. Google and Facebook dominate search and social media and digital advertising, Amazon is the leader in online retail and e-books in the USA and Alibaba controls 80% of the e-commerce market in China whilst Uber and Airbnb are the market leaders in their respective sectors. The two-sided firms are also broadening their product/service portfolios using growth-hacking (Ellis and Brown: 2017) and time pacing (Brown and Eisenhardt: 1998a) rather than event pacing (Gersick: 1994) strategies mentioned earlier. Alibaba and Amazon sell as many as 500 million products each through their Internet platforms and are moving into financial services and groceries. Uber is expanding into food delivery and autonomous cars and Airbnb is extending into the travel and tourism sector whilst all the large Internet firms are developing artificial intelligence (AI) technologies resulting in multiple product spin-offs etc.

Questions 3 and 8 also received higher scores from the respondents of the industry platform firms who appeared to use forecasting tools to plan for future threats and opportunities (Question 8) including scenario planning as well as using performance measures and goals for products, services and processes (Question 3). Meanwhile, the Internet based two-sided firms` constantly monitored user and revenue growth figures as a means of measuring the outcomes of their innovation based on the ability to scale their businesses.

The extent to which the two-sided firms have a policy for sourcing technologies (Question 1) and know and monitor competitors innovation rates (Question 2) is evidenced by the high level of mergers and acquisitions (M&A) activity with the leading Internet firms acquiring high growth start-ups on a regular basis. Facebooks acquisition of Instagram and WhatsApp and Apple`s takeover of Beats were responses to threats to their business models from high growth social networking apps and rival streaming service technologies (i.e. Spotify) respectively. This is sometimes referred to as external corporate venturing (Burns: 2013; Tidd and Bessant: 2013). Further evidence is provided of internal corporate venturing from the positive responses to Questions 4 to 7 and Question 9. Internal corporate venturing exists when there is an internal market and an innovation-friendly mind-set that encourages risk-taking (Question 4), the promotion of formalized innovation programmes (Questions 5 and 6) all of which are supported by top management (Question 7) through a shared vision (Question 9).

The next component of the innovation audit that will be analyzed is **`Organizational Processes`** (Questions 13 – 24).

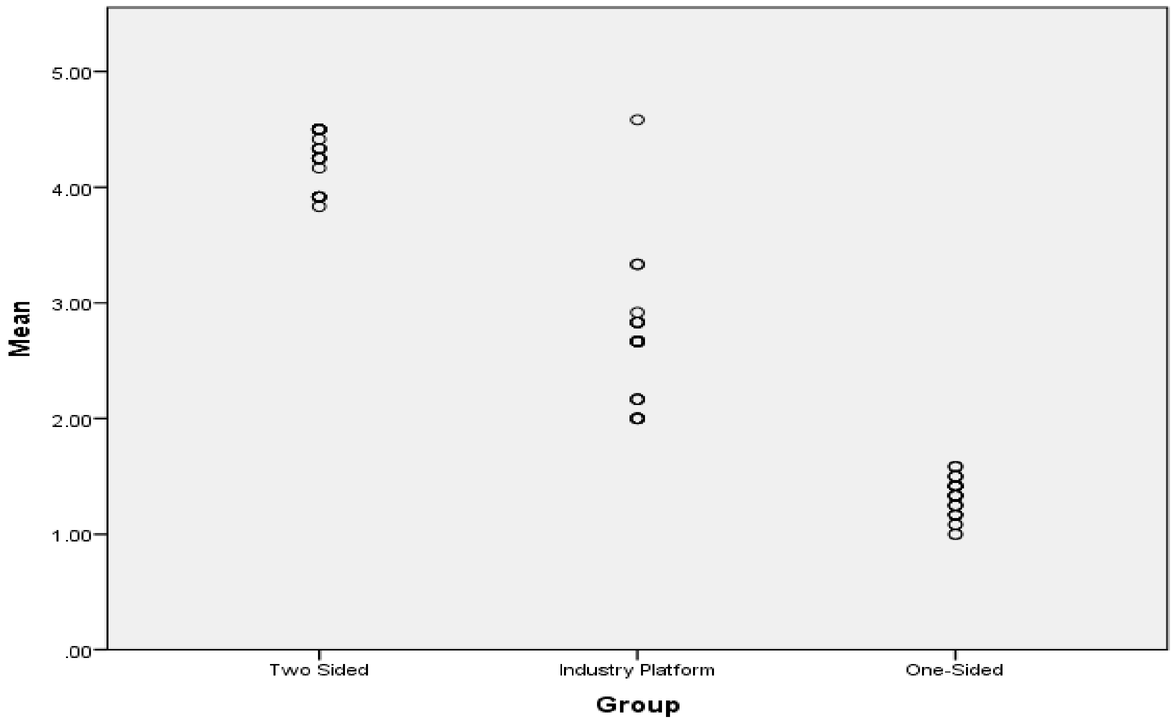

Figure 5.16: Scatter Plot – Organizational Processes: Questions 13 – 24 (Two-Sided & Industry Platform Companies).

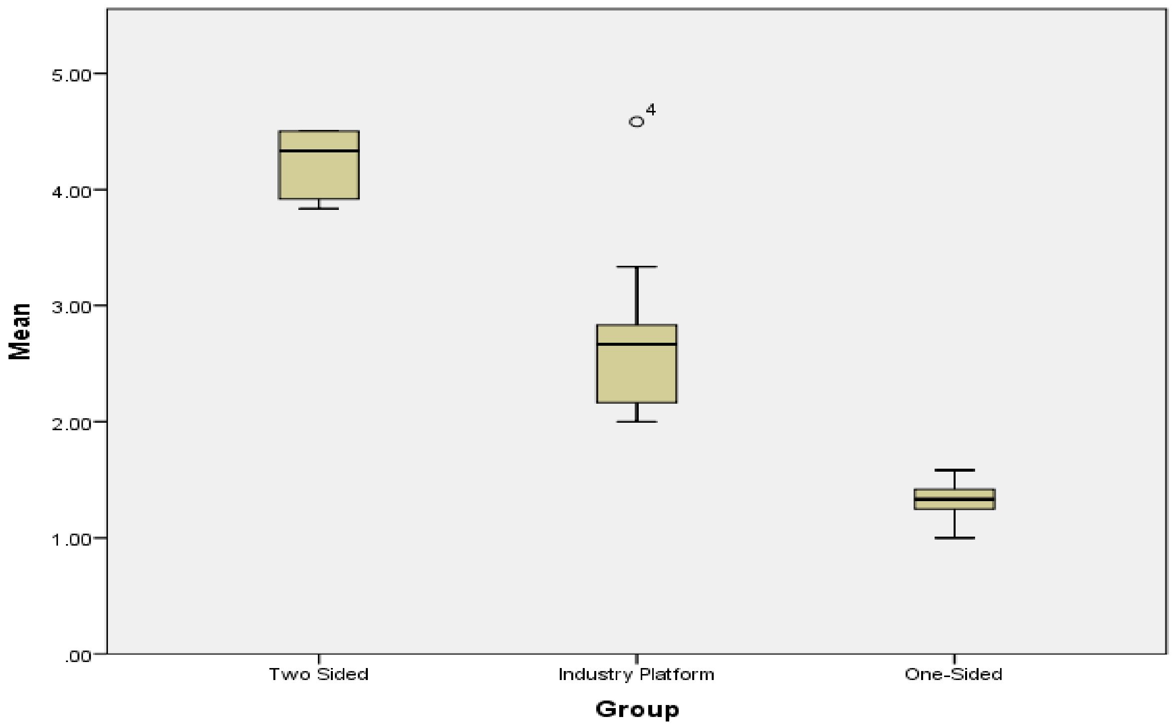

Figure 5.17: Box Plot – Organizational Processes: Questions 13 – 24 (Two-Sided & Industry Platform Companies).

The two-sided firms achieved a median score of just under 4.5 and are well located between positions 4 and 5 on the Likert scale (Figure 5.16). The industry platforms, meanwhile, received a median score of 2.75 and were located in positions 2 and 3 with a set of responses ranging from 2 to 3.5 (Figure 5.17). Question 19 and Question 21 are very significant in this category of the innovation audit. The two-sided firms received high scores in response to being at the leading edge of technology in their industry (Question 21) and not maintaining the status quo (Question 19). This is largely due to the fact that the two-sided firms are pursuing high levels of business model innovation by leveraging the data captured through their platforms. They are also continuously innovating and adapting their own processes and thereby disrupting the industry platform companies and one-sided firms. Artificial intelligence (AI) is currently the latest leading edge technology that the data-rich Internet-based firms are pursuing.

The industry platforms received lower scores in response to these questions because they have struggled to reinvent their organizations in response to new disruption from their two sided competitors. Intel`s failure to develop chip technologies for the mobile smart phone platform, Cisco and IBM were slow to respond to cloud computing and the software defined networks (SDN). Dell`s inability to migrate on to the mobile computing platform and the general commoditization of IT systems, software and hardware are all examples of failures to develop suitable innovation processes. This is reflected in the lower scores for Questions 13 to 18, Question 20 and Questions 22 to 24. These questions were concerned with the existence of appropriate processes for the management of new product development, process change, continuous performance improvement, rapid time-to-market and systems for choosing innovation projects.

The third component of the innovation audit that will be analyzed is **`Organizational Structure`** (Questions 25 – 36). The median score for the two-sided firms was marginally above 4 and just below 2.5 for the industry platform companies (Figure 5.19).

The spread of marks for the two-sided firms is very broad ranging from just below 3.5 to 5 on the Likert scale (Figure 5.18). However, the industry platform companies are firmly entrenched in the middle of position 2. This wide differential between the two groups reflects the problems companies have as they grow in size from being nimble start-ups to becoming large divisional bureaucracies. Mature established firms such as IBM, Hewlett Packard, Intel and Sony have struggled to avoid Larry Greiner`s (1972) `Red Tape` and `Growth Crisis` (Greiner`s Five Stage Growth model).

The two sided firms have been more adept at growing through collaboration, alliances and through networks of organizations (i.e. leveraging their external ecosystems) which Greiner (1998) referred to as the sixth stage of organizational growth. The fact that the two-sided firms are data-rich and data-driven means that they can leverage data-driven network effects more easily, build communities and enable exchanges to take place between ecosystem participants more effectively, which are key features of Choudary`s (2015) `platform stack` framework discussed in Chapter 2.

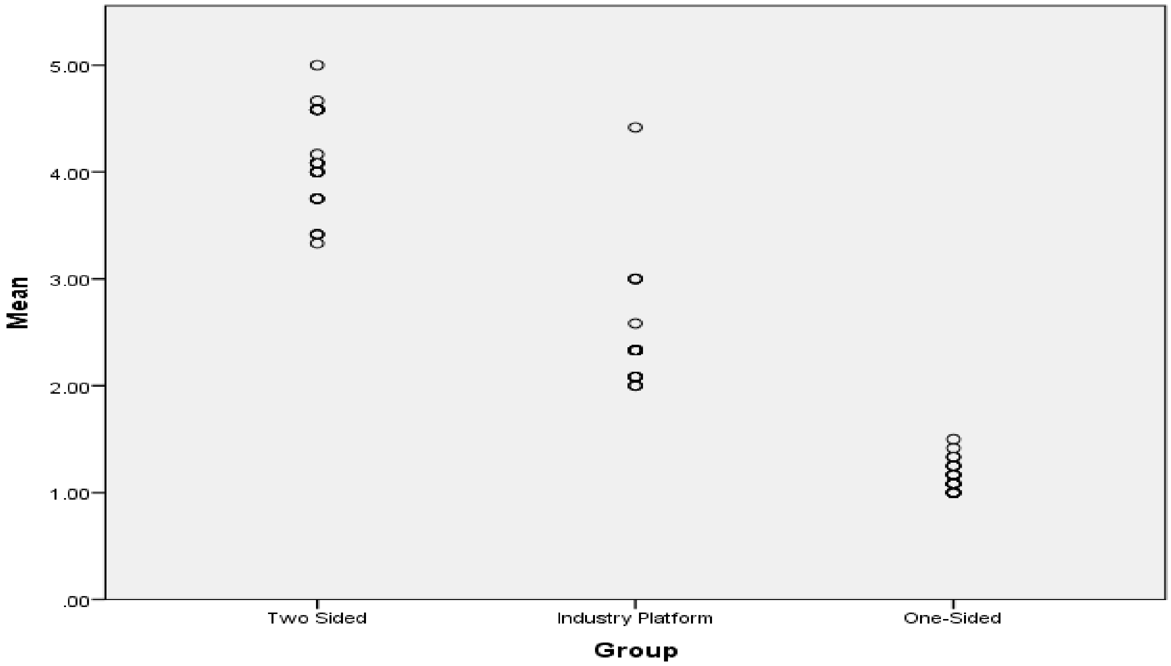

Figure 5.18: Scatter Plot – Organizational Structure: Questions 25 – 36 (Two-Sided & Industry Platform Companies).

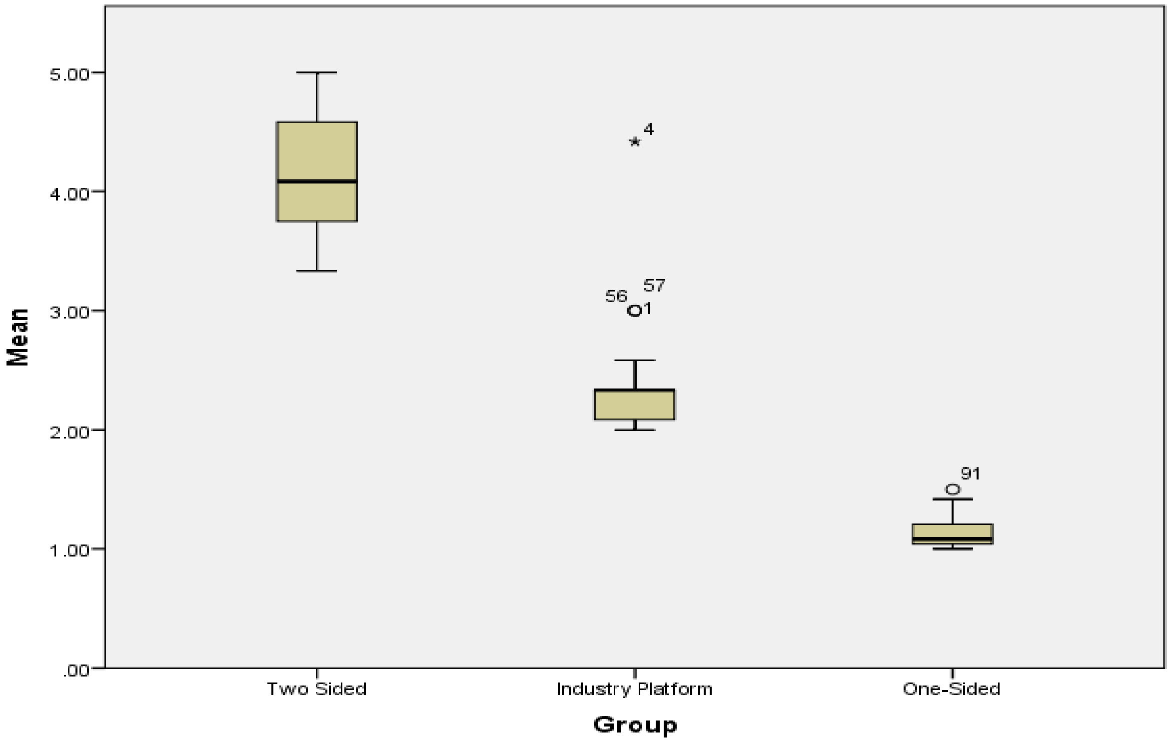

Figure 5.19: Box Plot – Organizational Structure: Questions 25 – 36 (Two-Sided & Industry Platform Companies).

The two-sided platforms therefore received more positive responses to Question 25 which asked if organization structures were flexible to facilitate innovation to happen and whether they facilitated rapid decision making (Question 28). Questions 26 and

29 were also concerned with the extent to which systemic structural barriers were present that prevented cross-departmental communication and interaction. This had obviously become an issue in the larger more mature industry platform companies that had become more bureaucratic.

Questions 32, 34 and 35 applied to both categories of organizations which were heavily project team based. However, systemic barriers to interaction between divisions obviously limited the cross-pollination of ideas in the larger, more mature firms judging from the negative responses provided by the industry platform firms.

Questions 27, 30, 31, 33 and 36 were all concerned with the impact of the structure on the internal innovation environment including: the space and autonomy to suggest improvements and share new ideas (Questions 27 and 33); suitable reward and recognitions systems (Question 30); a supportive climate overall (Question 31) and the existence of key personnel to drive innovation such as promoters, sponsors and champions (Question 36). However, as organizations grow in size and complexity getting ideas heard and accepted becomes increasingly difficult and getting promoters, sponsors and champions on board is more difficult in mature firms with embedded paradigms and dominant logics. This is also reflected in the lower scores for the industry platform companies.

The fourth component of the innovation audit that will be analyzed is **`Organizational Culture`** (Questions 37 – 48). The median score for the two-sided firms was marginally above the position 4 threshold and marginally under 3 (approximately 2.8) for the industry platform companies (Figure 5.21).

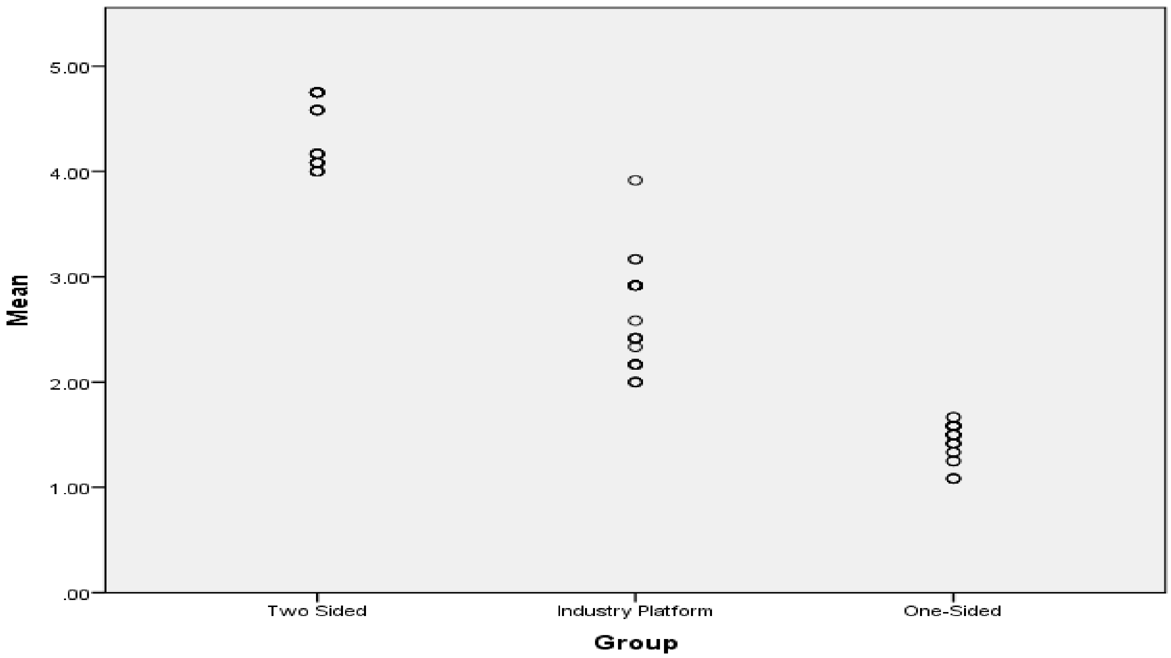

Figure 5.20: Scatter Plot – Organizational Culture: Questions 37 – 48 (Two-Sided & Industry Platform Companies).

The spread of marks for the two-sided firms is relatively narrow compared to the industry platform companies being firmly located between positions 4 and 5 (Figure

5.20). On the other hand, the responses for the industry platform companies are spread over a wide range from positions 2 to 4 with the bulk of the responses being between 2 and 3.

Questions 37 to 39 of the organizational culture component of the innovation audit are concerned with external network collaboration and a culture of open innovation with lead users.

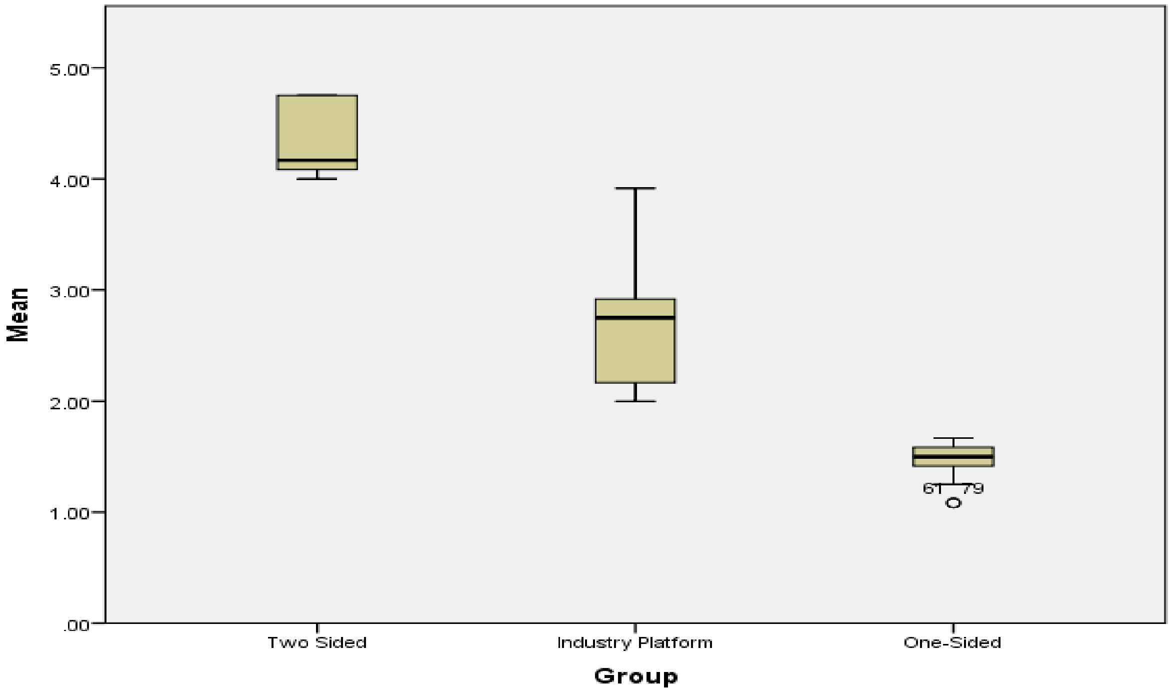

Figure 5.21: Box Plot – Organizational Culture: Questions 37 – 48 (Two-Sided & Industry Platform Companies).

The positive responses from the two-sided firms implies high leveraging of their external ecosystems to develop new products and access specialist expertise. However, the picture relating to the industry platform firms is not so unanimously positive. This implies a less open `not-invented-here` culture where external collaboration and ideas are not considered to be of primary importance to internal beliefs and paradigms. This culture evolves when a firm establishes a successful business model but instead of becoming a keystone (Iansiti and Levien: 2004) in its sector and nurturing its external ecosystem it adopts the strategy of a dominator. Problems occur when the business model is made obsolete by new technologies which happened following the launch of the iPhone which undermined the personal computer platform and Intel and Microsoft`s competitive advantage. IBM`s main frame domination was also usurped by the emergence of the personal computer whilst the Internet and cloud computing are having a similar impact on firms such as Cisco and Hewlett Packard.

In Chapter 3, Peter Senge`s (1990) five disciplines for creating a learning organization were analyzed and his fifth discipline referred to the need for the organization to have excellent knowledge management structures if the firm was to succeed. This would need to allow for the creation, acquisition, dissemination and implementation of knowledge.

Questions 40 to 48 explore the extent to which the two groups of firms have appropriate knowledge management structures by asking questions relating to HR policies to support creative problem solving (Question 40); innovation skills resourced through recruitment and training (Question 41); career structures and employee appraisals to support innovation (Questions 42 and 43); mechanisms for promoting ideas to top management and systems for screening and evaluating ideas (Questions 47 and 48) plus the deployment of innovation strategies to the employee level (Question 44) reducing power distance (Question 45) with clear innovation targets (Question 46).

Meanwhile, the two-sided data-rich companies typically have excellent knowledge management structures due to the nature of the work they perform which is systems and data-based which makes the dissemination of data, information and knowledge easier and more efficient compared to the industry platform firms which are frequently managing hardware products that cannot be digitised and dematerialised.

The fifth component of the innovation audit that will be analyzed is **`Organizational Learning`** (Questions 49 – 60). In this component of the audit questionnaire the two-sided firms recorded their highest average mean rank in the Mann-Whitney *U* test of 41.21. The median score for the two-sided firms was also high, being positioned above the 4.5 threshold (Figure 5.23). The range of responses was also much narrower (Figure 5.22) than in the other components of the innovation audit. Meanwhile, the industry platforms received a median score of approximately 2.8 but the spread of marks was very wide ranging from 1.75 to 3 (Figures 5.21 and 5.22).

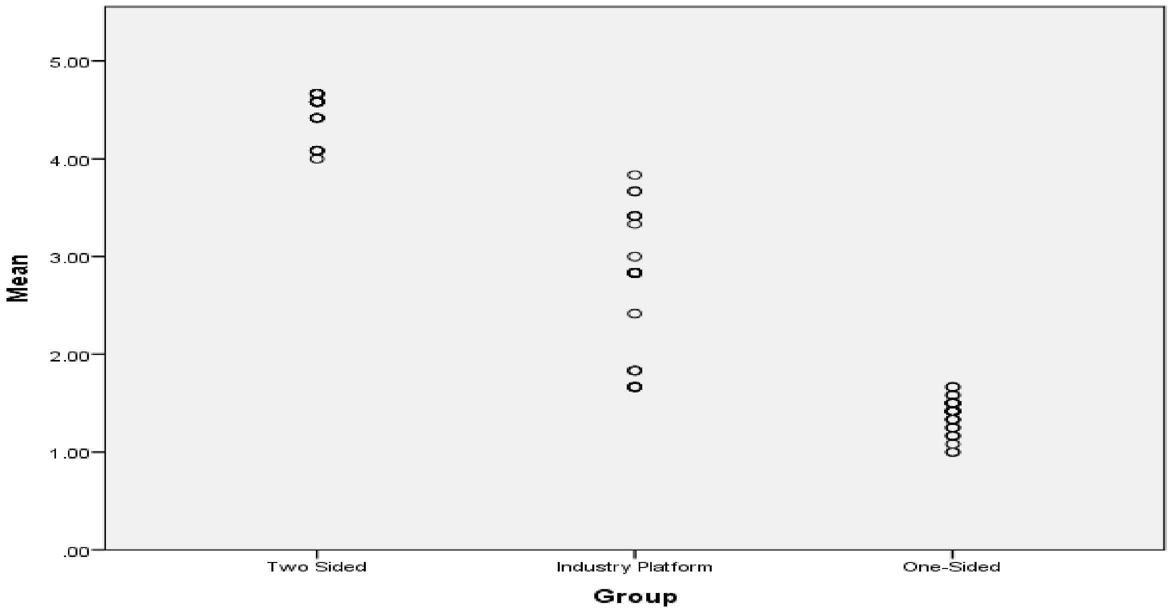

Figure 5.22: Scatter Plot – Organizational Learning: Questions 49 – 60 (Two-Sided & Industry Platform Companies).

The positive responses from the two-sided firms to Questions 49, 53, 54 and 56, compared to the industry platform companies, illustrates how the two sided firms leverage the data and information resources in their external ecosystems.

Figure 5.23: Box Plot – Organizational Learning: Questions 49 – 60 (Two-Sided & Industry Platform Companies).

The two-sided firms are highly adept at understanding the needs of customers/end users (Question 49) because they are capturing vast troves of consumer data from web transactions which they use to perform predictive and prescriptive analytics (Sharda *et al.,* 2014). The two-sided firms are also good at learning from other organizations when developing new products and processes (Questions 53, 54 and 56) because of the overlapping communities of people that they serve. Due to the high visibility of digital products on the world-wide-web firms can easily evaluate competitor processes and products when mining the unstructured data that is freely available on the Internet. Facebooks replication of Snap`s technologies and products are a recent example of this.

Questions 51 to 52, 55 to 57 and 59 to 60 are very important because they are designed to explore the extent to which the organization challenges existing mental models. These are the deeply ingrained assumptions that influence behaviour and represent the third discipline in Senge`s (1990) `Fifth Discipline` model. For example, reviewing the outcome of projects (Question 51), learning from mistakes (Question 52), capturing new knowledge and disseminating it to internal stakeholders (Question 55) plus high levels of experimentation (Question 59) and knowledge capture that is communicated through shared experiences (Question 60). These processes also use measurement to identify areas for further improvement (Question 57).

The two-sided firms scored very highly in this category compared to the industry platform companies. This is largely due to the fact that most of the two-sided companies are still relatively young in comparison and their purpose is to disrupt the `technology establishment` and `old economy` firms and markets using business model innovation. This involves challenging or even ignoring existing mental models held by the incumbent companies including other more mature organizations such as the industry platforms who have an interest in protecting their established business models.

The sixth and final component of the innovation audit that will be analyzed is **`Organizational Idea Generation`** (Questions 60 – 72). The median score for the two-sided firms was marginally above the 4.5 threshold with a narrow spread of responses all located between position 4 and 5. However, the spread of marks from the industry platform companies is very broad ranging from 1.7 to marginally above position 4, with a median score of 2.9. Unlike the two-sided firms, the majority of the responses are located between positions 2 and 3 not positions 4 and 5 (see Tables 5.24 and 5.25 below).

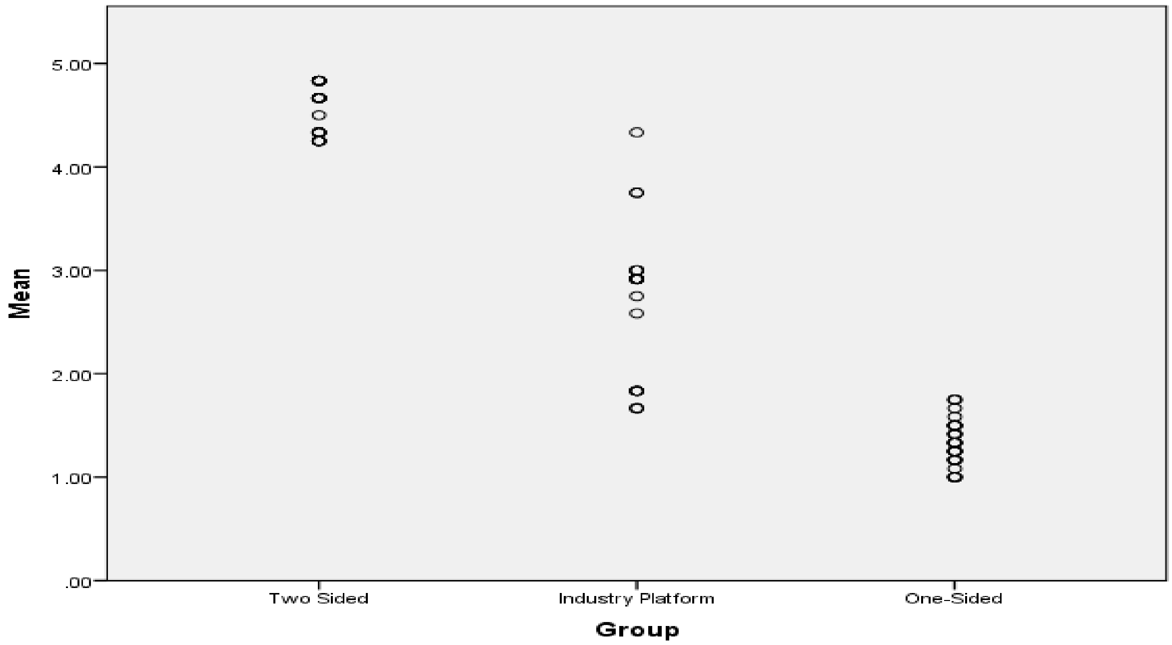

Figure 5.24: Scatter Plot – Organizational Idea Generation: Questions 60 – 72 (Two-Sided & Industry Platform Companies).

Question 61 of the `Organizational Idea Generation` component of the innovation audit questionnaire, asks whether or not the organization has search mechanisms in place for new product/service ideas. The two-sided firms, by virtue of their Internet platforms, have access to large amounts of data, information, knowledge and ideas from customer transactions and social media platforms and by using Big Data algorithms they can search systematically for patterns and new trends and perform predictive and prescriptive analytics.

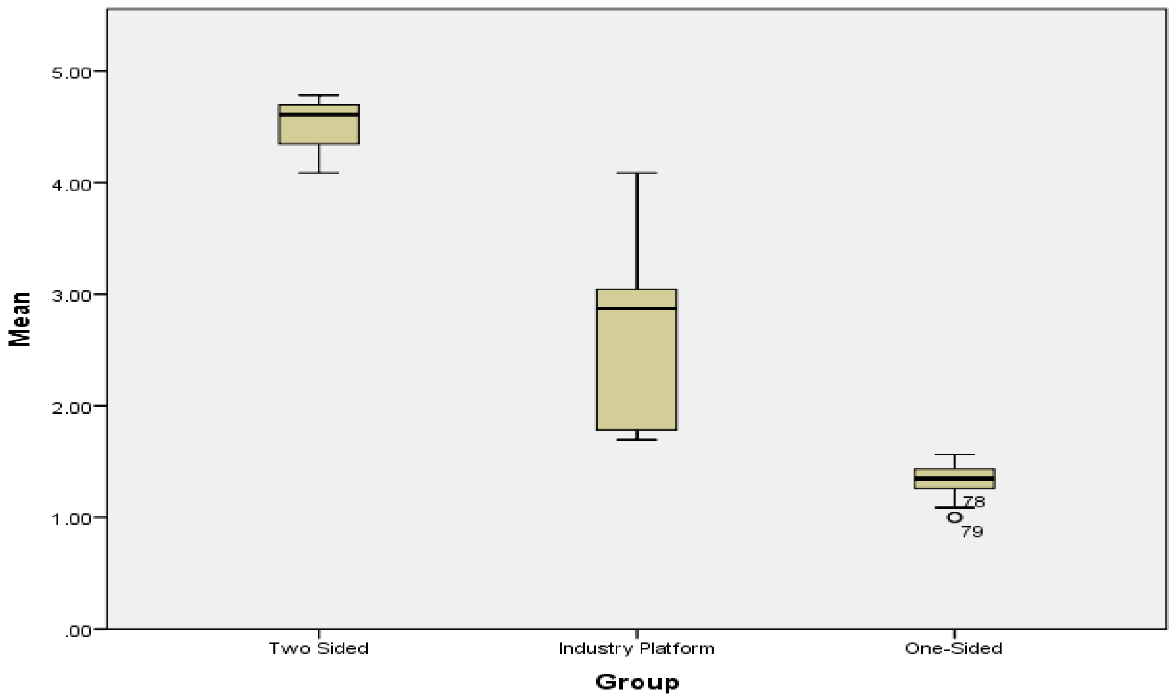

Figure 5.25: Box Plot – Organizational Idea Generation: Questions 60 – 72 (Two-Sided & Industry Platform Companies).

They can therefore test new product/service ideas online and receive real-time feedback. This is why the two-sided firms received a higher score for Question 70, due to their ability to quickly develop ideas into new product/service concepts.

This access to unstructured data from the Internet and new ideas is a distinctive capability not enjoyed by the industry platform companies and the traditional one-sided firms. This may also explain their lower scores in response to Question 63 which questioned the extent to which the number of ideas for new products, services and processes were comparable to the best in class.

In Chapter 3 of the dissertation, Peter Senge (1990) stated that to be true a learning organization and achieve high innovation, firms needed to share ideas and knowledge at all levels including the individual and team levels. He used the concept of personal mastery to describe the need to harness individual creativity and vision. Questions 62, 64, 69, 71 and 72 reveal consistently positive responses from the two-sided firms in this area which incorporates the collection of creative ideas form all employees on a regular basis (Question 62), sourcing ideas from all departments (Question 64), the need for people in the organization have an \`audience\` for their ideas i.e. they know where to take them (Question 69), the effective use of creativity techniques and workshops (Question 71) and the existence of a positive approach to creative ideas supported by relevant motivation systems [for individuals] (Question 72).

The extent to which ideas are generated externally, as well as from internal sources, was also explored in questions 65, 66, 67 and 68. This reveals whether the organization adopts an open innovation approach to idea generation using outside sources as well as internal methods or whether it only considers internal ideas i.e. a `not-invented-here` approach (where ideas are protected).

Overall the two-sided Internet firms display high levels of open source innovation compared to the industry platform companies as a result of consistent scanning of customer surveys and market trend analysis (Question 65) [from their online platforms], by sourcing ideas externally from suppliers and customers (Question 66) and by belonging to external networks (Question 67) [i.e. their external ecosystems] plus the possession of internal as well as external networking mechanisms (Question 68).

It would therefore appear that the two-sided firms have an advantage over industry platform companies and the one-sided businesses because they are data and information rich which means that the workforce can learn more quickly than employees in the industry platform and one-sided firms.

5.8 Conclusion

Chapter 5 has undertaken an analysis of the differences between the two-sided and one sided firms using the innovation audit questionnaire. This has revealed a consistently wide range of responses between the two groups with a large differential in the median and mean rankings for the two-sided firms compared to the one-sided companies. This would imply that the two-sided firms do have a clear innovation advantage over the traditional one-sided businesses due to their data-rich platform business models.

The chapter also explored the extent to which the two-sided Internet firms had an innovation advantage over the established industry platform firms. When Annabelle Gawer produced her `Typology of Platforms` model (Gawer 2009: 47- 48) eight years ago, she considered the two-sided firms (multi-sided markets or platforms) to be less innovative than the industry platform (ecosystem) firms. However, judging from the results of the innovation audit questionnaire and the financial performance of the two-sided firms compared the industry platform companies, the two typologies appear to have changed position with the two-sided business model demonstrating a clear innovation advantage across the full range of audit categories compared to the industry platform model.

The dissertation will now analyze the strategic implications of the data analysis in more depth in Chapter 6 using a range of models and frameworks from the earlier literature review undertaken in Chapters 1 to 3. It will test the robustness of the research findings by considering the drivers underpinning the two-sided business model and whether a sustainable data-driven innovation advantage genuinely exists.

Chapter 6.0

The Strategic Implications of the Data Analysis, the Research Limitations and Further Research

6.0 Introduction

Chapter 6 will analyze the strategic implications of the data analysis undertaken in Chapter 5 of the dissertation with references to models and frameworks from the earlier literature review undertaken in Chapters 1 to 3 and the methodology section in Chapter 4. It will test the robustness of the research findings by introducing additional theories relating to complexity and the implications for one-sided and two-sided business models. There will also be an analysis of why data is such an important driver and source of innovation advantage for the two sided firms. The chapter will conclude with a discussion of the research limitations relating to the concept of innovation and Gawer`s (2009) typology of platforms model (Chapter 2 Table 2.0) plus the implications for further research in the future.

6.1 The Strategic Implications of the Data Analysis for the One-Sided and Two-Sided Firms

The analysis of the innovation audit questionnaire survey results clearly revealed a significant differential between the median and mean scores for the two-sided and one-sided firms. This strongly suggests that the two-sided firms do have a clear innovation advantage over the traditional one-sided businesses due to their data-rich platform business models. If we revisit the `Framework for Innovation Measurement` (presented in Chapter 4), it is important to note that the innovation audit was designed to test the intangible innovation processes illustrated in the centre of the model (see Figure 6.0 below) relating to culture, structure, systems, learning, experimentation and an overall innovation-friendly environment.

Figure 6.0: A Framework for Innovation Measurement (Adapted from Tidd & Bessant: 2013: 631)

The high scores achieved by the two-sided companies (particularly the Internet-based firms) are reinforced by the high levels of achievement in other aspects of the model including both the inputs and the outputs. Not only do the data-rich two-sided firms generate large amounts of data and ideas, the leading firms also have very high R&D budgets as a percentage of sales (usually in double figures). The tangible outputs and financial performance of the two-sided firms, including the number of new products, new businesses acquired, market capitalization, revenue growth, profits, new users and brand value has also been extremely high. In fact the world`s most valuable companies (Statista: 2017) and leading brands (Kantar Millward Brown: 2017) are now technology platforms, with Apple, Google (Alphabet), Microsoft, Facebook and Amazon having a combined market capitalisation in excess of 2.6 trillion US dollars.

In contrast, the one-sided firms did not achieve high innovation audit scores relating to their innovation processes, nor were they able to match the financial performance of the two-sided companies in terms of profits, revenues, market value and new products and intellectual property.

Figure 6.1: The five stage high-involvement in innovation (HII) model (Bessant: 2003)

Using John Bessant`s (2003) high involvement in innovation (HII) model (presented in Chapter 4, Figure 4.1), the one-sided firms appear to be located at stages 1 and 2 in the model and the two-sided firms at stages 4 and 5 (see Figure 6.1 above).

The lowest survey responses (Appendix 6) from the one-sided firms (lower quartile/upper quartile 1.0) indicated that these companies occupied the first stage – Level 1 – in Bessant`s (2003) model which he referred to as `unconscious HII`. This meant that there was little if any high involvement in innovation (HII) activity going on in the firm and when it did happen it was random in nature and occasional in frequency. Employees would help to solve problems from time to time but there was no formal attempt to mobilize or build on the activity. This is also what Tidd and Bessant (2013), in their `developing innovation management capability model`, referred to as a low awareness of the need to change and a low awareness of how to change.

The slightly higher survey responses (Appendix 6) from the one-sided firms (lower quartile/upper quartile 2.0) indicated that these companies occupied the second stage – Level 2 – in Bessant`s (2003) model, Structured HII. This represented the firm`s first attempt to mobilize higher involvement in innovation (HII). According to Bessant (2003), this involved setting up a formal process for finding and solving problems in a structured and systematic way and training and encouraging people to use it. Supporting this would be some form of reward/recognition arrangement to motivate and encourage continued participation. There would be attempts to develop an infrastructure of teams, task forces, facilitators and some form of steering group to monitor and adjust the operations over time. Meanwhile, the awareness of the need to change and the awareness of how to change (Tidd and Bessant: 2013) would be low to moderate. Therefore there was an awareness of innovation but responses would be random and occasional based on internal systems.

Meanwhile, the innovation audit questionnaire results for the two-sided firms places them predominantly at stages 4 and 5 in the High Involvement in Innovation (HII) model. At Level 4 (Proactive HII), there was an element of empowerment of individuals and groups to experiment and innovate on their own initiative. This meant that the firm had a high awareness of the need to change and a high awareness of how to change. Highly developed and effective systems for innovation therefore existed including provisions for improvement and development (Bessant: 2003; Tidd and Bessant: 2013).

Individual empowerment to experiment and innovate also related closely to McGrath`s (2010) view of how business model innovation was changing strategy (discussed in Chapter 1). This is where the strategy process has become discovery-driven involving experimentation and evolutionary learning. This is aligned with the transformational, dynamic business model perspective rather than the one-sided, linear and static approach to business model development. Continuous business model innovation through experimentation was needed in order to react to market changes and survive in the longer term (Chesbrough: 2010; Pisano *et al.,* 2015).

At Level 5 (Full HII Capability) where the large Internet platforms reside, the firm becomes a learning organisation (Senge: 1990) where everyone is fully involved in experimentation, improvement and knowledge sharing. High involvement in innovation (HII) is the dominant way of life within the organisation and innovation is both incremental and radical. Awareness of the need to change and awareness of how to change are extremely high since this is embedded in the corporate culture with disruption serving as a key driver of growth. These organisations create and shape new environments and business models.

However, some of the more established industry platform firms did appear to be located at Level 3 (Goal-Oriented HII) or somewhere between Level 3 and Level 4 as they transitioned up or down the evolutionary scale. According to Bessant (2003), the key limitation of Level 3 HII was that the direction of activity was set by management within prescribed limits (goal oriented) and the focus was internal. The telecoms operators have traditionally been financially-oriented with a focus on economies of scale and return on capital employed based on the neoclassical approach to strategy. They have tended to adopt Physical Dominator (Iansiti and Levien: 2004) strategies by expanding their businesses through aggressive mergers and acquisitions (M&A) and pursuing monopolistic advantage rather than innovating. Their expenditure on R&D has been comparatively low with most of the research and development being undertaken by other firms within the ecosystem such as the telecoms equipment manufacturers and the technology firms or more recently through open source methods (Economist Intelligence Unit: 2008).

Although there is a clear difference between the innovation performance of the two-sided and one-sided firms based on the `Framework for Innovation Measurement` (Tidd and Bessant: 2013) and the `Five Stage High-Involvement in Innovation (HII)` model (Bessant: 2003) discussed in the chapter so far; it is also important to consider the role of data and how this has emerged as a source of competitive advantage and why the two sided-firms are able to outperform the one-sided companies in this new environment.

In their paper entitled, `*The Wheel of Business Model Reinvention: How to Reshape Your Business Model and Organizational Fitness to Leapfrog Competitors*`, Voelpel *et al.,* (2004), commented on how the competitive environment had undergone a fundamental change. They identified three major distinguishing features including how the environment had become more globalized and how it favoured intangible things such as ideas, information, relationships and knowledge. They also observed that it was intensely interlinked with ubiquitous networks. These three attributes had produced a new type of marketplace often termed the “new economy”, “knowledge economy” or “networked economy”.

There were, according to the authors, important discontinuities that differentiated the “new economy” from the “old economy”. First, there was the emergence of digitization, virtualization and networking. Networks and digitized information made it possible for copious amounts of information to be compressed, stored, retrieved and transmitted instantly from around the world. This created the availability and easy accessibility of information across the world and gave everyone instant access to each other. This led to the `data deluge` that we are familiar with today (*The Economist:* 2010; 2017).

The authors also noted a shift from the former industrial based economy to a knowledge and information-based economy with organizations relying more on intellectual (intangible) assets and less on physical (tangible) assets that were important in the industrial age. Third, the economy was also characterized as an innovation-based economy with human imagination and ingenuity as a main source of value resulting in a need to constantly innovate to keep ahead of imitating competitors i.e. the `Red Queen Effect` (Whittington: 2001; 2002). Fourth, the emergence of the `prosumer` and `prosumption` where consumers were actively involved in the production process and co-created products and services was another important development (Toffler: 1980: Kotler: 1986).

According to Voelpel *et al.,* (2004), in such an environment, organizations needed to shift from traditional (existing industry-focused, mechanistic thinking) approaches of strategic management to ones that were systemic (holistic, new value configuration focused) in nature. This systemic thinking helped organizations in developing sense making capabilities and systemic frameworks for reinventing business models.

In order to fully comprehend the nature of the change it is important to consider complexity theory (Pascale: 1999; McMillan: 2008) and how the types of systems have also changed following the shift from the post-capitalist industrial era to the knowledge and information age (Castells: 1999).

Table 6.0: Types of System and Degrees of Order and Stability (McMillan and Carlisle: 2007)

Figure 6.2: Degrees of Order and Stability (McMillan and Carlisle: 2007)

In the capitalist industrial era of the one-sided firm the most appropriate systems were mechanistic and hierarchical and the characteristics of these systems are illustrated in the two columns on the right hand side of Table 6.0. Maximising efficiencies and the high utilisation of capital assets were the key performance indicators during this period and economies of scale were critical. Top-down command and control prevailed, maintaining the stability and the status quo through tight rules and regulations and the ossification of ideas were paramount i.e. embedded dominant logic and fixed paradigms existed (Prahalad and Bettis: 1995). These legacies were evident in the one-sided firms whose response scores for the six dimensions of the innovation audit were consistently low indicating inflexible structures and cultures, an inability to learn new approaches and paradigms and an internal focus on efficiency and control rather than experimentation and innovation.

In the centre of Table 6.0 is the Complex system. This represents the `new economy` where relationships are not top-down but networked and interactions are interdependent (multi-directional) not dependent and linear. Flexibility replaces stability and systems thinking is paramount with the testing and questioning of established paradigms with new schemas and mental models (Sosna *et al.,* 2010).

In order to survive in this complex environment the firm has to be a learning organisation (Senge: 1991). This involves high levels of experimentation, probing and evolutionary learning (Chesbrough: 2010; McGrath: 2010) and the use of effectuation) Sarasvathy: 2001) and emergent strategy. This often resulted in failed innovations. When these failures occurred, the firm or industry could move from being a `complex` system to being `Chaotic`. This was often essential in order to test the boundaries of knowledge and to learn new things. The system would move from what Pascale (1999) referred to as `bounded instability` to `explosive instability` which was very damaging. The dot-com crash (2000) and the telecoms crash (2002) and high profile product failures are all examples of systems moving from complexity into chaos. The systems inevitably revert back to complexity and reform. The technology sector has recovered from the 2000 dot-com boom and bust cycle and the Nasdaq has now surpassed the pre-crash peak that it set in the year 2000 (*Financial Times:* 2017).

However, entropy can be even more damaging than explosive instability because entropy occurs when there is no instability and the system reaches a point of status quo. In a rapidly changing environment, Pascale *et al.,* (2001) said that this was a precursor to death. So innovation is essential to maintain bounded stability within the system to prevent entropy setting in.

However, this highlights a number of problems. If the one-sided firms continue to exhibit low levels of innovation then entropy will lead ultimately to extinction. They therefore need to develop what Demil and Le Coq (2010) referred to as `dynamic consistency`. This approach enables the firm to change its existing business model and develop a new one whilst maintaining sustainable performance with the old model. Davenport *et al.,* (2006: 168) referred to this as a `poised` strategy. The essence of the `poised` strategy was the ability of the organisation to create and manage multiple business models simultaneously. The ultimate competitive advantage derived from this was being able to sustain high levels of disruptive innovation.

The concept of `organisational poise`, according to Davenport *et al.* (2006: 168), was based on a dynamic capability rooted in a specific mind-set or range of diverse dexterities/ambidextrous capabilities (Tushman and O` Reilly: 1996) and an ability to effectively rejuvenate itself (i.e. to positively re-energise and change itself). The opposite to this was an `unpoised strategy` where the organisation had a limited managerial mind-set, a narrow range of dexterities (e.g. unable to move into diverse or emerging business landscapes) and/or paralyzing inertia (lack of positive, creative energy for change). The high innovation two-sided firms such as Google, Apple and

Amazon therefore have poised strategies but many of the one-sided incumbents in the industries they have disrupted have suffered from unpoised strategies as was illustrated in the innovation audit results.

This systems view of the new competitive landscape (Hitt *et al.,* 2003) in which the two-sided and one-sided firms compete is reinforced through the work of David Snowden (2000). Snowden (2000), identified four types of environment in his Cynefin framework which included the simple, complicated, complex and chaotic environments (see Figure 6.3 below).

The \`Simple\` environment in the Cynefin framework is typical of the 1960\`s classical approach to strategy where the relationship between cause and effect is linear and obvious to all. The strategist forecasts what will happen, categorises the problem and responds. The environment is considered to be predictable, repeatable and it can be determined in advance. The strategy is planned and deliberate (Mintzberg and Waters, 1985) based on the implementation of best practice methodologies.

Snowden\`s (2000) \`Complicated\` environment is similar to Whittington\`s (2002) evolutionary strategy where the environment is moving quickly (the \`Red Queen Effect\`) but there is still a cause and effect relationship although this requires analysis and investigation and/or the application of expert knowledge to sense the problems, analyse them and then respond.

The other two environments illustrated in Snowden\`s (2002) Cynefin model, namely: the \`Complex\` and \`Chaotic\` environments are starkly different. In a \`Complex\` environment there is no linear causality and any relationship between cause and effect can only be perceived in retrospect.

Figure 6.3: The Cynefin Framework (Snowden: 2000; Snowden and Boone: 2007)

This is only after a radical innovation has been successfully launched, which no-one understood had any perceived benefits beforehand, such as the personal computer and the search engine etc. In this environment safe-fail experimentation takes. If an experiment succeeds it is `amplified` and if the experiment fails it is `dampened` according to Snowden and Boone (2007). This process involves probing, sensing and then responding with agents modifying the system. There were also business model innovation techniques discussed in Chapter 1 (Sarasvathy: 2001; McGrath: 2010; Chesbrough: 2010).

In `Chaotic` environments there is no relationship at all between cause and effect. Firm`s enter chaotic environments when they innovate. Action precedes any sense or response processes. Strategy is therefore highly emergent (Mintzberg and Waters: 1985) based on novel practice. It can be compared to Brown and Eisenhardt`s (1998) strategy on the `edge of chaos` where the chaos trap exists. This involves breaking all the rules, loose structures and adaptive cultures with high levels of random communication.

At the centre of Snowden`s (2000) model is `Disorder`. Disorder occurs when the firm doesn`t know which domain it is in and situations are wrongly interpreted. Snowden`s (2000) requisite applicability concept is essential where a range of different environments converge together. Requisite applicability involves changing organisational strategies and thinking (paradigms) dependent upon the current environment i.e. a one-size fits all approach doesn’t work. Davenport *et al`s.,* (2006) `Poise` strategy (mentioned earlier) and the need for a portfolio of business models to suit each environment is relevant here i.e. a traditional business model (simple environment), a significantly reinvented business model (complicated environment) and an experimental new business model (complex and chaotic environments).

A major problem facing disrupted one-sided firms and industries is that when responding to threats from two-sided technology companies the incumbents cross the `Simple-Chaotic Boundary` as a defensive response and this is equivalent to what Snowden (2000) referred to as `falling off a cliff`, since the differences in competitive dynamics are so extreme. Firms therefore need to navigate through the more transitional boundaries between the complicated and complex domains and complex and chaotic segments.

The one-sided firms therefore appear to be located in the `Simple` and `Complicated` environments of the Cynefin model. The innovation audit revealed an absence of any product/service or process innovation with no clear attempts to develop idea generation mechanisms through probing, experimentation and evolutionary learning (becoming a learning organization). These are common characteristics in the `Complex` and `Chaotic` environments. There also appears to be an absence of what Snowden (2000) referred to as `requisite applicability`. This is where a range of different environments converge together and involves changing organisational strategies and thinking (paradigms) dependent upon the current environment i.e. a one-size fits all approach doesn’t work.

New technologies are now resulting in product, market and industry convergence and the blurring of boundaries. However, based on the audit results, the one-sided firms have not developed strategies of sourcing new technologies nor have they developed new paradigms oriented towards a culture of data acquisition (Choudary: 2015). The negative responses to the questions relating to product/service innovation also implied the existence of a one-size fits all and `if it isn`t broken don`t fix it` mind-set (Question 14 `Organizational Processes`).

In Chapter 1, research by Baden and Fuller *et al.,* (2013) referred to `project-based` (taxi) and `pre-designed` (bus) systems. Business models using the `project-based` (taxi) approach created value by interacting with customers to solve specific problems (Davies and Brady: 2000; Nightingale *et al.,* 2011; Hobday: 2000). Alternatively, those firms utilizing the `pre-designed` (bus) system (car parts makers, car assemblers and mass fast food producers) added value by producing `one size fits all` goods or services in a repetitive manner via standardized mass production processes (Hounshell: 1985; Chandler: 1990; Nightingdale: 2000). According to Demil and Lecoq (2013), Google appeared to be deploying a `bus-based` user engagement system for search engine users but a `taxi-based` user engagement system for its advertisers (who could tailor their advertising offering and set the price they were willing to pay). This approach applies to most two-sided platform companies that are Internet based including Facebook (matching users based on common interests), Amazon (bespoke promotional deals and pro-forma ordering), and Alibaba (matching buyers and sellers via a marketplace) etc. However, the one-sided firms are only able to deliver pre-designed bus systems because they do not have the digital capabilities of the Internet firms.

Disorder and not knowing which domain to navigate has been evidenced by one-sided companies that have suffered disruption from two-sided platforms. The music industry`s response to Napster`s digital file sharing and Apple`s iTunes was based on linear cause and effect logic by first seeking legal action followed by aggressive mergers and acquisitions to enhance bargaining power when negotiating licensing deals for their content. These companies entered Snowden`s (2000) `Chaotic` environment directly from the `Simple` environment and `fell off a cliff` as their revenues and profits were decimated.

In Chapter 1, Chesbrough (2010) highlighted a number of key barriers to business model innovation. These barriers included conflicts with existing assets and business models as well as an inability of the incumbent management to understand the new environment due to entrenched `dominant logic`.

Once an organisation develops an appropriate set of resources and capabilities and achieves a good `strategic fit` with its external environment, problems often occur when the environment changes but the firm isn`t able to change its resource configuration in response to these changes resulting in strategic drift (Johnson *et al.,* 2011). This is what Leonard Barton (1992) referred to as a `core rigidity`. This is the opposite of a core competency and a core rigidity occurs when there is an over-reliance by the firm on resource-based competitive advantage and the organisation fails to upgrade its resources and capabilities quickly enough. This has been a problem facing many single-sided firms in the era of hyper-competition (D`Aveni: 1994) as was the case with the music companies.

In order to avoid the threat of core rigidities (Leonard-Barton: 1992) occurring, firms need to develop dynamic capabilities (Teece *et al.,* 1997). A dynamic capability is therefore a class of capability that enables a firm to respond dynamically to changes in its operating context. It does this by reconfiguring its resources and capabilities in a transformational way in order to match the new industry key success factors (KSFs) which determine success or failure in the marketplace. However, this was not evident from the analysis of the one-sided firms` processes, culture and structures in the innovation audit where low scores were received for product/service and process innovation, the existence of teams (needed for flexible structures) and the existence of a learning organization and a change culture. This meant that reconfiguring and redeploying the resources and capabilities quickly in response to environmental change would have been very difficult.

More recent research on dynamic capabilities was undertaken by Danneels *et al* (2008) who formulated the concept of second-order competences. According to Danneels *et al.,* (2008), some firms were more capable than others at altering their resource base by adding, reconfiguring and deleting resources or competences. Danneels described two types of competences: customer competence, which was the ability of the firm to serve a particular group of customers and technological competence or the ability to use a particular technology to produce output.

These "first-order competences," as Danneels (2008) called them, were needed to keep a company's current business competitive. However, there were also what Danneels called "second-order competences" in both technology (R&D) and marketing. These second-order competences consisted of the ability to add new technological or customer competences. These, second-order competences therefore affected the company's ability to renew itself beyond its current business. According to Danneels (2008) although a company may have been good at serving an existing market this didn`t make it skilled at learning how to serve a new market. Similarly, a firm may have known a particular technology really well but this didn`t make it skilled at learning and using new technologies.

Danneels (2008) reference to technological competence is very important to the one-sided firms who do not have the ability to cross the divide between the `Simple` and `Chaotic` environments in Snowden`s (2000) model. These firms have so far not been able to develop robust Internet platform models, digitize their information systems and perform Big Data analytics incorporating both structured and unstructured data. They have therefore not been able to serve or engage with customers in the same way as the two-sided firms. This has prevented them from renewing themselves and serving new markets.

Danneels (2008) also explored how companies could learn how to learn i.e. become learning organizations (Senge: 1991) by rating them on five variables including: constructive conflict, willingness to cannibalize, slack resources, environmental scanning and a tolerance for failure. The one-sided firms performed poorly against all these variables in the innovation audit.

The first variable, constructive conflict, involved creating a climate of open debate plus the honest and frank exchange of ideas. However, the absence of team structures and mechanisms for sharing ideas internally and externally plus the structural barriers to networking and communication did not make this possible in the one-sided firms. Nevertheless, this was an area where the high-technology two-sided companies such as Google, Amazon, Apple and Alibaba excelled.

The second variable, willingness to cannibalize meant that companies needed to be willing to sacrifice some of their current business in order to develop longer-term initiatives. In the one-sided firms maintaining the status quo and not fixing what isn`t broken was the core dominant logic. This is reflected in the low scores for organizational processes where product/service and process innovation receive negative responses (Appendix 4 and 6). The existence of slack resources — having the time and money to explore future-oriented projects with uncertain returns — was also an important variable and second-order competence. However, the organizational learning component of the innovation audit and Question 48 (`There are high levels of proactive experimentation……..`) did not receive positive responses from the one-sided firms (Appendix 4 and 6). Alternatively, the two-sided high interest in innovation (HII) firms, were continuously probing and experimenting with new digital products.

Environmental scanning and the extent to which the company kept its eye on technology and market trends through outside sources was also an important second-order competency. The `Organizational Strategy` component of the audit also received negative responses to Question 2 (`Competitor`s innovation rates are known and monitored`) and Question 8 (`The organization looks ahead in a structured way, using forecasting tools and techniques, to try and imagine the future threats and opportunities`). Both received low scores as did questions relating to external networking and sourcing ideas externally in the `Organizational Idea Generation` component of the audit (Appendix 6). Since the information intensive platform companies have strong Big Data capabilities that can predict trends in real time they are well positioned to spot new developments quickly compared with the more traditional one-sided businesses.

A tolerance for failure was the final second order competency. In Chapter 1, the transformational view and business model innovation made frequent references to probing (Brown and Eisenhardt: 2008) and experimentation (Chesbrough: 2010; McGrath: 2010; Andries *et al.,* 2013). References were also made to discovery-driven planning (McGrath: 2010), dynamic consistency (Lecoq *et al.,* 2006) and effectuation (Sarasvathy: 2001). These are all techniques used to test product/service concepts in the marketplace prior to launch often resulting in failure. Due to the inability to forecast environmental change and consumer responses to technology driven products, these methods require a high tolerance for failure. However, in the `Organizational Learning` component of the audit, questions relating to `learning from mistakes and other organizations` and `high levels of proactive experimentation` do not receive high scoring responses (Appendix 4 and 6). The leading platform companies are all active in applying these methods in order to elicit market feedback. However, this is more difficult for one-sided companies that specialize in the production and marketing of hardware products and do not have access to a large ecosystem community where prototypes can be easily beta tested in a real-time, `live` environment.

6.2 The Strategic Implications of the Data Analysis & the Importance of Data as a Source of Innovation Advantage

Following the analysis in section 6.1 above, where the two-sided firms were clearly seen to have an innovation advantage over the one-sided companies, the chapter will now consider why data is such an important driver and source of innovation advantage for the two sided firms compared to the one-sided companies.

An important starting point is to consider the role that data plays in an organization. The `Transformation` model in Figure 6.4 (below) provides a very simple illustration of what organizations actually process in order to make products and deliver services. This element of the model can be broken down into three generic categories: materials, customers and data/information. The balance between the three generic categories will vary dependent upon the nature of the organization i.e. whether it is a service or a manufacturing company. Since most firms nowadays are service-oriented, this means that data/information play a key role in their success. Meanwhile, modern manufacturing firms are also becoming increasingly data-intensive or data-dependent as the technologies they use become digitized. This trend is likely to grow exponentially with the Internet-of Things and Industry 4.0, as factories and supply chains become digitized and automated. Artificial intelligence will also have a further multiplier effect on the amount of data produced.

Figure 6.4: Transformation Model (Slack *et al.,* 2013)

The famous saying: `*Information is the life blood of an organization*` (Scarrott: 1985) has never been more relevant than it is today.

It is also important at this stage to clarify how data drives innovation through knowledge creation. A very simple formula often used in connection with the Data/Knowledge Pyramid (Figure 6.5.1) is as follows:

Data + Processing = Information + Experience = Knowledge.

Figure 6.5: The Data/Knowledge Pyramid (Debons *et al.,* 1988)

Using the Knowledge Pyramid (Debons *et al.,* 1988), data forms the basis of the structure, followed by information, knowledge and then wisdom or innovation. In both instances data is seen as the critical resource that underpins the whole knowledge process but on its own data has no value if it is simply stored in a database. It therefore has to be put to use through some form processing or activity. However, recent developments in technology have meant that the methods and processes used to acquire, create and share knowledge have changed significantly. This has seen a shift in competitive advantage away from the single-sided firms towards the two-sided companies. This also gave rise to the knowledge-based view (KBV) of the firm which considered knowledge as the most strategically significant resource that a firm had (Grant: 2008).

In order for the one-sided firms to overcome the disadvantages relating to their static, linear business models and the drawbacks of their largely internal focus, Demil and Le Coq (2010) adopted a transformational perspective to business model analysis (discussed in Chapter 1) which they referred to as `dynamic consistency`. This approach focused upon business model innovation and dynamic interactions between the business model components and also included innovation within the business model as well. Lecoq *et al`s*., (2006) research also viewed the organisation as being dependent upon its ability to anticipate and react to the consequences of evolution in any given business model component. This `dynamic consistency` enabled the firm to change whilst maintaining sustainable performance.

In order to illustrate their viewpoint, Lecoq *et al.,* (2006) devised the RCOV model (see Figure 6.6 below). This perspective was based on Penrose`s (1959) dynamic view of organisational growth and argued that growth of the firm resulted from the interaction between its *resources,* its *organization* and its capacity to propose new *value propositions* in markets. Using a business model perspective, Demil and Lecoq (2010) linked this to three core business model components (illustrated in Figure 6.6) consisting of resources and competences, organisation structure and the proposition for value delivery (see Figure 6.6).

Figure 6.6: The RCOV model: the main Business Model Components and their relationships (Adapted from Lecoq, Demil and Warnier: 2006)

The chapter will now analyse each of the RCOV business model components in detail by adopting the perspective of data as a source of innovation and superior competitive advantage for two-sided firms. Starting with the ***resources and competences***, the *resources* can come from external markets or they can be developed internally, while the *competences* represented the ability and knowledge to improve or recombine the services that the resources can offer.

The *resources* in this case are the data and the *competences* are the ability of the two-sided firms to perform Big Data analytics (Sharda *et al.,* 2014) and `datafication` (Normann: 2001; Lycett: 2013). These competencies were discussed in Figure 3.0 Chapter 3, relating to the Core Competency Tree (Prahalad and Hamel: 1990). The `Big Data` competences comprise the ability to gather vast troves of data from both structured and unstructured sources (i.e. internally within an organisation as well as from the worldwide web) and to perform predictive and prescriptive analytics. This can also include sophisticated techniques such as data stream analytics or in-motion analytics. These competences are illustrated in Figure 6.7: The Analytics Value Chain (below).

This has given rise to new forms of analytics capabilities as illustrated in the `Analytics Value Chain` (Sharda *et al.,* 2014) in Figure 6.7 below. According to Sharda *et al.,* (2014), leading firms are those that have moved up the analytics value chain such as Amazon and Google, who can perform a broad range of Big Data analytics that now includes prescriptive analytics i.e. the ability to diagnose solutions to problems, predict future behaviour and to provide advanced solutions. Amazon has now filed for a patent relating to pro-forma ordering where the company would be able to despatch goods to a customer before receiving an order based on earlier purchase behaviour. However, most one-sided companies are still at the descriptive analytics stage i.e. they can only (at best) report what has happened after the event.

This also enhances the value proposition (which will be discussed in more detail shortly) by improving business value through differentiation i.e. the micro-targeting and micro-segmentation of advertisements by Google and Facebook.

Figure 6.7: The Analytics Value Chain (Sharda *et al.,* 2014)

Meanwhile, `Datafication` consists of three highly inter-linked stages: dematerialisation, liquification and density. Dematerialisation is the ability to reduce physical products down into a digital format. Liquification is the capability to manipulate and move/transfer the dematerialised information. Finally, density is the recombination of the dematerialised information as an end-user product or output (Normann: 2001; Lycett: 2013). Apple, Netflix, Spotify, Amazon Google all possess these competences that are unique to the two-sided data-rich Internet firms.

Datafication also refers to the collective tools, technologies and processes used to transform an organization into a data-driven enterprise. This involves defining the key to core business operations through a global reliance on data and its related infrastructure with high levels of digitalisation. This has not happened in the majority of one-sided businesses and this is reflected in the negative responses to Question 1 of the innovation audit which asked the one-sided firms if they had `a technology strategy and whether there were mechanisms for understanding the current and future technology needs of the organisation` (Appendix 4 and 6).

The second component of the RCOV model that will be analysed in more depth using the perspective of data as a source of innovation and competitive advantage for two-sided firms, is the ***organization (internal and external)*** and how this proposes new *value propositions* in markets. A unique characteristic of the organization of the two-sided Internet firms is that they invert the traditional one-sided resource-based view (RBV) model (Grant: 2013) because the resources and competences are not owned and controlled by the firm and do not reside within an internal organizational structure but are sourced externally from an ecosystem community (Moore: 1993; 1996) of individual and corporate contributors of data and data-related products. Choudary`s (2015) `platform stack` model illustrates very clearly how the two-sided Internet firms are configured based on three architectural layers consisting of data, infrastructure and the external network community (see Figure 6.8 below).

Figure 6.8: The Platform Stack (Choudary 2015: 61)

The two-sided firms operate across a value network not through a value chain. This resides at the top layer of the platform stack referred to in Figure 6.8 as the `Network – Marketplace Community`. According to Van Alstyne *et al.,* (2017), this has led to the shrinkage of the core resource base and structure at the centre of the organization (the platform) and the expansion outwards towards the periphery (the ecosystem).

When building the platform stack, successful platforms such as Uber, Airbnb, Facebook, You Tube and Upwork always start at the infrastructure layer first. It is important to build the infrastructure first in order to enable interactions to take place in the layer above. As the infrastructure gains adoption, an ecosystem of producers and consumers starts to evolve. For example, drivers and travellers start using Airbnb and developers and users start adopting Android. This becomes the next discernible stage in the evolution of the platform. Finally, activity by producers and consumers on the platform generates significant amounts of data. The data layer then serves to make future interactions more efficient and keeps users regularly engaged in the platform. As the data layer grows stronger, the network or ecosystem layer also increases in strength.

According to Choudary (2015: 319), most multibillion dollar start-ups have achieved platform scale using this tiered architectural process (Amazon, Google, Facebook and Alibaba etc.). However, although this process works for start-ups it doesn’t work for traditional one-sided businesses seeking to develop a platform. Traditional businesses according to Choudary (2015: 320), lack a culture of data acquisition and data management. Choudary (2015: 320) therefore recommended that the journey to platform scale needed to start with the data layer, followed by the infrastructure layer and then the development of the network-marketplace community.

So far, the traditional one-sided firms have failed to migrate their businesses onto technology platforms and scale-up to compete with the two sided firms. A key reason for this has been their adoption of a linear value chain (Porter: 1985) perspective rather than a value network (market community) approach (Peppard and Rylander: 2006).

Although the value chain has been a very useful mechanism for portraying the sequence of linked activities that exist in the physical world within traditional industries (particularly manufacturing) and one-sided firms, the model has very little relevance when applied to two-sided platform companies. As products and services have become dematerialised and as the value chain itself no longer has any physical dimension, the concept is now seen as being inappropriate (Norman and Ramirez: 1994). The model also lends itself to mechanistic linear thinking involving static rather than dynamic and transformational business model processes (Gossain and Kandiah: 1998; Rainbird: 2004).

However, the network perspective provides an alternative approach that is more suited to `New Economy` organisations particularly where both the product and supply and demand chain have been digitized (Peppard and Rylander: 2006). Hearn and Pace (2006), devised a `Value Ecology` model as a substitute for the value chain based on new conceptualisations of how value creation has changed in the digital era. They identified a number of key paradigm shifts including a shift in thinking about consumers to thinking about co-creators of value (Moore: 1993; 1996). The leading industry sectors in which these shifts were occurring included TV, computer games, e-business, mobile phones and any product that was digital (Hearn and Pace, 2006).

Unlike the value chain (Porter, 1985), Hearn and Pace`s (2006) value ecology model maintained that value creation was not a simple one-way linear process but involved processes of reiteration and feedback. Vargo and Lusch (2004:1) also stated that in the knowledge-based economy the notion of value was inherently different. The customer had become a co-producer or co-creator rather than a target and they could also be involved in the same value chain. This is an aspect of innovation that cannot be replicated by a one-sided business model that operates a supply-push approach and has comparatively poor feedback mechanisms i.e. high latency and fragmentation of data and information flows (Brynjolfsson and McAfee: 2011).

Prior to this, the dominant logic was based on the economic model of there being an exchange of goods usually based on manufactured outputs. However, new perspectives have now emerged where the dominant logic focuses on intangible resources, the co-creation of value and relationships. The computer games sector (Humphreys *et al.,* 2005) provides a good example of this whilst user-generated content on Wikipedia, Facebook, You Tube, Instagram and Snapchat are all testimony to this shift in attitude. Therefore, companies can no longer act autonomously in the value creation process (Prahalad and Ramaswarmy, 2004) since the co-creation experience itself and not the product have become the basis of value.

The idea of moving from a value chain to a network approach is also more appropriate from an information science perspective for two key reasons. First, networks are ideal data/information allocation and data/information flow mechanisms. Meanwhile, networks structurally facilitate rapid information transfer by providing horizontal links cutting across institutional boundaries to put people in direct contact with one-another. Networks also help to create information as well as transmit it (Barbasi: 2002). As each person in the network receives data/information, it is synthesised and new ideas generated i.e. information builds on information. Networks share new ideas and help create them and they are an ideal learning organisation for acquiring relevant, effective information (Bengtsson and Kock: 1999). Open innovation and crowdsourcing are also examples of how the Internet can act as source of free R&D (Chesbrough: 2003; Von Hippel: 2005).

Hearn and Pace (2006) also stated that by adopting a network rather than a value chain approach organisations focused not on the company or the industry but the value creating system itself within which different economic actors (suppliers, partners, allies and customers) worked together to co-produce value. This viewed strategy from an ecosystem perspective (Moore: 1993; 1996; 2014). Whereas in a value chain context individual firm`s competed against each other, today competition is between networks (or even ecosystems) of interconnected organisations.

As firms move towards a virtual marketplace (Rayport and Sviokla: 1994) in the networked economy traditional analytical tools such as the value chain fail to identify the true sources of value. The key to value creation in the networked economy lies in the understanding of how value is created in relationships (Blankenburg *et al.,* 1999). From a network perspective relationships are viewed as part of a larger whole i.e. a network of inter-dependent relationships (Andersson *et al.,* 1994). These relationships are therefore `connected` because what happens in one relationship affects the others (positively or negatively). These relationships also involve the dissemination and creation of data which has a multiplier effect by creating even more data which is then processed into knowledge and intelligence and used for predictive and prescriptive analytics and thereby disrupts more markets and industries through business model innovation. Any analysis undertaken must therefore view value creation based on how the organisation creates value within the network and not from the perspective of the organisation as an isolated unit.

This analysis of the value network perspective - and value networks in particular - has illustrated the high level of integration that exists between the `organization` component of the RCOV model and the `new value propositions` component. In fact, the two are in many respects inseparable. This will now be discussed in more depth before considering how network value creation has had a significant impact upon revenues, costs and margins, which are the final three components in the RCOV framework (see Figure 6.6).

The capacity to propose **new *value propositions*** in markets has been a key characteristic of business model innovation in two-sided firms operating as value networks driven by data/information resources that utilise datafication and Big Data competences.

Slack *et al.`s* Transformation Model (Figure 6.4), discussed earlier, demonstrated the key role played by data and information in all organizational processes. However, by digitizing data and disseminating it to large audiences across networks at low cost, two sided- firms have now been able to enter a broad range of markets and provide new value propositions. Since data is at the core of everything that two-sided firms do this can be recombined to produce a range of diverse products and services in a broad range of market sectors and industries. User data has been leveraged to market new products and services targeting media, health, financial services, transport, food and accommodation etc. This is what Prahalad and Hamel (1990) referred to as a strategy of stretch and leverage where a core competency approach is used to achieve three key benefits:

4) To provide potential access to a wide variety of markets.
5) To make a significant contribution to the perceived customer benefits of the end product.
6) The product/service benefits are difficult to imitate by competitors.

A key advantage that two-sided businesses have over one-sided firms (mentioned earlier) is the ability to harness and integrate user-generated data/content and to co-create value (Moore: 1993; 1996) using `prosumers` (Kotler: 1986**a**). High audience interactivity and engagement is also a new value proposition that single-sided firms cannot replicate through linear value chains. The ability to micro-target and micro-segment markets and provide customised services (mass customisation) is an additional value proposition that cannot be replicated by one-sided firms.

The cost benefits and the ability of platforms to reduce transaction costs, has also resulted in new value propositions. Content is often given away free in order to drive traffic to a website or smart phone app so that advertising streams can be monetized (Google). This is where one-side of the two-sided platform subsidises the other i.e. advertising revenues subsidise Google`s free Gmail and Google Maps products which generate user data etc.

Meanwhile, since the content on a vast proportion of social media sites is provided free-of charge from consumers, this enables the social media firms to focus on enhancing user experiences. Two-sided markets therefore offer much higher levels of interactivity and engagement for large audiences that cannot be replicated by one-sided firms. Services can also be provided on-demand and in real-time 24/7. This has resulted in both new and higher value propositions that one-sided firms are not able to match due to their structure.

Data driven innovation within the three core components of the RCOV model (resources and competences, organization and new value propositions) have also changed the economic models relating to costs, revenues and margins. The chapter will now analyse each of these components of the RCOV model in more depth starting with ***costs***.

The organizational structures of the two-sided firms are asset light and leverage assets and resources in external networks or ecosystems which they do not own thereby avoiding costly overheads. The core `raw material` is also data which is acquired free of charge in most cases. The two-sided firms also lower transaction costs through the utilisation of low cost cloud computing. As mentioned earlier when discussing `organization`, this has led to the shrinkage of the core resource base and structure at the centre of the platform ecosystem and the expansion outwards towards the periphery (Van Alstyne *et al.,* 2017). This asset light organization structure has resulted in a very low cost base leading to a performance advantage over traditional single-sided brick and mortar companies such as banks, high street retailers, hotels and taxi companies etc.

Transaction cost analysis theory (Williamson: 1985) also provides a way of understanding the impact of data networks and why transformations take place within industries. According to this theory, an organisation can organise its activities either as an internal hierarchical structure or through a market relationship with external firms (Ouchi: 1980). Digital data has significantly altered the cost structure of firms so that the cost of transactions both within and between organisations is dramatically declining (Malone *et al.,* 1988; Butler *et al.,* 1997). Therefore, many benefits associated with integrated firms (i.e. hierarchy), which primarily arise from their lower transaction costs, are eliminated.

Since the marginal cost of scaling a digital platform is close to zero (Rifkin: 2014), the two-sided firms have also changed the economic models of media industries including music and advertising etc. The cost of information production is independent of its scale of use and this implies increasing returns to the use of information (Rifkin: 2014). For example, a digital product can be replicated an infinite number of times at almost zero marginal cost unlike a physical product. This factor has conferred benefits to firms such as Google, Facebook and Netflix and Internet and app-based firms in general.

As mentioned earlier, a network approach is also more efficient from an information science perspective (Brynjolfsson *et al.,* 2011) because networks are ideal data/information allocation and data/information flow mechanisms. Meanwhile, networks structurally facilitate rapid information transfer by providing horizontal links cutting across institutional boundaries to put people in direct contact with one-another (Barbasi: 2002).

In terms of *revenues,* the data-driven two-sided firms have also had a transformational impact on how these are derived. For example, the value of a product increases in proportion to the number of people who use it i.e. the diffusion of the original iPhone. This is also known as network economics (Arthur: 1996). This implies that value lies in the ability of the product or service to connect to others. When connection happens early through various externalities an increasing returns effect is often generated. Arthur (1996: 100) argued that as the shift towards the `new economy` occurred, the underlying mechanisms that determined economic behaviour also shifted from one of diminishing returns to increasing returns.

The ability to scale rapidly using the word-wide web as a global platform and the availability of cloud infrastructure (platform as a service, software as a service and infrastructure as service) plus an ecosystem of apps and smart phones, means that the two-sided platform companies can generate high revenues and a large number of users through network effects. This is known as exponential growth (Ismail *et al.,*

2014) - not linear growth - or what Ray Kurzweil (2001) referred to as the law of accelerating returns (LOAR) made possible by Moore`s Law (Moore: 1965) and the doubling of computer power every two years. The growth of Amazon and Alibaba as the leading e-commerce platforms in the USA and China and the rapid scaling of the leading two-sided Unicorn companies in the shared economy (Uber, Airbnb and Deliveroo) provide good supporting examples of Arthur`s (1996) theory of increasing returns to scale as opposed to diminishing returns experienced by one-sided brick and mortar firms.

All of the variables and benefits discussed when analysing the `Costs` and `Revenues` components of the RCOV model also impact positively on the profit ***margins*** of the world`s leading two-sided firms. This has resulted in very large financial returns for the world`s leading technology firms (*Financial Times: 2017*) that have become known as `Superstars` (Rotman: 2017). Meanwhile, although the two-sided Unicorn companies and Amazon are not making large profits, this is because they are investing heavily in revenue growth and maximising returns to scale as they are competing in `winner-takes-all` or `winner-takes-most` markets.

This analysis of each of the RCOV business model components has clearly demonstrated how data-driven innovation by two-sided firms can transform not only the individual components within a business model but also the entire business model. This also illustrates the critical role played by data as a source of innovation advantage and how the data-rich platforms firms are able to use this to gain competitive advantage over less data-intensive single sided companies.

Section 6.2 will now conclude with a short analysis of Voelpel *et al`s.,* (2004) `Wheel of Business Model Reinvention` (Figure 6.9) and the importance of data as source of innovation advantage.

Figure 6.9: The Wheel of Business Model Reinvention (Voelpel *et al.,* 2004)

Voelpel *et al`s.,* (2004) four dimensional tool of business model reinvention was very important in that it attempted to make sense of environmental changes and their relevance in terms of shaping new business models. Their model is iterative and starts with `Customer Sensing`. This involves sensing the potential for change in customer/user behaviour and developing new customer value propositions. As mentioned earlier, this is an area of business model reinvention where the two-sided firms are very adept due to the vast troves of data that they accumulate from the strong network relationships they have developed due to network effects.

The two-sided firms are able to use sentiment analysis (opinion mining) and behavioural analytics to determine the attitude of consumers with respect to a topic, interaction or event. Amazon is a leader in using behavioural analytics to recommend additional products that customers are likely to buy based on their previous purchasing patterns on the platform.

The second dimension of Voelpel *et al`s.,* (2004) model is technology sensing. This indicates the ability of the firm to sense the relative strength and impact of technology on new customer value and business networks. Since the large industry platform companies have been the pioneers of new technologies including the Web 1.0 and Web 2.0 infrastructure, they are always well-positioned as the innovators of new technologies. The fast growing two-sided platforms, meanwhile, were early adopters of cloud computing, apps and other key infrastructure upon which their business models were based. In fact, the leading two-sided firms are running their own cloud platforms on a commercial basis (Amazon, Microsoft and Google) with Amazon pioneering cloud platform technology in 2006.

The third dimension in the model is business system infrastructure. This involves sensing the potential for value system (re)configuration including organisational structures. The world`s leading industry platform companies (Apple, Amazon, Google, Facebook, Microsoft, Alibaba, Tencent and Baidu) are all platform leaders (Cusumano and Gawer: 2002; Gawer and Cusumano: 2008) or keystones (Iansiti and Levien: 2004) in their respective fields such as ecommerce, search, mobile and cloud computing and social media. These firms have developed and constantly reconfigured their ecosystems and platforms. Amazon has been a pioneer in cloud computing services followed by Microsoft, Google, Alibaba and Tencent. Amazon revolutionised ecommerce in the West and Alibaba in the East. Google has revolutionised search and Facebook and Tencent have revolutionised social media in North America/Europe and China respectively. New infrastructures are also evolving such as the Internet-of-Things, artificial intelligence (AI), smart homes and cars. Meanwhile, the new two-sided platform companies (many of which are classified as Unicorns) have leveraged the ecosystem infrastructures of the industry platform firms to create new value through business model innovation in traditional one-sided markets such as food, hotels, transport and health etc.

The fourth and final dimension is concerned with economics and profitability. This entails sensing the economic feasibility and profitability of the proposed business models being pursued. The leading two-sided ecosystem firms (Gawer: 2009) are the world`s most valuable and profitable companies occupying five of the top seven places in terms of their market capitalization with Apple, Alphabet (Google) and Microsoft holding the top three positions. (Forbes.com: 2017). Meanwhile, the two-sided `Unicorns` represent the world`s fastest growing private companies with valuations of over one billion US dollars qualifying them as `Unicorns` or `Decacorns`. Decacorns are worth over ten million US dollars and include firms such as Airbnb, Dropbox, Pinterest, Snapchat, Uber and Flipkart (CB Insights: 2017) etc.

Finally, the Wheel of Business Model Reinvention is iterative since organizations should continuously attempt to reinvent themselves. The model also illustrates the interactive (systemic) flow from all four dimensions in business model reinvention. Moreover, the data-rich industry platform and multi-sided (two-sided) firms would appear to have a significant advantage over the less data-rich one-sided companies based on the level of data-driven innovation that occurs throughout all stages of the model ultimately generating high economic rents (Grant: 2013) in stage four.

6.3 Research Limitations

When undertaking any research on innovation there is always going to be an inherent limitation due to issues surrounding the measurement of what is an intangible phenomenon. Figure 6.0 (A Framework for Innovation Measurement) introduced at the beginning of section 6.1 in the early part of the chapter, illustrated the range of dimensions that can be used to evaluate innovation. These include tangible and intangible factors as well as leading (inputs to the process) and lagging (outputs from the process) indicators. Tangible input measures such as the percentage of sales spent on R&D and patent applications and tangible outputs such as financial performance, should be easy to measure in order to establish the true impact of innovation. However, this is easier said than done.

The number of successful patents awarded to a company is not a guarantee of high innovation since the patent may not be of a very high quality. Moreover, no metric exists for measuring patent quality so any judgements made are qualitative and subjective. The only real test of patent quality is when one is used in a patent litigation dispute which is highly retrospective. Meanwhile, the measurement of R&D spend as a percentage of sales and financial performance outputs are also not straightforward. Many publicly listed technology firms do not provide statements in their accounts specifying the level of R&D expenditure. Moreover, the R&D figures that are provided are often only for tax credit/tax relief purposes and are not a true reflection of overall expenditure. The amount that a firm spends on R&D is also not considered to be a reliable measure of innovation since many firms deliberately pursue follower strategies by replicating other firms` innovation (Sosna *et al.,* 2010) i.e. Dell in personal computers and many of the Chinese technological firms. It also ignores the importance of open innovation (Chesbrough: 2003; Von Hippel: 2005). Meanwhile, the valuable, intangible assets and indicators of innovation such as intellectual property and brands do not appear on corporate balances sheet unless the firm is the subject of an acquisition.

Meanwhile, when evaluating tangible outputs such as financial performance, the accounts of the listed companies concerned also lacked transparency when it came to providing separate revenue and profitability figures for individual product lines and businesses/divisions. Where the firm was a technological conglomerate such as Samsung, Sony, IBM, Hewlett Packard and even Amazon, it wasn't clear where the real economic rents were coming from (Grant: 2013). It wasn't until very recently that Amazon began to release separate figures for its Amazon Web services business that revealed the data-rich cloud platform was the `Cash Cow` of the company. The use of external corporate venturing (Mergers & Acquisitions) where firms buy-in innovation, is also difficult to evaluate precisely. Although the listed technology companies register their acquisitions they do not publicly announce the acquisition price or reveal the value of the target companies in the majority of cases. It is only the high profile acquisitions where full financial details are revealed (Bloomberg: 2016).

Some additional complications when evaluating output measures as an indicator of innovation performance is that the sheer scale of new product development makes it difficult to establish the accurate size of product portfolios particularly when analyzing two-sided firms such as Amazon, Facebook and Alibaba i.e. Amazon and Alibaba between them have over a trillion products on their platforms. There was also an absence of publicly available data on all the chosen two-sided firms. Many of these firms were still private, such as the Unicorns, so accurate and audited figures relating to revenues and margins were not available. Moreover, since many of the `Superstar` Internet firms had only been listed as public companies within the last few years (i.e. Google, Facebook, Alibaba and Tencent), there was insufficient data to undertake any regression analysis linking revenues to innovation. Longer publicly audited trading histories that were commensurate with other two-sided and one-sided firms were therefore needed.

Although these indicators could not be subjected to detailed statistical analysis to evaluate precise measures of innovation performance, the vast majority of two-sided firms have demonstrated high levels of financial performance based on high market capitalization, high profitability and/or high revenue growth (CB Insights: 2017; Forbes.Com: 2017). They also have large patent portfolios and high brand strength with high (top ten) rankings in the BrandZ top 100 global brands league table (Kantar Millward-Brown: 2017). There is also evidence of a high level of expenditure on R&D i.e. more than 10% of annual sales - on average (Strategy&: 2016).

The only remaining indicators of innovation performance in Tidd and Bessant`s (2013) `Framework for Innovation Measurement` (Figure 6.0) are the purely intangible variables such as the number of ideas generated as inputs to the innovation process and the actual process itself including: culture, structure, systems, the amount of learning and experimentation and the existence of a climate for innovation. These are all highly qualitative and intangible variables although an attempt was made to undertake quantitative measurement using an innovation audit questionnaire survey.

The limitations of using an innovation audit survey is that the survey is completed by members of the host organization so there is potential for subjectivity and bias. However, instead of using a `fast` innovation audit consisting of only a narrow number of questions based on `Yes/No` answers the survey type was comprehensive utilising 72 questions and a Likert scale with rankings from 1- 5. The size of the audit sample was 100 companies which is also large by innovation audit standards. However, the consistency of the answers illustrated in the overall responses - plus the high Cronbach Alpha scores (Appendix 5) and low variances (Appendix 6 and 7) - did not indicate any cause for concern.

The final research limitation related to the classification of the selected sample of firms using Gawer`s (2009) `Typology of Platforms Model`. Classifying the one-sided companies was relatively clear-cur and these firms constituted 43 companies from the overall sample. However, when classifying the remaining 57 companies it appeared that some elements of convergence had occurred between the firms who were originally industry platforms (ecosystems) and those who were two-sided/multi-sided platforms. The level of innovation attributed to the respective typologies also appeared to have been reversed.

For example, at the time of writing in 2009, Gawer stated that all industry platforms (ecosystems) facilitated innovation in new products whereas many multi-sided markets [two-sided firms] did not. However, since this research was carried out the two-sided firms are now out-innovating the industry platform (ecosystem) firms as is illustrated in the innovation audit.

Meanwhile, there also appears to have been a blurring of the boundaries between the two types of firm based on the original definitions with some companies exhibiting elements of both typologies. Established firms such as Microsoft and Apple, who were once classed as industry platforms (ecosystems), have now developed two-sided characteristics by performing platform shift and moving from their original personal computer platforms on to the Internet. They are now developing content and cloud capabilities and integrating their hardware and software with the worldwide web to become major data companies. They have therefore moved from industry platforms to become two-sided firms and at the same time the level of product/service innovation has increased.

However, many of the established industry platform companies have not migrated and developed big data capabilities such as Dell, Intel and Cisco. These firms have demonstrated lower levels of innovation thereby reversing Gawer`s earlier statement. This reversal has been reinforced by the emergence of new two-sided firms such as Uber and Airbnb who have been responsible for disruptive business model innovation instead.

Finally, it is often difficult to categorise firms that change their innovation strategies in dynamic fast-moving environments and/or demonstrate hybrid characteristics. For example, the telecoms operators appear to have combined elements of both industry platforms and two-sided markets. For example, although several firms or groups of firms do transact with each other through the intermediary of a double-sided or multi-sided market and telecoms operators do facilitate transactions between different sides of their platform or market, the actual network effects are comparatively small compared to the two-sided Internet firms. However, if we apply Fransman`s (2010) ICT (ELM) ecosystem layered model, the telecoms operators appear to integrate with several firms or organisations who don`t necessarily buy or sell from each other but whose products/services function together as part of a technological system.

These would include telecoms equipment providers, hand-set manufacturers and the Internet firms that would use their infrastructure. As the platform owners, the telecoms operators would therefore stimulate and capture value from external complementary innovation by offering content and bundled packages such as quad play.

The chapter will now consider the important topic of Further Research in Section 6.4.

6.4 Further Research

At the beginning of Chapter 1, the dissertation made reference to the fact that the term business model was synonymous with the `new economy` and the Internet particularly since the term came to prominence during dot-com boom (Wurtz *et al.,* 2010). It is therefore fitting to consider the important topic of future research within the context of the waves of technological change that have driven business model innovation in the past and as well as considering the future trajectories.

In a recent publication entitled: `*The Third Wave: An Entrepreneur`s Vison of the Future*`, Steve Case (2016) discussed how the Internet had evolved through two waves up until the present day. The first wave involved Web 1.0 and the period of the dot.com boom and bust followed by the second wave, Web 2.0 which saw a period of exponential growth in two-sided Internet-based firms. Wave 3 is a vision of how the Internet-economy is likely to develop in the future.

A slightly different timeline has been adopted for this analysis. For example, Wave 1 covers the birth of the Internet (the ARPANET in 1969) and the personal computer (PC) industry in particular which involved the establishment of a PC industry standard. The timeline then follows Case`s (2016) Web 1.0 and Web 2.0 evolutionary stages although these are classed as waves 2 and 3 not waves 1 and 2 (see Figure 6.10 and Table 6.1 below).

Figure 6.10: The Three Waves of Internet Development (Adapted from Case: 2016).

The dissertation was based on Wave 3 of the Internet`s evolutionary cycle commonly known as Web 2.0. This period of exponential growth has also been referred to as the `age of the platform` (Simon: 2011; Choudary: 2015; Van Alstyne *et al.,* 2016) by many authors and academics. In Chapter 2, Martin Fransman (2010) also stated that the Internet had become a key and ubiquitous infrastructure that was shaping virtually all economic activity (Fransman 2010: 22).

Future research is therefore recommended to test how sustainable the two-sided platform`s innovation advantage really is in relation to both the one-sided firms and the industry platform (ecosystem) business models.

Table 6.1: The Three Waves of Internet Development – Key Technologies & Developments (Walton: 2017).

At the time that the dissertation research was undertaken, there were signs of increasing levels of disruption occurring in a broad range of market sectors and industries at the hands of the new two-sided platform business models. As the dissertation has revealed, the two-sided platform model is more efficient and effective in delivering a broad range of data-based products and services than traditional one-sided business models and network configurations are more efficient at disseminating ideas and information.

As a new wave of technologies unfold (see Table 6.2), it is predicted that the platform model will become even more pervasive as one-sided incumbents struggle to remain relevant and are forced to adopt platform business models themselves where possible. Key technologies driving this trend (which are visible and emerging today) include the Internet of Things (IOT), Industry 4.0, artificial intelligence (AI), Blockchain technology, fifth generation mobile networks (5G), robotics, autonomous cars and (in the longer term) quantum computing networks.

The Internet-of Things, Industry 4.0 and artificial intelligence will have a major impact on the traditional one-sided business model because it will change the nature of the relationships in business-to-business markets.

Table 6.2: Future Waves of Innovation – Key Technologies and Key Developments (Walton: 2017).

As manufacturing companies and their supply chains become digitised (Industry 4.0) and automated using robotic technologies, this will require two-sided platform business models not traditional one-sided configurations. As consumer products are linked to the Internet (the Internet-of-Things and autonomous cars), this will also require a two-sided market platform to manage all the data flowing between the various hardware devices.

In three to five years` time further research to evaluate whether the pervasiveness of the two-sided platforms has continued and whether the two-sided firms have managed to maintain their data-based innovation advantages as more data is created from the new wave of technologies is highly recommended. The extent to which the one-sided business model is still relevant in 3 to 5 years` time and the survival rates of one-sided businesses is also very important. Finally, the level of convergence between the two-sided firms and the industry platform companies is also an area of research worth pursuing.

However, further research could also be considered in the area of non-market strategy due to recent threats of regulatory action and concerns relating to data privacy and security. The power of the data-rich oligopoly of Internet-based firms known as the `superstars` (Rotman: 2017), has created a need for the adoption of non-market strategies to pursue strategic goals through political and social leverage to help gain soft power and influence as a source of competitive advantage. A failure to do this may result in attempts by governments and competition authorities to break up the leading platform firms which could retard the continued growth and pervasiveness of the two-sided platform model into new markets and industries. Further research to evaluate two-sided platform growth levels in the context of non-market strategy is therefore important.

6.5 Conclusion

Chapter 6 provided a detailed analysis of the strategic implications of the data analysis undertaken in Chapter 5. The analysis of the innovation audit questionnaire survey results clearly revealed a significant differential between the median and mean scores for the two-sided and one-sided firms. This strongly suggested that the two-sided firms did have a clear innovation advantage over the traditional one-sided businesses due to their data-rich platform business models.

This was reinforced by analyzing the different components and dimensions of innovation in the `Framework for Innovation management Model` (Tidd and Bessant: 2013) at the beginning of the chapter. The one-sided and two-sided firms were then categorized based on their audit scores at positions 1 and 2 (one-sided) and 4 and 5 in Bessant`s (2003) `High Involvement in Innovation (HII)` framework. The appropriateness of the structural configurations of the two types of firms in respect to the new competitive landscape (Hitt *et al.,* 2003) and environment was also considered in some depth using chaos and complexity theory and Snowden`s (2000) Cynefin framework.

This was followed by an exploration of how the two-sided firms used data to achieve an innovation advantage with respect to business model innovation based on an analysis of the RCOV model (Lecoq, Demil and Warnier: 2006) and Voelpel *et al`s.,* (2004) `Wheel of Business Model Reinvention`. This revealed that the two-sided firms did have a significant innovation advantage due to their ability to capture and manage data through their network configurations which was highly disruptive to the one-sided incumbents.

Finally, the research limitations and considerations for future research were discussed revealing a number of challenges due to the intangible nature of innovation and barriers to the collection of financial data. There were, however, a number of opportunities for further research going forward due to the range of related technologies currently being developed.

Chapter 7 - Summary and Conclusion

7.0 Introduction

An overview and summary of the content of the dissertation will now be undertaken and the extent to which the original aims and objectives and the research hypothesis were met and fulfilled.

The first three sections of Chapter 7 will consist of an analysis of the literature review (Chapters 1 – 3) and how these were aligned with the first three research objectives. The second part of the chapter will consider the original hypothesis and research findings (Chapters 4 - 6) and the extent to which research objectives 4 and 5 were actually fulfilled.

7.1 Chapter 1 – Research Objective 1

Chapter 1 of the literature review (Business Models and Business Model Innovation) undertook a detailed analysis of literature relating to business model theory and highlighted gaps in the literature relating to the research question. The aim of Chapter 1 was to meet research objective 1 outlined below.

Research Objective 1:

Conduct a literature review of business model theory to identify the differences between the static and dynamic perspectives and how the application of the Penrosian (1959) and RCOV approaches (Lecoq et al., 2006) might be developed further using data as the key integrating mechanism that drives business model innovation.

The literature review revealed a range of common themes but also some notable gaps. For example, the use of the term business model grew exponentially during the `new economy` boom (Wirtz *et al.,* 2010). In fact, the term `business model` had hardly been used before 2000 but the dot-com boom caused it to become highly relevant and widespread in practice. This was largely the reason for the shift in approach from the earlier static view of business models and a move towards a new dynamic transformational perspective.

Second, the transformational business model approach (Demil and Lecoq: 2010), was characterised by high levels of probing and experimentation through trial and error as well as incorporating dynamic capabilities (Teece *et al.,* 1997) and the knowledge-based view of strategy (Grant: 2008). These new methods of formulating and implementing strategy were key drivers of business model innovation and new ways of creating value. This was revealed in Demil and Lecoq`s (2010) RCOV model and Volepel *et al`s.* (2004) `Wheel of Business Model Reinvention`.

Third, the literature review highlighted the existence of a new and previously un-noticed business model called the multi-sided (two-sided) model (Baden-Fuller *et al.*, 2013). This category of business model was different because engagement and value creation involved several customer groups and a whole new dynamic.

An initial research gap was therefore identified that revealed the under-representation of the two-sided firm as a new and emergent business model and the absence of data as a key input into the knowledge and innovation-generation process. Data as a key integrating mechanism in driving business model innovation in terms of the RCOV model and business model reinvention were therefore considered to be important and the extent to which the new two-sided platform-ecosystem companies (the dynamic transformational business model perspective) had an innovation advantage (due to their rich data resources) compared to the established one-sided firms (the static business model perspective).

7.2 Chapter 2 – Research Objective 2

Chapter 2 of the literature review (Ecosystems Thinking and Modern Platform-Based Ecosystem Theory) defined and explained the two-sided business model concept based on ecosystem and platform theories and frameworks. It then compared the two-sided and one-sided business model configurations and the benefits and advantages offered by the two-sided concept over the one-sided model in terms of innovation. The overall aim of Chapter 2 was to meet research objective 2 outlined below.

Research Objective 2:

Undertake an analysis of platform and ecosystem theories and typologies and explore how they demonstrate the business model innovation advantages achieved by two-sided platform companies over established one-sided firms due to the their unique configurations.

Seminal literature was used, including ecosystem theories from Moore (1993; 1996), Iansiti and levien: (2004) and Fransman (2010), to explain the nature and characteristics of ecosystems. This was followed by an explanation of platform characteristics using Gawer`s (2006) four platform typologies and Choudary`s (2015) platform stack.

This revealed that the industry platform (ecosystem) and two-sided (multi-sided models were more innovative than the one-sided product and platform configurations. For example, according to Iansiti and Levien (2004), with the platform ecosystem model, value was enabled by the platform leaders and was co-created via a network of participants. Successful, modern ecosystem platforms therefore created huge value not through their access to physical resources (as was the case with the one-sided firms) but through leveraging data to coordinate physical and digital resources across their ecosystems.

The benefits and advantages included the low cost base and asset light nature of the resources used. Two-sided platforms such as Airbnb and Uber were able to de-link assets from value. These app-based platforms did not own real estate or automobiles (fixed assets) but used their software infrastructures and network effects to generate value for buyers and sellers by leveraging the under-utilised assets of third parties that would otherwise not yield any likely return.

These firms were also able to remove costly intermediaries (disintermediation) and lower the price of service and product delivery i.e. movie and music downloads or streaming through Netflix and Spotify. Market aggregation was another benefit over the one-sided firms. Aggregating unorganised markets was a process where the platforms provided centralised markets to serve widely distributed individuals and organisations. Market aggregation provided information and power to users who previously engaged in interactions in a haphazard fashion often without access to reliable or up-to-date market data and/or infrastructure. Platforms such as Upwork brought thousands of skilled professionals together making it easier for potential employers to evaluate, compare and hire them.

Another unique advantage of the two-sided firms was the ability to create network effects. In the Internet economy, these companies achieved higher “volume” than one-sided competitors (by attracting more platform participants) and offered a higher average value per transaction. Due to their large networks, these firms were able to provide a closer match between supply and demand from the different sides of the platform (owing to their possession of larger and “richer” troves of data). Subsequently, greater scale generated more value, which attracted more participants, which created even more value. This created another virtuous feedback loop that also produced monopolies. This was an increasing return to scale rather than a diminishing return.

Finally, two-sided firms could capture innovative ideas from a broad and large external ecosystem of consumers who would help to co-produce and co-evolve products and services as `prosumers` providing user-generated content. This was not possible in a one-sided business which didn`t have the same access to pervasive networks and efficient feedback mechanisms.

7.3 Chapter 3 – Research Objective 3

Chapter 3 of the literature review (A Resource-Based View of the Innovation Advantage of a Two-Sided Business Model over a One-Sided Business Model & the Role of Data) analysed the literature relating to the resource-based view (RBV) of strategy, dynamic capabilities, the knowledge-based view plus the value chain and whether these theories were still appropriate in the data-rich Internet economy from an innovation perspective. The aim of Chapter 3 was to meet research objective 3 outlined below.

Research Objective 3:

Critically review of the relevance of the resource-based view (RBV) of strategy (including dynamic capabilities and the knowledge based view) and the value chain approach in relation to innovation in the data-rich Internet economy and the advantages of the two-sided platform companies.

Chapter 3 revealed that the resource-based (RBV) was only relevant to the two-sided firm if it was inverted. This was because the resources were located externally within the ecosystem and were therefore controlled rather than owned. This was one of the reasons for the low cost structure and asset light business model where the core of the organisation had shrunk but the periphery had expanded (Van Alstyne *et al.,* 2016). This also meant that the resources and capabilities of the two-sided firms were highly dynamic (Teece *et al.,* 1997) compared to the one-sided firms.

However, the analysis revealed that the traditional linear value chain was only relevant when analysing traditional one-sided businesses that made and distributed physical products (Norman and Ramirez: 1994). The two-sided firms operated through value networks instead (Peppard and Rylander: 2006: Hearn and Pace: 2006) which were far more efficient at transferring data and information and creating high levels of engagement and innovation from members of the ecosystem community. Digitisation significantly altered the cost structure of firms and therefore the cost of transactions both within and between organisations dramatically declined (Malone *et al.,* 1988; Butler *et al.,* 1997). The data-rich two-sided firms also appeared to have a core competency (Prahalad and Hamel: 1990) advantage since their platforms enabled them to gain access to a wide variety of markets, to make a significant contribution to the perceived customer benefits of the end product as well as being difficult for one-sided competitors to imitate. This was illustrated using the core competency tree and how `datafication` and Big Data analytics provided a sustainable competitive advantage for the large Internet firms.

The knowledge-based view (KBV) was also relevant and this was illustrated using the Analytics Value Chain (Sharda *et al.,* 2014) and the Knowledge Pyramid (Debons *et al.,* 1988) which explained the the role of data in the innovation process. The chapter also included an analysis of Demil and Le Coq`s (2010) RCOV model explaining the dynamic aspects of business model innovation and how data played a key role in transforming individual elements of the model as well as the model itself. A similar analysis was also undertaken using Voelpel *et al`s* (2004) Wheel of Business Model Reinvention concept. Both frameworks illustrated the significant innovation advantages that were achieved by the data-rich two-sided firms.

Finally, the chapter concluded by identifying the research gap or hypothesis which is explained below:

The extent to which data-rich firms operating two-sided platform-ecosystem business models are able to use data to gain an innovation advantage over established one-sided companies.

7.4 Chapters 4 and 5: Testing the Hypothesis - Research Objective 4

Chapter 4 explained the methodological approach adopted to test the research hypothesis identified in the literature review. This was followed by an analysis of the data in Chapter 5. The aim of Chapters 4 and 5 was to test research objective 4 outlined below.

Research Objective 4:

Test the hypothesis that the two-sided data-rich Internet based firms have a superior innovation advantage over the established one-sided firms using an innovation audit to evaluate the innovation capabilities of high growth two-sided Internet firms against established one-sided businesses.

Chapter 4 explained why an innovation audit was selected to measure the levels of innovation within a sample of 100 firms consisting of 57 two-sided platform companies and 43 traditional one-sided businesses. Six dimensions of innovation were assessed (organizational strategy, organizational processes, organizational structure, organizational culture, organizational learning, and organizational idea generation) using a comprehensive innovation audit questionnaire incorporating 72 questions ranked on a Likert scale from 1 – 5. The results were analysed in Chapter 5 using a range of statistical methodologies including Cronbach`s Alpha (Cronbach: 1951), a correlation matrix based on Spearman`s rank correlation (Spearman: 1904), a cluster analysis (Bailey: 1994; Everitt: 2011) using scatter plots to illustrate the grouping of the of the surveyed firms. A Mann-Whitney *U* test (Mann-Whitney: 1947) was then used to determine whether the two independent samples (the one-sided and two-sided firms) had been selected from populations that had the same distribution. A Factor Analysis (Child: 2006) was also used to determine which were the most important variables in the innovation process. Finally, box plots were applied to illustrate the differences between two-sided and one-sided firms from an innovation perspective.

The data analysis revealed that the two-sided firms did have a clear innovation advantage over the traditional one-sided businesses due to their data-rich platform business models. There was a consistently wide range of responses between the two groups with a large differential in the median and mean rankings for the two-sided firms compared to the one-sided companies.

The data analysis also revealed that the two-sided Internet firms not only had an innovation advantage over the one–sided firms but also over the more established industry platform companies. When Annabelle Gawer produced her `Typology of Platforms` model (Gawer 2009: 47- 48) eight years ago, she considered the two-sided firms (multi-sided markets or platforms) to be less innovative than the industry platform (ecosystem) firms. However, the results of the innovation audit questionnaire revealed that the two typologies appear to have changed position with the two-sided business model demonstrating a clear innovation advantage across the full range of audit categories compared to the industry platform model.

7.5 Chapter 6 - Research Objective 5

Chapter 6 (The Strategic Implications of the Data Analysis, the Research Limitations and Further Research) analysed the strategic implications of the research findings using a range of models and concepts from the earlier literature review to illustrate the importance of data as a source of innovation advantage particularly with regards to the components of the RCOV model and (Demil and Le Coq: 2010) and Voelpel *et al`s.,* (2004) Wheel of Business Model Reinvention framework. So the aim of Chapter 6 was to test research objective 5 outlined below.

Research Objective 5:

Undertake an analysis of the research findings and consider the strategic implications of the results. This will involve the detailed application the RCOV model (Lecoq et al., 2006) and will analyse the extent to which data has been a source of innovation advantage for the two-sided firms over the one-sided companies by integrating models and theories from the earlier literature review.

The chapter started by explaining how the two-sided firms had gained an innovation advantage on all the dimensions illustrated in Tidd and Bessant`s (2013) `Framework for Innovation management` model including the tangible and intangible factors and the lagging and leading indicators. It also used Bessant`s (2003) High Involvement in Innovation (HII) model to demonstrate how the two-sided platform firms occupied positions 4 and 5 in the framework compared to the one-sided firms that resided at positions 1 and 2.

Complexity and chaos theories from McMillan and Carlisle (2007) and Snowdon`s (2000) Cynefin framework explained how the two-sided firms were better equipped to succeed in a volatile environment compared to the traditional one-sided businesses due to their dynamic capabilities (Teece *et al.,* 1997).

Meanwhile, the latter part of the chapter focused on the role of data as a source of innovation advantage for the two-sided platforms. This used the transformation model (Slack *et al.,* 2013) and the Data/Knowledge Pyramid (Debons *et al.,* 1988) to explain how data and information had become the key source of competitive advantage and how data formed the basis of innovation. This was followed by a detailed analysis of each individual component of the RCOV model (Demil and Le Coq: 2010) with linkages to earlier concepts and theories from the literature review. The analysis of how data created unique `Resources and Competences` for the two-sided firms was supported with underpinning from the Core Competency Tree (Prahalad and Hamel: 1990) and the Analytics Value Chain (Sharda *et al.,* 2014). The benefits of `datafication` and big data analytics were critical in this instance.

Moreover, when analysing the `Organisation (Internal and External)` component of the model, Choudary`s (2015) three layered platform stack (data, infrastructure and network marketplace community) and Peppard and Rylander`s (2006) network value perspective were used. These concepts (and how the resource-based view was inverted) illustrated the advantages of being a data-based company and how platforms were able to innovate more successfully than one-sided firms that had rigid and inflexible structures. The `organisation` component of the model was also closely integrated with the `Value Proposition` since it was possible to leverage core competences (Prahalad and Hamel: 1990) to provide access to a wide variety of markets and enhance perceived customer benefits due to lower costs and their ability to mass customise through micro-targeting and segmentation.

These benefits also resulted in lower costs, higher revenues and higher margins in most cases. Using resources that were free or cheap and being able to scale rapidly at near-zero marginal cost using network effects produced above normal returns in all of these components of the RCOV model when compared to one-sided businesses. These benefits were reinforced with an analysis of the `Wheel of Business Model Reinvention` (Voelpel *et al.,* 2004) where the two-sided firms excelled at customer and technology sensing, the development and integration of new business systems and infrastructure and the monetization of new technologies through better financial returns.

7.6 Conclusion

In conclusion, it can be said that the primary research undertaken using the innovation audit questionnaire clearly identified that the two-sided platform companies had an innovation advantage over the less data-intensive and traditional one-sided companies. The data analysis also revealed that the newer two-sided

Internet-based platforms appeared to be overtaking the older and more established industry platform ecosystem firms from an innovation stand point thereby reversing Gawer`s (2009) earlier findings.

Moreover, by analysing a wide range of academic literature, it could be seen that data now played a crucial role as a source of innovation in the data-driven digital economy. The academic theories demonstrated how the unique configuration of the two-sided platform enabled the organization to gather, internalize, synthesize and analyse data and to drive business model innovation across a range of different industries. Meanwhile, as new waves of technology emerge and unfold, the current data deluge is forecast to continue thereby offering a sustainable competitive advantage to the leading two-sided platform companies as well as increasing the level of creative destruction (Schumpeter: 1949; 1954) in traditional industries.

This provides opportunities for further research regarding the sustainability of the two-sided business model against the one-sided frim and the need for non-market strategies to off-set challenges from regulators and civil rights groups regarding anti-trust and privacy issues. Security concerns are also another potential challenge that could stymy future progress. However, based on the dissertation research, what is still an under-represented business model appears to have a clear innovation advantage due to the use of multi-sided data-intensive platforms and this is appears to be a sustainable threat to one-sided firms as platform ecosystems become more pervasive and influential.

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Appendix 1

Sample of a `Full` Innovation Audit Questionnaire (Tidd and Bessant: 2013)

How well do we manage innovation?

This simple self-assessment tool focuses attention on some of the important areas of innovation management. Below you will find statements which describe 'the way we do things around here' -the pattern of behaviour which describes how the organization handles the question of innovation. For each statement simply put a score between 1 (= not true at all) to 7 (= very true).

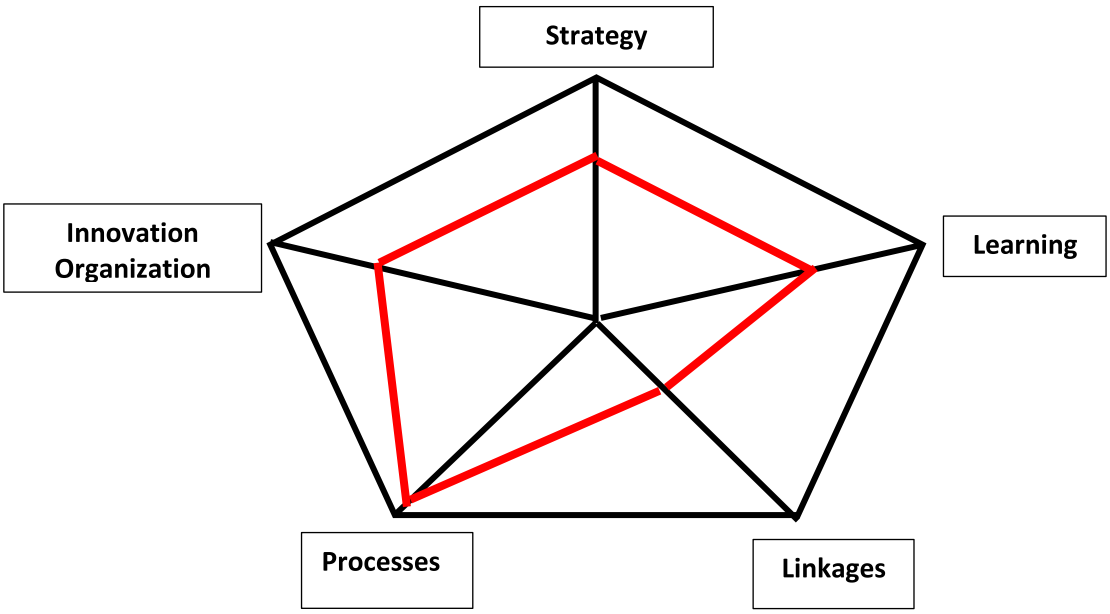
Score 1= Not true at all to 7 == Very true

1. People have a dear idea of how innovation can help us compete
2. We have processes in place to help us manage new product development effectively from idea to launch
3. Our organization structure does not help new product development to happen
4. There is a strong commitment to training and the development of people
5. We have good 'win-win' relationships with our suppliers
6. Our innovation strategy is clearly communicated so everyone knows the targets for improvement
7. Our innovation projects usually completed on time and within budget
8. People work well together across departmental boundaries
9. We take time to review our projects to improve our performance next time
10. We are good at understanding the needs of our customers/end-users
11. People know what our distinctive competence is - what gives us a competitive edge
12. We have effective mechanisms to make sure everyone (not just marketing) understands customer needs
13. People are involved in suggesting ideas for improvements to products or processes
14. We work well with universities and other research centres to help develop our knowledge
15. We learn from our mistakes
16. We look ahead in a structured way (using forecasting tools and techniques) to try and imagine future threats and opportunities
17. We have effective mechanisms for managing process 'change from idea through to successful implementation
18. Our structure helps us to take decisions rapidly
19. We work closely with our customers in exploring and developing new concepts
20. We systematically compare our products and processes with other firms
21. Our top team have a shared vision of how the company will develop through innovation
22. We systematically search for new product ideas
23. Communication is effective and works top-down, bottom-up and across the organization
24. We collaborate with other firms to develop new products or processes
25. We meet and share experiences with other firms to help us learn
26. There is top management commitment and support for innovation

27. We have mechanisms in place to ensure early involvement of all departments in developing new products/processes
28. Our reward and recognition system supports innovation
29. We try to develop external networks of people who can help us - for example, with specialist knowledge
30. We are good at capturing what we have learned so that others in the organization can make use of it
31. We have processes in place to review new technological or market developments and what they mean for our firm's
32. We have a clear system for choosing innovation projects
33. We have a supportive climate for new ideas - people don't have to leave the organization to make them happen
34. We work closely with the local and national education system to communicate our needs for skills
35. We are good at learning from other organizations
36. There is a clear link between the innovation projects we carry out and the overall strategy of the business
37. There is sufficient flexibility in our system for product development to allow small 'fast -track' projects to happen
38. We work well in teams
39. We work closely with 'lead users' to develop innovative new products and services
40. We use measurement to help identify where and when we can improve our innovation management

Tidd & Bessant (2013)

Now Plot a profile for the five dimensions:



Appendix 2

Sample of a `Fast` Innovation Audit Questionnaire (Goffin and Pfeiffer: 1999)

Innovation Strategy

1) Has innovation been introduced as a fundamental part of your company philosophy and values?
2) Does technology have a role in your organisation`s innovation?
3) Does top management spend sufficient time supporting all types of innovation?
4) Are innovation goals for new products and processes defined?
5) Has the organization developed an innovation network?

Ideas

1) Are creative ideas collected on a regular basis?
2) Can you quantify how many ideas for new products, services and processes were developed in the last 12 months?
3) Do all ideas originate from all department often from contacts with customers?
4) Are new ideas quickly developed into new product/service concepts?
5) Are creativity techniques and workshops used?

Prioritization

1) Is there a good balance of ideas for new products, services and processes?
2) Are concept reviews held quickly?
3) Are choices made quickly?
4) Is there a good feedback mechanism from actual product performance to ensure screening decisions?
5) Are appropriate tools and techniques used?

Implementation

1) Is this a bottleneck stage because too many products are attempted?
2) Are best practice techniques such as simultaneous engineering applied where appropriate?
3) Is the time-to-market comparable to competitors?
4) Are new processes regularly developed?
5) Are project reviews effectively used?

People & Organization

1) Is the broad meaning and importance of innovation understood by all employees?
2) Are clear individual innovation targets set and known by all employees?
3) Do human resource polices support a culture of innovation?
4) Is innovation covered by employees` appraisals?
5) Does the responsibility for screening decisions lie too high in the company hierarchy?

Appendix 3

Sample of a Technical Innovation Audit Questionnaire

Introduction

The Audit works by rating organisational innovation management performance in eight dimensions, these are:

- Product Innovation
- Service Innovation
- Process/Technology Innovation
- Innovation Strategy
- Ideas
- Prioritisation (Portfolio Management)
- Implementation
- People and Organisation

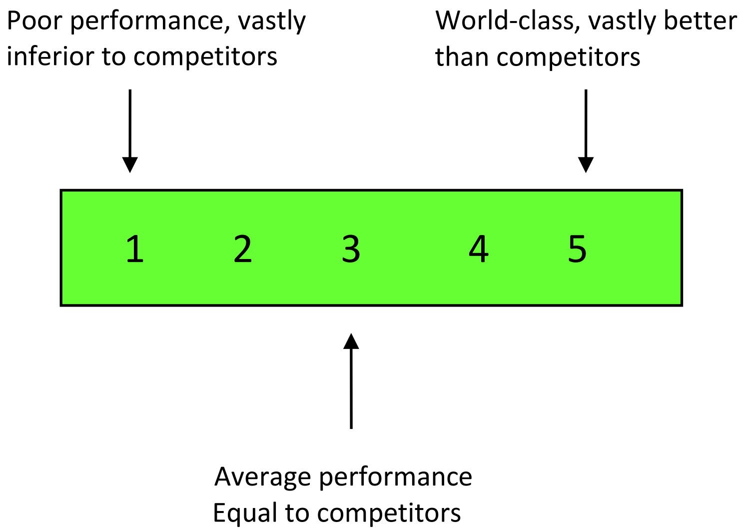
The dimensions are based on the Pentathlon Framework for Innovation Management. For each dimension there is a series of questions to consider and based on your responses you are asked to give an overall rating for the performance in that dimension. The rating is a 1-5 point scale, shown below.

The results will be used to give an indication of the perceived innovation management performance.

Data Collection

Name	
Area of responsibility	
Organisation	
Do you want your responses to be treated anonymously?	Y/N
Would you mind being contacted for further discussion?	Y/N

Scale



Questions

1) Product Innovation

1) The number of new products in our portfolio has been increasing over the last 3 years
2) The time-to-market of new products in the company is very short compared to our competitors
3) The percentage of revenue from products introduced in the last 3 years is high compared to our competitors
4) Our market share has increased as a result of new products introduced in the last few years

Your rating	

2) Service Innovation

5) We pay particular attention to developing new services as well as new products
6) The number of new services that we offer has increased significantly over the last 3 years
7) We are constantly developing and introducing new services

Your rating	

3) Process/Technology Innovation

8) We constantly review our processes to identify areas for improvement
9) We focus on process improvement rather than on maintenance of processes
10) There have been many process improvements/innovations that have significantly impacted on our costs in the last 3 years
11) If it isn't broken, leave it alone is NOT an accepted philosophy in the organisation
12) There is a strong link between product innovation and process improvement to support the product
13) Information on new process technology is actively sought
14) We are at the leading edge of technology in our industry

Your rating	

4) Innovation Strategy

15) Innovation is a fundamental part of our company philosophy and values. It is mentioned in our mission statement
16) Top management spends sufficient time supporting all stages of innovation.
17) Innovation or R&D spend is protected and related to potential business contribution over the short and long term.
18) Innovation goals / measures are defined - for new products, services and processes? And are deployed effectively.
19) We effectively use technology in our innovation.
20) There exists a technology strategy (I.e. an explicit policy for sourcing technologies) and there are mechanisms for understanding current and future technology needs
21) Competitors' innovation rates are known/monitored
22) Performance measures are in place for innovation
23) Risk taking is encouraged rather than penalized by management
24) There is a formalized innovation programme in the organization
25) A communication system exists for marketing the corporate approach to innovation

Your rating	

5) Ideas

26) Creative ideas are collected on a regular basis from all employees

27) The number of ideas for new products, services and processes developed in the last 12 months is comparable to the best in class
28) Ideas do originate from all departments, often from contacts with customers
29) Competitors are monitored regularly. There is a consistent approach to customer surveys and market trend analysis
30) The company sources for ideas externally e.g. from suppliers
31) The company belongs to a network. i.e. have close relationships with suppliers and customers and ongoing contacts with universities, government agencies, industry consortia etc.
32) People in the organization know where to take their ideas
33) Ideas are quickly developed into new product / service concepts
34) Creativity techniques and workshops are used. They are effective
35) The location of knowledge is understood and capitalized upon

Your rating	

6) Prioritization (Portfolio Management)

36) There is a good balance of ideas for new products, services and processes in your "funnel"
37) Concept reviews are held regularly. Choices are made quickly
38) There is a system for screening and evaluating ideas in the organization
39) The portfolio management process is "visible"
40) There is a good feedback mechanism from actual product performance to ensure screening decisions
41) The responsibility for screening decisions lies too high in the company hierarchy
42) The number of projects are reduced to a manageable level at the right time

Your rating	

7) Implementation (NPD, etc.)

43) This is a bottleneck stage, because too many projects are attempted
44) We have a well-defined "living" NPD/NSD process. There is a systematic product development process
45) The procedures are flexible enough to allow small projects to move through quickly
46) Best practice techniques such as simultaneous engineering (or doing activities in parallel) are applied, where appropriate
47) Our time-to-market is comparable to our competitors
48) We use X-functional project teams effectively
49) Project teams and their leaders are fully responsible for the development from start to finish

50) There is good communication between the different groups inside and outside the company involved in the development of new products/services
51) Project reviews are effective and used to improve performance
52) There are measures to show that each stage of the process has been completed and done thoroughly
53) There are means to ensure that customer and end user input is used throughout the process

Your rating	

8) People and Organization

54) The broad meaning and importance of innovation-new products, services and processes- is understood by all employees
55) Clear innovation targets are set and known by all employees
56) Human resource policies support a culture of innovation through stimulating a creative, problem-solving working environment. Organizational structures are flexible and effective
57) The skills required for innovation are identified and they are fully resourced through recruitment and training
58) Career structures support innovation through development of people across different functions
59) Innovation covered by employees' appraisals
60) Innovation strategies are deployed to the employee level
61) Employees are rewarded for innovation activities
62) Staff can approach top management with ideas and get a fair hearing

Your rating	

Appendix 4

Innovation Audit Questionnaire

The Audit works by rating organisational innovation management performance in six dimensions, these are:

Organizational Strategy
Organizational Processes
Organizational Structure
Organizational Culture
Organizational Learning
Organizational Idea Generation

For each dimension there is a series of questions to consider and based on your responses you are asked to give an overall rating for the performance in that dimension. The rating is a 1-5 point scale, shown below.

The results will be used to give an indication of the perceived organization’s innovation performance.

1	2	3	4	5
Strongly Disagree	Disagree	Partially Agree	Agree	Strongly Agree

Organizational Strategy

1) A technology strategy exists (i.e. an explicit policy for sourcing technologies) and there are mechanisms for understanding the current and future technology needs of the organization.
2) Competitors' innovation rates are known/monitored.
3) Performance measures are in place for innovation including goals for new products, services and processes.
4) Risk taking is encouraged rather than penalized by management.
5) There is a formalized innovation programme in the organization.
6) The organization's innovation strategy/policy is promoted throughout the organization.
7) There is top management commitment and support for innovation.
8) The organization looks ahead in a structured way (using forecasting tools and techniques) to try and imagine future threats and opportunities.
9) The top team have a shared vision of how the company will develop through innovation.
10) The percentage of revenue from products/services introduced in the last 3 years is high compared to competitors.
11) Market share has increased as a result of new products/services introduced in the last 3 years
12) The number of new products/services in the portfolio has been increasing over the last 3 years

Organizational Processes

13) There are processes in place to help manage new product development effectively from idea to launch.
14) There are effective mechanisms for managing process change from idea through to successful implementation.
15) There are mechanisms in place to ensure early involvement of all departments in developing new products/processes.
16) There is a clear system for choosing innovation projects.
17) Processes are constantly reviewed to identify areas for improvement
18) There is a focus on process improvement rather than on maintenance of processes.
19) If it isn't broken, leave it alone is NOT an accepted philosophy in the organisation
20) There is a strong link between product innovation and process improvement to support the product.
21) The organisation is at the leading edge of technology in our industry.
22) There is participation in organization-wide continuous improvement activity.
23) The time-to-market of new products is very short compared to our competitors.
24) The organization is constantly developing and introducing new products/services.

Organizational Structure

13) The organization structures are flexible and facilitate innovation to happen.
14) People work well together across departmental boundaries.
15) People are involved in suggesting ideas for improvements to products or processes.
16) The structure facilitates rapid decision making.
17) Communication is effective and works top-down, bottom-up and across the organization.
18) The reward and recognition system supports innovation
19) There is a supportive climate for new ideas - people don't have to leave the organization to make them happen.
20) The employees work well in teams.
21) Individuals and teams have space and autonomy for idea generation and creative problem solving.
22) Teams are diverse and heterogeneous in structure i.e. diverse educational, functional and industrial backgrounds.
23) There is an appropriate use of teams to solve problems (at local, cross-functional and inter-organizational level)
24) There are key individuals who energize and facilitate innovation within the organization i.e. promoters, sponsors and champions.

Organizational Culture

13) There is collaboration with other firms to develop new products or processes.
14) The organization develops external networks with people who can provide specialist knowledge.
15) The organization works closely with 'lead users' and customers to develop innovative new products and services
16) Human resource policies support a culture of innovation through stimulating a creative, problem-solving working environment.
17) The skills required for innovation are identified and they are fully resourced through recruitment and training.
18) Career structures support innovation through development of people across different functions.
19) Innovation is covered by employees' appraisals and employees are rewarded for innovation activities.
20) Innovation strategies are deployed to the employee level.
21) Staff can approach top management with ideas and get a fair hearing.
22) Clear innovation targets are set and known by all employees.
23) There is a system for screening and evaluating ideas in the organization.
24) The responsibility for screening decisions doesn't lie too high in the company hierarchy.

Organizational Learning

13) The organization is good at understanding the needs of customers/end-users.
14) There is a strong commitment to training and development of people.
15) Time is taken to review projects to improve performance next time around.
16) The organization learns from its mistakes.
17) The organization systematically compares its products and processes with other firms.
18) The organization meets and shares experiences with other firms to help it learn.
19) The organization is good at capturing what it has learned so that others in the organization can make use of it.
20) The firm is good at learning from other organizations.
21) The organization uses measurement to help identify where and when it can improve its innovation management.
22) The organization design enables creativity, learning and interaction.
23) There is a continuing commitment to education and training.
24) There are high levels of proactive experimentation such as finding and solving problems, communication and sharing of experiences and knowledge capture and dissemination.

Organizational Idea Generation

13) The organization systematically searches for new product/service ideas.
14) Creative ideas are collected on a regular basis from all employees.
15) The number of ideas for new products, services and processes developed in the last 12 months is comparable to the best in class.
16) Ideas originate from all departments, often from contacts with customers.
17) Competitors are monitored regularly. There is a consistent approach to customer surveys and market trend analysis.
18) The company sources for ideas externally e.g. from suppliers.
19) The company belongs to a network i.e. it has close relationships with suppliers and customers and ongoing contacts with universities, government agencies, industry consortia etc.
20) There is extensive networking internal and external.
21) People in the organization know where to take their ideas.
22) Ideas are quickly developed into new product/service concepts.
23) Creativity techniques and workshops are effectively used.
24) There is a positive approach to creative ideas, supported by relevant motivation systems.

Appendix 5

Cronbach`s Alpha

Organizational Strategy – Questions 1 -12

Reliability Statistics

Cronbach's Alpha	N of Items
.987	12

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
1. A technology strategy exists (i.e. an explicit policy for sourcing technologies) and there are mechanisms for understanding current and future technology needs.	29.54	238.857	.907	.986
2. Competitors' innovation rates are known/monitored.	29.52	237.888	.922	.986
3. Performance measures are in place for innovation including goals for new products, services and processes.	29.63	238.256	.944	.985
4. Risk taking is encouraged rather than penalized by management.	29.39	243.675	.901	.986
5. There is a formalized innovation programme in the organization.	29.41	236.992	.931	.986
6. The organization's innovation strategy/policy is promoted throughout the organization.	29.53	239.181	.918	.986
7. There is top management commitment and support for innovation.	29.49	243.081	.884	.986

8. The organization looks ahead in a structured way (using forecasting tools and techniques) to try and imagine future threats and opportunities.	29.31	243.065	.904	.986
9. The top team have a shared vision of how the company will develop through innovation.	29.62	240.622	.940	.985
10. The percentage of revenue from products/services introduced in the last 3 years is high compared to competitors.	29.56	238.653	.942	.985
11. Market share has increased as a result of new products/services introduced in the last 3 years.	29.50	235.687	.948	.985
12. The number of new products/services in the portfolio has been increasing over the last 3 years	29.48	237.525	.933	.985

Organizational Processes – Questions 13 - 24

Reliability Statistics

Cronbach's Alpha	N of Items
.979	12

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
13. There are processes in place to help manage new product development effectively from idea to launch.	27.88	191.743	.904	.977

14. There are effective mechanisms for managing process change from idea through to successful implementation.	28.00	198.566	.856	.978
15. There are mechanisms in place to ensure early involvement of all departments in developing new products/processes.	28.17	189.334	.909	.977
16. There is a clear system for choosing innovation projects.	28.12	191.662	.911	.977
17. Processes are constantly reviewed to identify areas for improvement.	28.03	197.605	.842	.978
18. There is a focus on process improvement rather than on maintenance of processes.	27.82	197.503	.859	.978
19. If it isn't broken, leave it alone is NOT an accepted philosophy in the organisation.	27.89	199.331	.818	.979
20. There is a strong link between product innovation and process improvement to support the product.	28.08	198.014	.840	.979
21. The organisation is at the leading edge of technology in our industry.	28.13	189.266	.914	.977
22. There is participation in organization-wide continuous improvement activity.	28.14	190.324	.928	.977
23. The time-to-market of new products is very short compared to our competitors.	28.21	194.673	.881	.978
24. The organization is constantly developing and introducing new products/services.	28.02	185.515	.955	.976

Organizational Structure – Questions 25 - 36

Reliability Statistics

Cronbach's Alpha	N of Items
.986	12

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
25. The organization structures are flexible and facilitate innovation to happen.	26.01	202.959	.946	.984
26. People work well together across departmental boundaries.	26.03	202.837	.925	.985
27. People are involved in suggesting ideas for improvements to products or processes.	25.75	204.553	.900	.985
28. The structure facilitates rapid decision making.	25.99	202.656	.916	.985
29. Communication is effective and works top-down, bottom-up and across the organization.	25.99	202.838	.921	.985
30. The reward and recognition system supports innovation	25.94	206.501	.918	.985
31. There is a supportive climate for new ideas - people don't have to leave the organization to make them happen.	25.98	205.575	.925	.985
32. The employees work well in teams.	25.84	207.287	.913	.985
33. Individuals and teams have space and autonomy for idea generation and creative problem solving.	25.90	200.475	.942	.984

34. Teams are diverse and heterogeneous in structure i.e. diverse educational, functional and industrial backgrounds.	25.84	204.075	.898	.985
35. There is an appropriate use of teams to solve problems (at local, cross-functional and inter-organizational level)	26.02	203.939	.915	.985
36. There are key individuals who energize and facilitate innovation within the organization i.e. promoters, sponsors and champions.	25.90	206.131	.908	.985

Organizational Culture – Questions 37 - 48

Reliability Statistics

Cronbach's Alpha	N of Items
.983	12

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
37. There is collaboration with other firms to develop new products or processes.	28.99	191.121	.906	.981
38. The organization develops external networks with people who can provide specialist knowledge.	28.89	194.240	.905	.981
39. The organization works closely with 'lead users' and customers to develop innovative new products and services.	29.29	187.359	.915	.981

40. Human resource policies support a culture of innovation through stimulating a creative, problem-solving working environment.	28.91	196.265	.877	.982
41. The skills required for innovation are identified and they are fully resourced through recruitment and training.	28.92	197.145	.860	.982
42. Career structures support innovation through development of people across different functions.	28.90	196.414	.902	.982
43. Employee appraisals reward innovation activities by employees.	28.93	195.379	.887	.982
44. Innovation strategies are deployed to the employee level.	29.28	185.941	.934	.981
45. Staff can approach top management with ideas and get a fair hearing.	28.93	192.631	.881	.982
46. Clear innovation targets are set and known by all employees.	29.32	187.654	.913	.981
47. There is a system for screening and evaluating ideas in the organization.	29.20	186.626	.929	.981
48. The responsibility for screening decisions doesn't lie too high in the company hierarchy.	29.25	185.139	.950	.980

Organizational Learning - Questions 49 – 60

Reliability Statistics

Cronbach's Alpha	N of Items
.988	12

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
49. The organization is good at understanding the needs of customers/end-users.	28.85	222.593	.913	.987
50. There is a strong and continuing commitment to the training and development of people.	28.86	223.172	.926	.987
51. Time is taken to review projects to improve performance next time around.	29.08	217.852	.925	.986
52. The organization learns from its mistakes.	28.99	224.454	.888	.987
53. The organization systematically compares its products and processes with other firms.	28.88	224.127	.919	.987
54. The organization meets and shares experiences with other firms to help it to learn.	29.27	217.027	.925	.986
55. The organization is good at capturing what it has learned so that others in the organization can make use of it.	29.32	216.947	.928	.986
56. The firm is good at learning from other organizations.	28.94	221.916	.926	.987
57. The organization uses measurement to help identify where and when it can improve its innovation management.	29.34	216.307	.931	.986
58. The organization design enables creativity, learning and interaction.	29.18	211.381	.966	.986

59. There are high levels of proactive experimentation such as finding and solving problems.	29.28	215.598	.942	.986
60. There are high levels of knowledge capture and the communication and sharing of experiences.	29.15	210.937	.965	.986

Organizational Idea Generation - Questions 61 - 72

Reliability Statistics

Cronbach's Alpha	N of Items
.986	12

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
61. The organisation systematically searches for new product/service ideas.	29.19	241.852	.921	.985
62. Creative ideas are collected on a regular basis from all employees.	29.23	243.250	.931	.985
63. The number of ideas for new products, services and processes developed in the last 12 months is comparable to the best in class.	29.39	239.230	.937	.984
64. Ideas originate from all departments.	29.32	237.998	.948	.984
65. There is consistent scanning of customer surveys and market trend analysis.	29.01	247.828	.900	.985
66. The company sources for ideas externally e.g. from suppliers and customers.	29.06	249.471	.882	.986

67. The company belongs to a network i.e. it has close relationships with suppliers and customers and ongoing contacts with universities, government agencies, industry consortia etc.	29.08	253.670	.850	.986
68. There is extensive networking internal and external.	29.33	245.819	.877	.986
69. People in the organization know where to take their ideas.	29.09	242.325	.928	.985
70. Ideas are quickly developed into new product/service concepts.	29.24	239.093	.946	.984
71. Creativity techniques and workshops are effectively used.	29.23	238.401	.954	.984
72. There is a positive approach to creative ideas, supported by relevant motivation systems.	29.18	235.947	.963	.984

All Categories - Questions 1 - 72

Reliability Statistics

Cronbach's Alpha	N of Items
.997	72

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
1. A technology strategy exists (i.e. an explicit policy for sourcing technologies) and there are mechanisms for understanding current and future technology needs.	183.72	8680.789	.871	.997
2. Competitors' innovation rates are known/monitored.	183.70	8666.273	.915	.997

3. Performance measures are in place for innovation including goals for new products, services and processes.	183.81	8671.731	.923	.997
4. Risk taking is encouraged rather than penalized by management.	183.57	8702.934	.886	.997
5. There is a formalized innovation programme in the organization.	183.59	8661.436	.922	.997
6. The organization's innovation strategy/policy is promoted throughout the organization.	183.71	8682.632	.880	.997
7. There is top management commitment and support for innovation.	183.67	8697.274	.879	.997
8. The organization looks ahead in a structured way (using forecasting tools and techniques) to try and imagine future threats and opportunities.	183.49	8698.899	.891	.997
9. The top team have a shared vision of how the company will develop through innovation.	183.80	8686.949	.915	.997
10. The percentage of revenue from products/services introduced in the last 3 years is high compared to competitors.	183.74	8674.982	.918	.997
11. Market share has increased as a result of new products/services introduced in the last 3 years.	183.68	8650.179	.949	.997
12. The number of new products/services in the portfolio has been increasing over the last 3 years	183.66	8674.085	.890	.997

13. There are processes in place to help manage new product development effectively from idea to launch.	183.65	8687.058	.910	.997
14. There are effective mechanisms for managing process change from idea through to successful implementation.	183.77	8732.846	.862	.997
15. There are mechanisms in place to ensure early involvement of all departments in developing new products/processes.	183.94	8668.360	.924	.997
16. There is a clear system for choosing innovation projects.	183.89	8686.301	.917	.997
17. Processes are constantly reviewed to identify areas for improvement.	183.80	8724.747	.857	.997
18. There is a focus on process improvement rather than on maintenance of processes.	183.59	8726.911	.861	.997
19. If it isn't broken, leave it alone is NOT an accepted philosophy in the organisation.	183.66	8738.994	.822	.997
20. There is a strong link between product innovation and process improvement to support the product.	183.85	8726.311	.860	.997
21. The organisation is at the leading edge of technology in our industry.	183.90	8668.475	.926	.997
22. There is participation in organization-wide continuous improvement activity.	183.91	8676.265	.937	.997
23. The time-to-market of new products is very short compared to our competitors.	183.98	8703.535	.901	.997

24. The organization is constantly developing and introducing new products/services.	183.79	8644.693	.959	.997
25. The organization structures are flexible and facilitate innovation to happen.	184.08	8686.357	.942	.997
26. People work well together across departmental boundaries.	184.10	8687.465	.916	.997
27. People are involved in suggesting ideas for improvements to products or processes.	183.82	8697.038	.899	.997
28. The structure facilitates rapid decision making.	184.06	8685.552	.910	.997
29. Communication is effective and works top-down, bottom-up and across the organization.	184.06	8686.683	.915	.997
30. The reward and recognition system supports innovation	184.01	8710.980	.909	.997
31. There is a supportive climate for new ideas - people don't have to leave the organization to make them happen.	184.05	8702.553	.926	.997
32. The employees work well in teams.	183.91	8713.052	.917	.997
33. Individuals and teams have space and autonomy for idea generation and creative problem solving.	183.97	8668.797	.944	.997
34. Teams are diverse and heterogeneous in structure i.e. diverse educational, functional and industrial backgrounds.	183.91	8692.931	.901	.997

35. There is an appropriate use of teams to solve problems (at local, cross-functional and inter-organizational level)	184.09	8694.083	.908	.997
36. There are key individuals who energize and facilitate innovation within the organization i.e. promoters, sponsors and champions.	183.97	8709.524	.896	.997
37. There is collaboration with other firms to develop new products or processes.	183.64	8700.132	.908	.997
38. The organization develops external networks with people who can provide specialist knowledge.	183.54	8720.998	.906	.997
39. The organization works closely with 'lead users' and customers to develop innovative new products and services.	183.94	8671.208	.930	.997
40. Human resource policies support a culture of innovation through stimulating a creative, problem-solving working environment.	183.56	8734.249	.881	.997
41. The skills required for innovation are identified and they are fully resourced through recruitment and training.	183.57	8742.753	.853	.997
42. Career structures support innovation through development of people across different functions.	183.55	8736.270	.899	.997
43. Employee appraisals reward innovation activities by employees.	183.58	8728.448	.891	.997
44. Innovation strategies are deployed to the employee level.	183.93	8664.955	.936	.997

45. Staff can approach top management with ideas and get a fair hearing.	183.58	8707.216	.897	.997
46. Clear innovation targets are set and known by all employees.	183.97	8675.363	.920	.997
47. There is a system for screening and evaluating ideas in the organization.	183.85	8669.422	.931	.997
48. The responsibility for screening decisions doesn't lie too high in the company hierarchy.	183.90	8661.626	.943	.997
49. The organization is good at understanding the needs of customers/end-users.	183.47	8712.151	.907	.997
50. There is a strong and continuing commitment to the training and development of people.	183.48	8716.474	.915	.997
51. Time is taken to review projects to improve performance next time around.	183.70	8680.980	.924	.997
52. The organization learns from its mistakes.	183.61	8724.038	.882	.997
53. The organization systematically compares its products and processes with other firms.	183.50	8722.091	.910	.997
54. The organization meets and shares experiences with other firms to help it to learn.	183.89	8675.271	.927	.997
55. The organization is good at capturing what it has learned so that others in the organization can make use of it.	183.94	8672.885	.937	.997
56. The firm is good at learning from other organizations.	183.56	8707.097	.922	.997

57. The organization uses measurement to help identify where and when it can improve its innovation management.	183.96	8671.211	.931	.997
58. The organization design enables creativity, learning and interaction.	183.80	8636.727	.974	.997
59. There are high levels of proactive experimentation such as finding and solving problems.	183.90	8664.535	.949	.997
60. There are high levels of knowledge capture and the communication and sharing of experiences.	183.77	8634.664	.970	.997
61. The organisation systematically searches for new product/service ideas.	183.70	8663.485	.929	.997
62. Creative ideas are collected on a regular basis from all employees.	183.74	8675.992	.923	.997
63. The number of ideas for new products, services and processes developed in the last 12 months is comparable to the best in class.	183.90	8645.525	.951	.997
64. Ideas originate from all departments.	183.83	8640.264	.954	.997
65. There is consistent scanning of customer surveys and market trend analysis.	183.52	8701.848	.898	.997
66. The company sources for ideas externally e.g. from suppliers and customers.	183.57	8710.773	.884	.997
67. The company belongs to a network i.e. it has close relationships with suppliers and customers and ongoing contacts with universities, government agencies, industry consortia etc.	183.59	8735.335	.853	.997

68. There is extensive networking internal and external.	183.84	8685.954	.892	.997
69. People in the organization know where to take their ideas.	183.60	8668.283	.928	.997
70. Ideas are quickly developed into new product/service concepts.	183.75	8647.886	.949	.997
71. Creativity techniques and workshops are effectively used.	183.74	8642.922	.959	.997
72. There is a positive approach to creative ideas, supported by relevant motivation systems.	183.69	8627.004	.971	.997

Appendix 6

The Innovation Audit Questionnaire Results – One-Sided Firms

Organizational Strategy

Question 1: A technology strategy exists (i.e. an explicit policy for sourcing technologies) and there are mechanisms for understanding current and future technology needs.

Rank value	Option	Count
1	1 Strongly Disagree	37
2	2 Disagree	6
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.14	
Variance	0.12	
Standard Deviation	0.35	
Lower Quartile	1.0	
Upper Quartile	1.0	

Question 2: Competitors' innovation rates are known/monitored.

Rank value	Option	Count
1	1 Strongly Disagree	37
2	2 Disagree	6
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.14	
Variance	0.12	
Standard Deviation	0.35	
Lower Quartile	1.0	
Upper Quartile	1.0	

Question 3: Performance measures are in place for innovation including goals for new products, services and processes.

Rank value	Option	Count
1	1 Strongly Disagree	41
2	2 Disagree	2
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.05	
Variance	0.04	
Standard Deviation	0.21	
Lower Quartile	1.0	
Upper Quartile	1.0	

Question 4: Risk taking is encouraged rather than penalized by management.

Rank value	Option	Count
1	1 Strongly Disagree	22
2	2 Disagree	21
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.49	
Variance	0.25	
Standard Deviation	0.5	
Lower Quartile	1.0	
Upper Quartile	2.0	

Question 5: There is a formalized innovation programme in the organization.

Rank value	Option	Count
1	1 Strongly Disagree	34
2	2 Disagree	9
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.21	
Variance	0.17	
Standard Deviation	0.41	
Lower Quartile	1.0	
Upper Quartile	1.0	

Question 6: The organization's innovation strategy/policy is promoted throughout the organization.

Rank value	Option	Count
1	1 Strongly Disagree	36
2	2 Disagree	7
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.16	
Variance	0.14	
Standard Deviation	0.37	
Lower Quartile	1.0	
Upper Quartile	1.0	

Question 7: There is top management commitment and support for innovation.

Rank value	Option	Count
1	1 Strongly Disagree	27
2	2 Disagree	16
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0

Mean rank	1.37
Variance	0.23
Standard Deviation	0.48
Lower Quartile	1.0
Upper Quartile	2.0

Question 8: The organization looks ahead in a structured way (using forecasting tools and techniques) to try and imagine future threats and opportunities.

Rank value	Option	Count
1	1 Strongly Disagree	22
2	2 Disagree	21
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0

Mean rank	1.49
Variance	0.25
Standard Deviation	0.5
Lower Quartile	1.0
Upper Quartile	2.0

Question 9: The top team have a shared vision of how the company will develop through innovation.

Rank value	Option	Count
1	1 Strongly Disagree	36
2	2 Disagree	7
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0

Mean rank	1.16
Variance	0.14
Standard Deviation	0.37
Lower Quartile	1.0
Upper Quartile	1.0

Question 10: The percentage of revenue from products/services introduced in the last 3 years is high compared to competitors.

Rank value	Option	Count
1	1 Strongly Disagree	36
2	2 Disagree	7
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.16	
Variance	0.14	
Standard Deviation	0.37	
Lower Quartile	1.0	
Upper Quartile	1.0	

Question 11: Market share has increased as a result of new products/services introduced in the last 3 years

Rank value	Option	Count
1	1 Strongly Disagree	37
2	2 Disagree	6
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.14	
Variance	0.12	
Standard Deviation	0.35	
Lower Quartile	1.0	
Upper Quartile	1.0	

Question 12: The number of new products/services in the portfolio has been increasing over the last 3 years

Rank value	Option	Count
1	1 Strongly Disagree	36
2	2 Disagree	7
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.16	
Variance	0.14	
Standard Deviation	0.37	
Lower Quartile	1.0	
Upper Quartile	1.0	

Organizational Processes

Question 13: There are processes in place to help manage new product development effectively from idea to launch.

Rank value	Option	Count
1	1 Strongly Disagree	22
2	2 Disagree	21
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.49	
Variance	0.25	
Standard Deviation	0.5	
Lower Quartile	1.0	
Upper Quartile	2.0	

Question 14: There are effective mechanisms for managing process change from idea through to successful implementation.

Rank value	Option	Count
1	1 Strongly Disagree	20
2	2 Disagree	23
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.53	
Variance	0.25	
Standard Deviation	0.5	
Lower Quartile	1.0	
Upper Quartile	2.0	

Question 15: There are mechanisms in place to ensure early involvement of all departments in developing new products/processes.

Rank value	Option	Count
1	1 Strongly Disagree	41
2	2 Disagree	2
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.05	
Variance	0.04	
Standard Deviation	0.21	
Lower Quartile	1.0	
Upper Quartile	1.0	

Question 16: **There is a clear system for choosing innovation projects.**

Rank value	Option	Count
1	1 Strongly Disagree	36
2	2 Disagree	7
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.16	
Variance	0.14	
Standard Deviation	0.37	
Lower Quartile	1.0	
Upper Quartile	1.0	

Question 17: **Processes are constantly reviewed to identify areas for improvement**

Rank value	Option	Count
1	1 Strongly Disagree	22
2	2 Disagree	21
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.49	
Variance	0.25	
Standard Deviation	0.5	
Lower Quartile	1.0	
Upper Quartile	2.0	

Question 18: **There is a focus on process improvement rather than on maintenance of processes.**

Rank value	Option	Count
1	1 Strongly Disagree	9
2	2 Disagree	34
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.79	
Variance	0.17	
Standard Deviation	0.41	
Lower Quartile	2.0	
Upper Quartile	2.0	

Question 19: If it isn't broken, leave it alone is NOT an accepted philosophy in the organisation.

Rank value	Option	Count
1	1 Strongly Disagree	9
2	2 Disagree	34
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.79	
Variance	0.17	
Standard Deviation	0.41	
Lower Quartile	2.0	
Upper Quartile	2.0	

Question 20: There is a strong link between product innovation and process improvement to support the product.

Rank value	Option	Count
1	1 Strongly Disagree	25
2	2 Disagree	18
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.42	
Variance	0.24	
Standard Deviation	0.49	
Lower Quartile	1.0	
Upper Quartile	2.0	

Question 21: The organisation is at the leading edge of technology in our industry.

Rank value	Option	Count
1	1 Strongly Disagree	42
2	2 Disagree	1
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.02	
Variance	0.02	
Standard Deviation	0.15	
Lower Quartile	1.0	
Upper Quartile	1.0	

Question 22: There is participation in organization-wide continuous improvement activity.

Rank value	Option	Count
1	1 Strongly Disagree	39
2	2 Disagree	4
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0

Mean rank	1.09
Variance	0.08
Standard Deviation	0.29
Lower Quartile	1.0
Upper Quartile	1.0

Question 23: The time-to-market of new products is very short compared to our competitors.

Rank value	Option	Count
1	1 Strongly Disagree	35
2	2 Disagree	8
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0

Mean rank	1.19
Variance	0.15
Standard Deviation	0.39
Lower Quartile	1.0
Upper Quartile	1.0

Question 24: The organization is constantly developing and introducing new products/services.

Rank value	Option	Count
1	1 Strongly Disagree	42
2	2 Disagree	1
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0

Mean rank	1.02
Variance	0.02
Standard Deviation	0.15
Lower Quartile	1.0
Upper Quartile	1.0

Organizational Structure

Question 25: The organization structures are flexible and facilitate innovation to happen.

Rank value	Option	Count
1	1 Strongly Disagree	43
2	2 Disagree	0
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.0	
Variance	0.0	
Standard Deviation	0.0	
Lower Quartile	1.0	
Upper Quartile	1.0	

Question 26: People work well together across departmental boundaries.

Rank value	Option	Count
1	1 Strongly Disagree	42
2	2 Disagree	1
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.02	
Variance	0.02	
Standard Deviation	0.15	
Lower Quartile	1.0	
Upper Quartile	1.0	

Question 27: People are involved in suggesting ideas for improvements to products or processes.

Rank value	Option	Count
1	1 Strongly Disagree	27
2	2 Disagree	16
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.37	
Variance	0.23	
Standard Deviation	0.48	
Lower Quartile	1.0	
Upper Quartile	2.0	

Question 28: **The structure facilitates rapid decision making.**

Rank value	Option	Count
1	1 Strongly Disagree	43
2	2 Disagree	0
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0

Mean rank	1.0
Variance	0.0
Standard Deviation	0.0
Lower Quartile	1.0
Upper Quartile	1.0

Question 29: **Communication is effective and works top-down, bottom-up and across the organization.**

Rank value	Option	Count
1	1 Strongly Disagree	43
2	2 Disagree	0
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0

Mean rank	1.0
Variance	0.0
Standard Deviation	0.0
Lower Quartile	1.0
Upper Quartile	1.0

Question 30: **The reward and recognition system supports innovation**

Rank value	Option	Count
1	1 Strongly Disagree	34
2	2 Disagree	9
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0

Mean rank	1.21
Variance	0.17
Standard Deviation	0.41
Lower Quartile	1.0
Upper Quartile	1.0

Question 31: There is a supportive climate for new ideas - people don't have to leave the organization to make them happen.

Rank value	Option	Count
1	1 Strongly Disagree	41
2	2 Disagree	2
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.05	
Variance	0.04	
Standard Deviation	0.21	
Lower Quartile	1.0	
Upper Quartile	1.0	

Question 32: The employees work well in teams.

Rank value	Option	Count
1	1 Strongly Disagree	28
2	2 Disagree	15
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.35	
Variance	0.23	
Standard Deviation	0.48	
Lower Quartile	1.0	
Upper Quartile	2.0	

Question 33: Individuals and teams have space and autonomy for idea generation and creative problem solving.

Rank value	Option	Count
1	1 Strongly Disagree	42
2	2 Disagree	1
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.02	
Variance	0.02	
Standard Deviation	0.15	
Lower Quartile	1.0	
Upper Quartile	1.0	

Question 34: Teams are diverse and heterogeneous in structure i.e. diverse educational, functional and industrial backgrounds.

Rank value	Option	Count
1	1 Strongly Disagree	35
2	2 Disagree	8
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.19	
Variance	0.15	
Standard Deviation	0.39	
Lower Quartile	1.0	
Upper Quartile	1.0	

Question 35: There is an appropriate use of teams to solve problems (at local, cross-functional and inter-organizational level).

Rank value	Option	Count
1	1 Strongly Disagree	39
2	2 Disagree	4
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.09	
Variance	0.08	
Standard Deviation	0.29	
Lower Quartile	1.0	
Upper Quartile	1.0	

Question 36: There are key individuals who energize and facilitate innovation within the organization i.e. promoters, sponsors and champions.

Rank value	Option	Count
1	1 Strongly Disagree	29
2	2 Disagree	14
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.33	
Variance	0.22	
Standard Deviation	0.47	
Lower Quartile	1.0	
Upper Quartile	2.0	

Organizational Culture

Question 37: There is collaboration with other firms to develop new products or processes.

Rank value	Option	Count
1	1 Strongly Disagree	17
2	2 Disagree	26
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.6	
Variance	0.24	
Standard Deviation	0.49	
Lower Quartile	1.0	
Upper Quartile	2.0	

Question 38: The organization develops external networks with people who can provide specialist knowledge.

Rank value	Option	Count
1	1 Strongly Disagree	9
2	2 Disagree	34
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.79	
Variance	0.17	
Standard Deviation	0.41	
Lower Quartile	2.0	
Upper Quartile	2.0	

Question 39: The organization works closely with 'lead users' and customers to develop innovative new products and services.

Rank value	Option	Count
1	1 Strongly Disagree	42
2	2 Disagree	1
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.02	
Variance	0.02	
Standard Deviation	0.15	
Lower Quartile	1.0	
Upper Quartile	1.0	

Question 40: **Human resource policies support a culture of innovation through stimulating a creative, problem-solving working environment.**

Rank value	Option	Count
1	1 Strongly Disagree	9
2	2 Disagree	34
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.79	
Variance	0.17	
Standard Deviation	0.41	
Lower Quartile	2.0	
Upper Quartile	2.0	

Question 41: **The skills required for innovation are identified and they are fully resourced through recruitment and training.**

Rank value	Option	Count
1	1 Strongly Disagree	5
2	2 Disagree	38
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.88	
Variance	0.1	
Standard Deviation	0.32	
Lower Quartile	2.0	
Upper Quartile	2.0	

Question 42: **Career structures support innovation through development of people across different functions.**

Rank value	Option	Count
1	1 Strongly Disagree	5
2	2 Disagree	38
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.88	
Variance	0.1	
Standard Deviation	0.32	
Lower Quartile	2.0	
Upper Quartile	2.0	

Question 43: Employee appraisals reward innovation activities by employees.

Rank value	Option	Count
1	1 Strongly Disagree	7
2	2 Disagree	36
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.84	
Variance	0.14	
Standard Deviation	0.37	
Lower Quartile	2.0	
Upper Quartile	2.0	

Question 44: Innovation strategies are deployed to the employee level.

Rank value	Option	Count
1	1 Strongly Disagree	43
2	2 Disagree	0
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.0	
Variance	0.0	
Standard Deviation	0.0	
Lower Quartile	1.0	
Upper Quartile	1.0	

Question 45: Staff can approach top management with ideas and get a fair hearing.

Rank value	Option	Count
1	1 Strongly Disagree	15
2	2 Disagree	28
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.65	
Variance	0.23	
Standard Deviation	0.48	
Lower Quartile	1.0	
Upper Quartile	2.0	

Question 46: Clear innovation targets are set and known by all employees.

Rank value	Option	Count
1	1 Strongly Disagree	43
2	2 Disagree	0
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.0	
Variance	0.0	
Standard Deviation	0.0	
Lower Quartile	1.0	
Upper Quartile	1.0	

Question 47: There is a system for screening and evaluating ideas in the organization.

Rank value	Option	Count
1	1 Strongly Disagree	37
2	2 Disagree	6
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.14	
Variance	0.12	
Standard Deviation	0.35	
Lower Quartile	1.0	
Upper Quartile	1.0	

Question 48: The responsibility for screening decisions doesn't lie too high in the company hierarchy.

Rank value	Option	Count
1	1 Strongly Disagree	40
2	2 Disagree	3
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.07	
Variance	0.06	
Standard Deviation	0.25	
Lower Quartile	1.0	
Upper Quartile	1.0	

Organizational Learning

Question 49: The organization is good at understanding the needs of customers/end-users.

Rank value	Option	Count
1	1 Strongly Disagree	8
2	2 Disagree	35
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.81	
Variance	0.15	
Standard Deviation	0.39	
Lower Quartile	2.0	
Upper Quartile	2.0	

Question 50: There is a strong and continuing commitment to the training and development of people.

Rank value	Option	Count
1	1 Strongly Disagree	7
2	2 Disagree	36
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.84	
Variance	0.14	
Standard Deviation	0.37	
Lower Quartile	2.0	
Upper Quartile	2.0	

Question 51: Time is taken to review projects to improve performance next time around.

Rank value	Option	Count
1	1 Strongly Disagree	25
2	2 Disagree	18
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.42	
Variance	0.24	
Standard Deviation	0.49	
Lower Quartile	1.0	
Upper Quartile	2.0	

Question 52: The organization learns from its mistakes.

Rank value	Option	Count
1	1 Strongly Disagree	7
2	2 Disagree	36
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0

Mean rank	1.84
Variance	0.14
Standard Deviation	0.37
Lower Quartile	2.0
Upper Quartile	2.0

Question 53: The organization systematically compares its products and processes with other firms.

Rank value	Option	Count
1	1 Strongly Disagree	6
2	2 Disagree	37
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0

Mean rank	1.86
Variance	0.12
Standard Deviation	0.35
Lower Quartile	2.0
Upper Quartile	2.0

Question 54: The organization meets and shares experiences with other firms to help it to learn.

Rank value	Option	Count
1	1 Strongly Disagree	39
2	2 Disagree	4
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0

Mean rank	1.09
Variance	0.08
Standard Deviation	0.29
Lower Quartile	1.0
Upper Quartile	1.0

Question 55: The organization is good at capturing what it has learned so that others in the organization can make use of it.

Rank value	Option	Count
1	1 Strongly Disagree	42
2	2 Disagree	1
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.02	
Variance	0.02	
Standard Deviation	0.15	
Lower Quartile	1.0	
Upper Quartile	1.0	

Question 56: The firm is good at learning from other organizations.

Rank value	Option	Count
1	1 Strongly Disagree	14
2	2 Disagree	29
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.67	
Variance	0.22	
Standard Deviation	0.47	
Lower Quartile	1.0	
Upper Quartile	2.0	

Question 57: The organization uses measurement to help identify where and when it can improve its innovation management.

Rank value	Option	Count
1	1 Strongly Disagree	38
2	2 Disagree	5
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.12	
Variance	0.1	
Standard Deviation	0.32	
Lower Quartile	1.0	
Upper Quartile	1.0	

Question 58: **The organization design enables creativity, learning and interaction.**

Rank value	Option	Count
1	1 Strongly Disagree	42
2	2 Disagree	1
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0

Mean rank	1.02
Variance	0.02
Standard Deviation	0.15
Lower Quartile	1.0
Upper Quartile	1.0

Question 59: **There are high levels of proactive experimentation such as finding and solving problems.**

Rank value	Option	Count
1	1 Strongly Disagree	42
2	2 Disagree	1
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0

Mean rank	1.02
Variance	0.02
Standard Deviation	0.15
Lower Quartile	1.0
Upper Quartile	1.0

Question 60: **There are high levels of knowledge capture and the communication and sharing of experiences.**

Rank value	Option	Count
1	1 Strongly Disagree	43
2	2 Disagree	0
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0

Mean rank	1.0
Variance	0.0
Standard Deviation	0.0
Lower Quartile	1.0
Upper Quartile	1.0

Organizational Idea Generation

Question 61: The organisation systematically searches for new product/service ideas.

Rank value	Option	Count
1	1 Strongly Disagree	32
2	2 Disagree	11
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0

Mean rank	1.26
Variance	0.19
Standard Deviation	0.44
Lower Quartile	1.0
Upper Quartile	1.5

Question 62: Creative ideas are collected on a regular basis from all employees.

Rank value	Option	Count
1	1 Strongly Disagree	28
2	2 Disagree	15
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0

Mean rank	1.35
Variance	0.23
Standard Deviation	0.48
Lower Quartile	1.0
Upper Quartile	2.0

Question 63: The number of ideas for new products, services and processes developed in the last 12 months is comparable to the best in class.

Rank value	Option	Count
1	1 Strongly Disagree	43
2	2 Disagree	0
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0

Mean rank	1.0
Variance	0.0
Standard Deviation	0.0
Lower Quartile	1.0
Upper Quartile	1.0

Question 64: **Ideas originate from all departments.**

Rank value	Option	Count
1	1 Strongly Disagree	42
2	2 Disagree	1
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.02	
Variance	0.02	
Standard Deviation	0.15	
Lower Quartile	1.0	
Upper Quartile	1.0	

Question 65: **There is consistent scanning of customer surveys and market trend analysis.**

Rank value	Option	Count
1	1 Strongly Disagree	12
2	2 Disagree	31
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.72	
Variance	0.2	
Standard Deviation	0.45	
Lower Quartile	1.0	
Upper Quartile	2.0	

Question 66: **The company sources for ideas externally e.g. from suppliers and customers.**

Rank value	Option	Count
1	1 Strongly Disagree	12
2	2 Disagree	31
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.72	
Variance	0.2	
Standard Deviation	0.45	
Lower Quartile	1.0	
Upper Quartile	2.0	

Question 67: **The company belongs to a network i.e. it has close relationships with suppliers and customers and ongoing contacts with universities, government agencies, industry consortia etc.**

Rank value	Option	Count
1	1 Strongly Disagree	10
2	2 Disagree	33
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.77	
Variance	0.18	
Standard Deviation	0.42	
Lower Quartile	2.0	
Upper Quartile	2.0	

Question 68: **There is extensive networking internal and external.**

Rank value	Option	Count
1	1 Strongly Disagree	34
2	2 Disagree	9
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.21	
Variance	0.17	
Standard Deviation	0.41	
Lower Quartile	1.0	
Upper Quartile	1.0	

Question 69: **People in the organization know where to take their ideas.**

Rank value	Option	Count
1	1 Strongly Disagree	21
2	2 Disagree	22
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0
Mean rank	1.51	
Variance	0.25	
Standard Deviation	0.5	
Lower Quartile	1.0	
Upper Quartile	2.0	

Question 70: Ideas are quickly developed into new product/service concepts.

Rank value	Option	Count
1	1 Strongly Disagree	36
2	2 Disagree	7
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0

Mean rank	1.16
Variance	0.14
Standard Deviation	0.37
Lower Quartile	1.0
Upper Quartile	1.0

Question 71: Creativity techniques and workshops are effectively used.

Rank value	Option	Count
1	1 Strongly Disagree	37
2	2 Disagree	6
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0

Mean rank	1.14
Variance	0.12
Standard Deviation	0.35
Lower Quartile	1.0
Upper Quartile	1.0

Question 72: There is a positive approach to creative ideas, supported by relevant motivation systems.

Rank value	Option	Count
1	1 Strongly Disagree	38
2	2 Disagree	5
3	3 Partially Agree	0
4	4 Agree	0
5	5 Strongly Agree	0

Mean rank	1.12
Variance	0.1
Standard Deviation	0.32
Lower Quartile	1.0
Upper Quartile	1.0

Appendix 7

The Innovation Audit Questionnaire Results – Two-Sided Firms

Organizational Strategy

Question 1: A technology strategy exists (i.e. an explicit policy for sourcing technologies) and there are mechanisms for understanding current and future technology needs.

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	6
3	3 Partially Agree	21
4	4 Agree	10
5	5 Strongly Agree	20
Mean rank	3.77	
Variance	1.09	
Standard Deviation	1.04	
Lower Quartile	3	
Upper Quartile	5	

Question 2: Competitors' innovation rates are known/monitored.

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	7
3	3 Partially Agree	16
4	4 Agree	15
5	5 Strongly Agree	19
Mean rank	3.81	
Variance	1.07	
Standard Deviation	1.03	
Lower Quartile	3	
Upper Quartile	5	

Question 3: Performance measures are in place for innovation including goals for new products, services and processes.

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	5
3	3 Partially Agree	24
4	4 Agree	12
5	5 Strongly Agree	16
Mean rank	3.68	
Variance	0.95	
Standard Deviation	0.98	
Lower Quartile	3	
Upper Quartile	5	

Question 4: Risk taking is encouraged rather than penalized by management.

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	4
3	3 Partially Agree	22
4	4 Agree	14
5	5 Strongly Agree	17

Mean rank 3.77
Variance 0.91
Standard Deviation 0.96
Lower Quartile 3
Upper Quartile 5

Question 5: There is a formalized innovation programme in the organization.

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	4
3	3 Partially Agree	17
4	4 Agree	14
5	5 Strongly Agree	22

Mean rank 3.95
Variance 0.96
Standard Deviation 0.98
Lower Quartile 3
Upper Quartile 5

Question 6: The organization's innovation strategy/policy is promoted throughout the organization.

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	6
3	3 Partially Agree	18
4	4 Agree	16
5	5 Strongly Agree	17

Mean rank 3.77
Variance 0.98
Standard Deviation 0.99
Lower Quartile 3
Upper Quartile 5

Question 7: There is top management commitment and support for innovation.

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	8
3	3 Partially Agree	19
4	4 Agree	13
5	5 Strongly Agree	17
Mean rank	3.68	
Variance	1.09	
Standard Deviation	1.05	
Lower Quartile	3	
Upper Quartile	5	

Question 8: The organization looks ahead in a structured way (using forecasting tools and techniques) to try and imagine future threats and opportunities.

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	4
3	3 Partially Agree	11
4	4 Agree	28
5	5 Strongly Agree	14
Mean rank	3.91	
Variance	0.71	
Standard Deviation	0.84	
Lower Quartile	3	
Upper Quartile	4	

Question 9: The top team have a shared vision of how the company will develop through innovation.

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	7
3	3 Partially Agree	20
4	4 Agree	18
5	5 Strongly Agree	12
Mean rank	3.61	
Variance	0.9	
Standard Deviation	0.95	
Lower Quartile	3	
Upper Quartile	4	

Question 10: The percentage of revenue from products/services introduced in the last 3 years is high compared to competitors.

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	4
3	3 Partially Agree	27
4	4 Agree	7
5	5 Strongly Agree	19
Mean rank	3.72	
Variance	1.01	
Standard Deviation	1.0	
Lower Quartile	3	
Upper Quartile	5	

Question 11: Market share has increased as a result of new products/services introduced in the last 3 years

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	6
3	3 Partially Agree	21
4	4 Agree	6
5	5 Strongly Agree	24
Mean rank	3.84	
Variance	1.19	
Standard Deviation	1.09	
Lower Quartile	3	
Upper Quartile	5	

Question 12: The number of new products/services in the portfolio has been increasing over the last 3 years

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	5
3	3 Partially Agree	17
4	4 Agree	16
5	5 Strongly Agree	19
Mean rank	3.86	
Variance	0.96	
Standard Deviation	0.98	
Lower Quartile	3	
Upper Quartile	5	

Organizational Processes

Question 13: There are processes in place to help manage new product development effectively from idea to launch.

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	13
3	3 Partially Agree	17
4	4 Agree	5
5	5 Strongly Agree	22
Mean rank	3.63	
Variance	1.46	
Standard Deviation	1.21	
Lower Quartile	3	
Upper Quartile	5	

Question 14: There are effective mechanisms for managing process change from idea through to successful implementation.

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	10
3	3 Partially Agree	27
4	4 Agree	8
5	5 Strongly Agree	12
Mean rank	3.39	
Variance	1.01	
Standard Deviation	1.0	
Lower Quartile	3	
Upper Quartile	4	

Question 15: There are mechanisms in place to ensure early involvement of all departments in developing new products/processes.

Rank value	Option	Count
1	1 Strongly Disagree	1
2	2 Disagree	16
3	3 Partially Agree	14
4	4 Agree	8
5	5 Strongly Agree	18
Mean rank	3.46	
Variance	1.55	
Standard Deviation	1.24	
Lower Quartile	2	
Upper Quartile	5	

Question 16: **There is a clear system for choosing innovation projects.**

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	14
3	3 Partially Agree	17
4	4 Agree	12
5	5 Strongly Agree	14
Mean rank	3.46	
Variance	1.23	
Standard Deviation	1.11	
Lower Quartile	3	
Upper Quartile	4	

Question 17: **Processes are constantly reviewed to identify areas for improvement**

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	14
3	3 Partially Agree	22
4	4 Agree	7
5	5 Strongly Agree	14
Mean rank	3.37	
Variance	1.22	
Standard Deviation	1.1	
Lower Quartile	3	
Upper Quartile	4	

Question 18: **There is a focus on process improvement rather than on maintenance of processes.**

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	15
3	3 Partially Agree	17
4	4 Agree	6
5	5 Strongly Agree	19
Mean rank	3.51	
Variance	1.44	
Standard Deviation	1.2	
Lower Quartile	2	
Upper Quartile	5	

Question 19: If it isn't broken, leave it alone is NOT an accepted philosophy in the organisation

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	20
3	3 Partially Agree	12
4	4 Agree	8
5	5 Strongly Agree	17
Mean rank	3.39	
Variance	1.54	
Standard Deviation	1.24	
Lower Quartile	2	
Upper Quartile	5	

Question 20: There is a strong link between product innovation and process improvement to support the product.

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	13
3	3 Partially Agree	24
4	4 Agree	8
5	5 Strongly Agree	12
Mean rank	3.33	
Variance	1.1	
Standard Deviation	1.05	
Lower Quartile	3	
Upper Quartile	4	

Question 21: The organisation is at the leading edge of technology in our industry.

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	12
3	3 Partially Agree	20
4	4 Agree	7
5	5 Strongly Agree	18
Mean rank	3.54	
Variance	1.3	
Standard Deviation	1.14	
Lower Quartile	3	
Upper Quartile	5	

Question 22: There is participation in organization-wide continuous improvement activity.

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	13
3	3 Partially Agree	19
4	4 Agree	10
5	5 Strongly Agree	15
Mean rank	3.47	
Variance	1.23	
Standard Deviation	1.11	
Lower Quartile	3	
Upper Quartile	5	

Question 23: The time-to-market of new products is very short compared to our competitors.

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	16
3	3 Partially Agree	22
4	4 Agree	6
5	5 Strongly Agree	13
Mean rank	3.28	
Variance	1.22	
Standard Deviation	1.1	
Lower Quartile	2	
Upper Quartile	4	

Question 24: The organization is constantly developing and introducing new products/services.

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	9
3	3 Partially Agree	20
4	4 Agree	5
5	5 Strongly Agree	23
Mean rank	3.74	
Variance	1.32	
Standard Deviation	1.15	
Lower Quartile	3	
Upper Quartile	5	

Organizational Structure

Question 25: The organization structures are flexible and facilitate innovation to happen.

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	20
3	3 Partially Agree	13
4	4 Agree	14
5	5 Strongly Agree	10
Mean rank	3.25	
Variance	1.24	
Standard Deviation	1.11	
Lower Quartile	2	
Upper Quartile	4	

Question 26: People work well together across departmental boundaries.

Rank value	Option	Count
1	1 Strongly Disagree	3
2	2 Disagree	19
3	3 Partially Agree	10
4	4 Agree	14
5	5 Strongly Agree	11
Mean rank	3.19	
Variance	1.52	
Standard Deviation	1.23	
Lower Quartile	2	
Upper Quartile	4	

Question 27: People are involved in suggesting ideas for improvements to products or processes.

Rank value	Option	Count
1	1 Strongly Disagree	1
2	2 Disagree	14
3	3 Partially Agree	19
4	4 Agree	6
5	5 Strongly Agree	17
Mean rank	3.42	
Variance	1.44	
Standard Deviation	1.2	
Lower Quartile	2	
Upper Quartile	5	

Question 28: **The structure facilitates rapid decision making.**

Rank value	Option	Count
1	1 Strongly Disagree	1
2	2 Disagree	18
3	3 Partially Agree	16
4	4 Agree	8
5	5 Strongly Agree	14
Mean rank	3.28	
Variance	1.43	
Standard Deviation	1.2	
Lower Quartile	2	
Upper Quartile	4	

Question 29: **Communication is effective and works top-down, bottom-up and across the organization.**

Rank value	Option	Count
1	1 Strongly Disagree	2
2	2 Disagree	16
3	3 Partially Agree	14
4	4 Agree	14
5	5 Strongly Agree	11
Mean rank	3.28	
Variance	1.36	
Standard Deviation	1.17	
Lower Quartile	2	
Upper Quartile	4	

Question 30: **The reward and recognition system supports innovation.**

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	19
3	3 Partially Agree	15
4	4 Agree	15
5	5 Strongly Agree	8
Mean rank	3.21	
Variance	1.11	
Standard Deviation	1.06	
Lower Quartile	2	
Upper Quartile	4	

Question 31: There is a supportive climate for new ideas - people don't have to leave the organization to make them happen.

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	14
3	3 Partially Agree	21
4	4 Agree	15
5	5 Strongly Agree	7
Mean rank	3.26	
Variance	0.93	
Standard Deviation	0.96	
Lower Quartile	3	
Upper Quartile	4	

Question 32: The employees work well in teams.

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	17
3	3 Partially Agree	15
4	4 Agree	17
5	5 Strongly Agree	8
Mean rank	3.28	
Variance	1.08	
Standard Deviation	1.04	
Lower Quartile	2	
Upper Quartile	4	

Question 33: Individuals and teams have space and autonomy for idea generation and creative problem solving.

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	17
3	3 Partially Agree	15
4	4 Agree	9
5	5 Strongly Agree	16
Mean rank	3.42	
Variance	1.4	
Standard Deviation	1.18	
Lower Quartile	2	
Upper Quartile	5	

Question 34: **Teams are diverse and heterogeneous in structure i.e. diverse educational, functional and industrial backgrounds.**

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	14
3	3 Partially Agree	22
4	4 Agree	5
5	5 Strongly Agree	16
Mean rank	3.4	
Variance	1.29	
Standard Deviation	1.14	
Lower Quartile	3	
Upper Quartile	5	

Question 35: **There is an appropriate use of teams to solve problems (at local, cross-functional and inter-organizational level)**

Rank value	Option	Count
1	1 Strongly Disagree	3
2	2 Disagree	20
3	3 Partially Agree	10
4	4 Agree	13
5	5 Strongly Agree	11
Mean rank	3.16	
Variance	1.54	
Standard Deviation	1.24	
Lower Quartile	2	
Upper Quartile	4	

Question 36: **There are key individuals who energize and facilitate innovation within the organization i.e. promoters, sponsors and champions.**

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	24
3	3 Partially Agree	10
4	4 Agree	11
5	5 Strongly Agree	12
Mean rank	3.19	
Variance	1.42	
Standard Deviation	1.19	
Lower Quartile	2	
Upper Quartile	4	

Organizational Culture

Question 37: There is collaboration with other firms to develop new products or processes.

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	15
3	3 Partially Agree	14
4	4 Agree	9
5	5 Strongly Agree	19
Mean rank	3.56	
Variance	1.44	
Standard Deviation	1.2	
Lower Quartile	2	
Upper Quartile	5	

Question 38: The organization develops external networks with people who can provide specialist knowledge.

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	10
3	3 Partially Agree	20
4	4 Agree	10
5	5 Strongly Agree	17
Mean rank	3.6	
Variance	1.19	
Standard Deviation	1.09	
Lower Quartile	3	
Upper Quartile	5	

Question 39: The organization works closely with 'lead users' and customers to develop innovative new products and services.

Rank value	Option	Count
1	1 Strongly Disagree	1
2	2 Disagree	13
3	3 Partially Agree	16
4	4 Agree	12
5	5 Strongly Agree	15
Mean rank	3.47	
Variance	1.34	
Standard Deviation	1.16	
Lower Quartile	3	
Upper Quartile	5	

Question 40: **Human resource policies support a culture of innovation through stimulating a creative, problem-solving working environment.**

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	11
3	3 Partially Agree	15
4	4 Agree	19
5	5 Strongly Agree	12
Mean rank	3.56	
Variance	1.05	
Standard Deviation	1.03	
Lower Quartile	3	
Upper Quartile	4	

Question 41: **The skills required for innovation are identified and they are fully resourced through recruitment and training.**

Rank value	Option	Count
1	1 Strongly Disagree	1
2	2 Disagree	11
3	3 Partially Agree	21
4	4 Agree	8
5	5 Strongly Agree	16
Mean rank	3.47	
Variance	1.3	
Standard Deviation	1.14	
Lower Quartile	3	
Upper Quartile	5	

Question 42: **Career structures support innovation through development of people across different functions.**

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	13
3	3 Partially Agree	15
4	4 Agree	16
5	5 Strongly Agree	13
Mean rank	3.51	
Variance	1.16	
Standard Deviation	1.08	
Lower Quartile	3	
Upper Quartile	4	

Question 43: **Employee appraisals reward innovation activities by employees.**

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	15
3	3 Partially Agree	15
4	4 Agree	11
5	5 Strongly Agree	16
Mean rank	3.49	
Variance	1.34	
Standard Deviation	1.16	
Lower Quartile	2	
Upper Quartile	5	

Question 44: **Innovation strategies are deployed to the employee level.**

Rank value	Option	Count
1	1 Strongly Disagree	1
2	2 Disagree	12
3	3 Partially Agree	18
4	4 Agree	9
5	5 Strongly Agree	17
Mean rank	3.51	
Variance	1.37	
Standard Deviation	1.17	
Lower Quartile	3	
Upper Quartile	5	

Question 45: **Staff can approach top management with ideas and get a fair hearing.**

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	10
3	3 Partially Agree	21
4	4 Agree	6
5	5 Strongly Agree	20
Mean rank	3.63	
Variance	1.29	
Standard Deviation	1.13	
Lower Quartile	3	
Upper Quartile	5	

Question 46: Clear innovation targets are set and known by all employees.

Rank value	Option	Count
1	1 Strongly Disagree	2
2	2 Disagree	14
3	3 Partially Agree	9
4	4 Agree	21
5	5 Strongly Agree	11
Mean rank	3.44	
Variance	1.33	
Standard Deviation	1.15	
Lower Quartile	2	
Upper Quartile	4	

Question 47: There is a system for screening and evaluating ideas in the organization.

Rank value	Option	Count
1	1 Strongly Disagree	1
2	2 Disagree	11
3	3 Partially Agree	20
4	4 Agree	6
5	5 Strongly Agree	19
Mean rank	3.54	
Variance	1.41	
Standard Deviation	1.19	
Lower Quartile	3	
Upper Quartile	5	

Question 48: The responsibility for screening decisions doesn't lie too high in the company hierarchy.

Rank value	Option	Count
1	1 Strongly Disagree	1
2	2 Disagree	14
3	3 Partially Agree	16
4	4 Agree	7
5	5 Strongly Agree	19
Mean rank	3.51	
Variance	1.51	
Standard Deviation	1.23	
Lower Quartile	2	
Upper Quartile	5	

Organizational Learning

Question 49: The organization is good at understanding the needs of customers/end-users.

Rank value	Option	Count
1	1 Strongly Disagree	2
2	2 Disagree	6
3	3 Partially Agree	18
4	4 Agree	12
5	5 Strongly Agree	19
Mean rank	3.7	
Variance	1.3	
Standard Deviation	1.14	
Lower Quartile	3	
Upper Quartile	5	

Question 50: There is a strong and continuing commitment to the training and development of people.

Rank value	Option	Count
1	1 Strongly Disagree	2
2	2 Disagree	6
3	3 Partially Agree	18
4	4 Agree	14
5	5 Strongly Agree	17
Mean rank	3.67	
Variance	1.24	
Standard Deviation	1.11	
Lower Quartile	3	
Upper Quartile	5	

Question 51: Time is taken to review projects to improve performance next time around.

Rank value	Option	Count
1	1 Strongly Disagree	2
2	2 Disagree	11
3	3 Partially Agree	13
4	4 Agree	13
5	5 Strongly Agree	18
Mean rank	3.6	
Variance	1.47	
Standard Deviation	1.21	
Lower Quartile	3	
Upper Quartile	5	

Question 52: The organization learns from its mistakes.

Rank value	Option	Count
1	1 Strongly Disagree	5
2	2 Disagree	9
3	3 Partially Agree	13
4	4 Agree	16
5	5 Strongly Agree	14
Mean rank	3.44	
Variance	1.58	
Standard Deviation	1.26	
Lower Quartile	3	
Upper Quartile	4	

Question 53: The organization systematically compares its products and processes with other firms.

Rank value	Option	Count
1	1 Strongly Disagree	2
2	2 Disagree	8
3	3 Partially Agree	15
4	4 Agree	17
5	5 Strongly Agree	15
Mean rank	3.61	
Variance	1.25	
Standard Deviation	1.12	
Lower Quartile	3	
Upper Quartile	5	

Question 54: The organization meets and shares experiences with other firms to help it to learn.

Rank value	Option	Count
1	1 Strongly Disagree	2
2	2 Disagree	10
3	3 Partially Agree	15
4	4 Agree	17
5	5 Strongly Agree	13
Mean rank	3.51	
Variance	1.27	
Standard Deviation	1.13	
Lower Quartile	3	
Upper Quartile	4	

Question 55: **The organization is good at capturing what it has learned so that others in the organization can make use of it.**

Rank value	Option	Count
1	1 Strongly Disagree	3
2	2 Disagree	7
3	3 Partially Agree	19
4	4 Agree	16
5	5 Strongly Agree	12
Mean rank	3.47	
Variance	1.23	
Standard Deviation	1.11	
Lower Quartile	3	
Upper Quartile	4	

Question 56: **The firm is good at learning from other organizations.**

Rank value	Option	Count
1	1 Strongly Disagree	1
2	2 Disagree	8
3	3 Partially Agree	16
4	4 Agree	17
5	5 Strongly Agree	15
Mean rank	3.65	
Variance	1.14	
Standard Deviation	1.07	
Lower Quartile	3	
Upper Quartile	5	

Question 57: **The organization uses measurement to help identify where and when it can improve its innovation management.**

Rank value	Option	Count
1	1 Strongly Disagree	4
2	2 Disagree	15
3	3 Partially Agree	8
4	4 Agree	16
5	5 Strongly Agree	14
Mean rank	3.37	
Variance	1.67	
Standard Deviation	1.29	
Lower Quartile	2	
Upper Quartile	4	

Question 58: The organization design enables creativity, learning and interaction.

Rank value	Option	Count
1	1 Strongly Disagree	3
2	2 Disagree	6
3	3 Partially Agree	16
4	4 Agree	11
5	5 Strongly Agree	21

Mean rank	3.72
Variance	1.47
Standard Deviation	1.21
Lower Quartile	3
Upper Quartile	5

Question 59: There are high levels of proactive experimentation such as finding and solving problems.

Rank value	Option	Count
1	1 Strongly Disagree	2
2	2 Disagree	8
3	3 Partially Agree	18
4	4 Agree	15
5	5 Strongly Agree	14

Mean rank	3.54
Variance	1.23
Standard Deviation	1.11
Lower Quartile	3
Upper Quartile	4

Question 60: There are high levels of knowledge capture and the communication and sharing of experiences.

Rank value	Option	Count
1	1 Strongly Disagree	3
2	2 Disagree	4
3	3 Partially Agree	16
4	4 Agree	13
5	5 Strongly Agree	21

Mean rank	3.79
Variance	1.36
Standard Deviation	1.17
Lower Quartile	3
Upper Quartile	5

Organizational Idea Generation

Question 61: The organisation systematically searches for new product/service ideas.

Rank value	Option	Count
1	1 Strongly Disagree	1
2	2 Disagree	11
3	3 Partially Agree	12
4	4 Agree	12
5	5 Strongly Agree	21
Mean rank	3.72	
Variance	1.43	
Standard Deviation	1.2	
Lower Quartile	3	
Upper Quartile	5	

Question 62: Creative ideas are collected on a regular basis from all employees.

Rank value	Option	Count
1	1 Strongly Disagree	4
2	2 Disagree	6
3	3 Partially Agree	19
4	4 Agree	9
5	5 Strongly Agree	19
Mean rank	3.58	
Variance	1.54	
Standard Deviation	1.24	
Lower Quartile	3	
Upper Quartile	5	

Question 63: The number of ideas for new products, services and processes developed in the last 12 months is comparable to the best in class.

Rank value	Option	Count
1	1 Strongly Disagree	5
2	2 Disagree	6
3	3 Partially Agree	19
4	4 Agree	6
5	5 Strongly Agree	21
Mean rank	3.56	
Variance	1.72	
Standard Deviation	1.31	
Lower Quartile	3	
Upper Quartile	5	

Question 64: Ideas originate from all departments.

Rank value	Option	Count
1	1 Strongly Disagree	5
2	2 Disagree	4
3	3 Partially Agree	18
4	4 Agree	8
5	5 Strongly Agree	22
Mean rank	3.67	
Variance	1.66	
Standard Deviation	1.29	
Lower Quartile	3	
Upper Quartile	5	

Question 65: There is consistent scanning of customer surveys and market trend analysis.

Rank value	Option	Count
1	1 Strongly Disagree	3
2	2 Disagree	6
3	3 Partially Agree	18
4	4 Agree	9
5	5 Strongly Agree	21
Mean rank	3.68	
Variance	1.48	
Standard Deviation	1.22	
Lower Quartile	3	
Upper Quartile	5	

Question 66: The company sources for ideas externally e.g. from suppliers and customers.

Rank value	Option	Count
1	1 Strongly Disagree	1
2	2 Disagree	14
3	3 Partially Agree	10
4	4 Agree	14
5	5 Strongly Agree	18
Mean rank	3.6	
Variance	1.47	
Standard Deviation	1.21	
Lower Quartile	2	
Upper Quartile	5	

Question 67: **The company belongs to a network i.e. it has close relationships with suppliers and customers and ongoing contacts with universities, government agencies, industry consortia etc.**

Rank value	Option	Count
1	1 Strongly Disagree	1
2	2 Disagree	12
3	3 Partially Agree	12
4	4 Agree	20
5	5 Strongly Agree	12
Mean rank	3.53	
Variance	1.2	
Standard Deviation	1.09	
Lower Quartile	3	
Upper Quartile	4	

Question 68: **There is extensive networking internal and external.**

Rank value	Option	Count
1	1 Strongly Disagree	3
2	2 Disagree	9
3	3 Partially Agree	16
4	4 Agree	14
5	5 Strongly Agree	15
Mean rank	3.51	
Variance	1.41	
Standard Deviation	1.19	
Lower Quartile	3	
Upper Quartile	5	

Question 69: **People in the organization know where to take their ideas.**

Rank value	Option	Count
1	1 Strongly Disagree	4
2	2 Disagree	7
3	3 Partially Agree	17
4	4 Agree	3
5	5 Strongly Agree	26
Mean rank	3.7	
Variance	1.79	
Standard Deviation	1.34	
Lower Quartile	3	
Upper Quartile	5	

Question 70: Ideas are quickly developed into new product/service concepts.

Rank value	Option	Count
1	1 Strongly Disagree	3
2	2 Disagree	7
3	3 Partially Agree	18
4	4 Agree	5
5	5 Strongly Agree	24
Mean rank	3.7	
Variance	1.61	
Standard Deviation	1.27	
Lower Quartile	3	
Upper Quartile	5	

Question 71: Creativity techniques and workshops are effectively used.

Rank value	Option	Count
1	1 Strongly Disagree	3
2	2 Disagree	5
3	3 Partially Agree	21
4	4 Agree	3
5	5 Strongly Agree	25
Mean rank	3.74	
Variance	1.56	
Standard Deviation	1.25	
Lower Quartile	3	
Upper Quartile	5	

Question 72: There is a positive approach to creative ideas, supported by relevant motivation systems.

Rank value	Option	Count
1	1 Strongly Disagree	0
2	2 Disagree	14
3	3 Partially Agree	11
4	4 Agree	2
5	5 Strongly Agree	30
Mean rank	3.84	
Variance	1.68	
Standard Deviation	1.29	
Lower Quartile	3	
Upper Quartile	5	

Appendix 8

Spearman`s Correlation Matrix

Organizational Strategy – Questions 1 – 6

1. A technology strategy exists (i.e. an explicit policy for sourcing technologies) and there are mechanisms for understanding current and future technology needs.	2. Competitors' innovation rates are known/monitored.	3. Performance measures are in place for innovation including goals for new products, services and processes.	4. Risk taking is encouraged rather than penalized by management.	5. There is a formalized innovation programme in the organization.	6. The organization's innovation strategy/policy is promoted throughout the organization.
Correlation Coefficient 1.000	.893**	.951**	.845**	.869**	.813**
.	.000	.000	.000	.000	.000
100	100	100	100	100	100
Correlation Coefficient .893**	1.000	.889**	.885**	.856**	.865**
.000	.	.000	.000	.000	.000
100	100	100	100	100	100
Correlation Coefficient .951**	.889**	1.000	.852**	.892**	.863**
.000	.000	.	.000	.000	.000
100	100	100	100	100	100
Correlation Coefficient .845**	.885**	.852**	1.000	.821**	.885**
.000	.000	.000	.	.000	.000
100	100	100	100	100	100
Correlation Coefficient .869**	.856**	.892**	.821**	1.000	.875**
.000	.000	.000	.000	.	.000
100	100	100	100	100	100
Correlation Coefficient .813**	.865**	.863**	.885**	.875**	1.000
.000	.000	.000	.000	.000	.
100	100	100	100	100	100

Organizational Strategy – Questions 7 – 12

7. There is top management commitment and support for innovation.	8. The organization looks ahead in a structured way (using forecasting tools and techniques) to try and imagine future threats and opportunities.	9. The top team have a shared vision of how the company will develop through innovation.	10. The percentage of revenue from products/services introduced in the last 3 years is high compared to competitors.	11. Market share has increased as a result of new products/services introduced in the last 3 years.	12. The number of new products/services in the portfolio has been increasing over the last 3 years
Correlation Coefficient 1.000	.841**	.875**	.825**	.849**	.805**
.	.000	.000	.000	.000	.000
100	100	100	100	100	100
Correlation Coefficient .841**	1.000	.817**	.849**	.844**	.850**
.000	.	.000	.000	.000	.000
100	100	100	100	100	100
Correlation Coefficient .875**	.817**	1.000	.908**	.970**	.901**
.000	.000	.	.000	.000	.000
100	100	100	100	100	100
Correlation Coefficient .825**	.849**	.908**	1.000	.920**	.968**
.000	.000	.000	.	.000	.000
100	100	100	100	100	100
Correlation Coefficient .849**	.844**	.970**	.920**	1.000	.910**
.000	.000	.000	.000	.	.000
100	100	100	100	100	100
Correlation Coefficient .805**	.850**	.901**	.968**	.910**	1.000
.000	.000	.000	.000	.000	.
100	100	100	100	100	100

Organizational Processes – Questions 13 – 18

	13. There are processes in place to help manage new product development effectively from idea to launch.	14. There are effective mechanisms for managing process change from idea through to successful implementation.	15. There are mechanisms in place to ensure early involvement of all departments in developing new products/processes.	16. There is a clear system for choosing innovation projects.	17. Processes are constantly reviewed to identify areas for improvement.	18. There is a focus on process improvement rather than on maintenance of processes.
Correlation Coefficient	1.000	.831**	.849**	.814**	.800**	.774**
	.	.000	.000	.000	.000	.000
	100	100	100	100	100	100
Correlation Coefficient	.831**	1.000	.796**	.851**	.809**	.808**
	.000	.	.000	.000	.000	.000
	100	100	100	100	100	100
Correlation Coefficient	.849**	.796**	1.000	.869**	.822**	.811**
	.000	.000	.	.000	.000	.000
	100	100	100	100	100	100
Correlation Coefficient	.814**	.851**	.869**	1.000	.756**	.830**
	.000	.000	.000	.	.000	.000
	100	100	100	100	100	100
Correlation Coefficient	.800**	.809**	.822**	.756**	1.000	.731**
	.000	.000	.000	.000	.	.000
	100	100	100	100	100	100
Correlation Coefficient	.774**	.808**	.811**	.830**	.731**	1.000
	.000	.000	.000	.000	.000	.
	100	100	100	100	100	100

Organizational Processes – Questions 19 – 24

19. If it isn't broken, leave it alone is NOT an accepted philosophy in the organisation.	20. There is a strong link between product innovation and process improvement to support the product.	21. The organisation is at the leading edge of technology in our industry.	22. There is participation in organization-wide continuous improvement activity.	23. The time-to-market of new products is very short compared to our competitors.	24. The organization is constantly developing and introducing new products/services.
Correlation Coefficient 1.000	.648**	.815**	.758**	.750**	.764**
.	.000	.000	.000	.000	.000
100	100	100	100	100	100
Correlation Coefficient .648**	1.000	.785**	.840**	.803**	.856**
.000	.	.000	.000	.000	.000
100	100	100	100	100	100
Correlation Coefficient .815**	.785**	1.000	.892**	.910**	.919**
.000	.000	.	.000	.000	.000
100	100	100	100	100	100
Correlation Coefficient .758**	.840**	.892**	1.000	.856**	.968**
.000	.000	.000	.	.000	.000
100	100	100	100	100	100
Correlation Coefficient .750**	.803**	.910**	.856**	1.000	.894**
.000	.000	.000	.000	.	.000
100	100	100	100	100	100
Correlation Coefficient .764**	.856**	.919**	.968**	.894**	1.000
.000	.000	.000	.000	.000	.
100	100	100	100	100	100

Organizational Structure – Questions 25 – 30

	25. The organization structures are flexible and facilitate innovation to happen.	26. People work well together across departmental boundaries.	27. People are involved in suggesting ideas for improvements to products or processes.	28. The structure facilitates rapid decision making.	29. Communication is effective and works top-down, bottom-up and across the organization.	30. The reward and recognition system supports innovation
Correlation Coefficient	1.000	.912**	.876**	.929**	.932**	.889**
	.	.000	.000	.000	.000	.000
	100	100	100	100	100	100
Correlation Coefficient	.912**	1.000	.824**	.899**	.871**	.880**
	.000	.	.000	.000	.000	.000
	100	100	100	100	100	100
Correlation Coefficient	.876**	.824**	1.000	.825**	.851**	.829**
	.000	.000	.	.000	.000	.000
	100	100	100	100	100	100
Correlation Coefficient	.929**	.899**	.825**	1.000	.886**	.870**
	.000	.000	.000	.	.000	.000
	100	100	100	100	100	100
Correlation Coefficient	.932**	.871**	.851**	.886**	1.000	.876**
	.000	.000	.000	.000	.	.000
	100	100	100	100	100	100
Correlation Coefficient	.889**	.880**	.829**	.870**	.876**	1.000
	.000	.000	.000	.000	.000	.
	100	100	100	100	100	100

Organizational Structure – Questions 31 – 36

31. There is a supportive climate for new ideas - people don't have to leave the organization to make them happen.	32. The employees work well in teams.	33. Individuals and teams have space and autonomy for idea generation and creative problem solving.	34. Teams are diverse and heterogeneous in structure i.e. diverse educational, functional and industrial backgrounds.	35. There is an appropriate use of teams to solve problems (at local, cross-functional and inter-organizational level)	36. There are key individuals who energize and facilitate innovation within the organization i.e. promoters, sponsors and champions.
Correlation Coefficient 1.000	.845**	.938**	.853**	.895**	.848**
.	.000	.000	.000	.000	.000
100	100	100	100	100	100
Correlation Coefficient .845**	1.000	.872**	.874**	.847**	.849**
.000	.	.000	.000	.000	.000
100	100	100	100	100	100
Correlation Coefficient .938**	.872**	1.000	.876**	.900**	.863**
.000	.000	.	.000	.000	.000
100	100	100	100	100	100
Correlation Coefficient .853**	.874**	.876**	1.000	.827**	.803**
.000	.000	.000	.	.000	.000
100	100	100	100	100	100
Correlation Coefficient .895**	.847**	.900**	.827**	1.000	.876**
.000	.000	.000	.000	.	.000
100	100	100	100	100	100
Correlation Coefficient .848**	.849**	.863**	.803**	.876**	1.000
.000	.000	.000	.000	.000	.
100	100	100	100	100	100

Organizational Culture – Questions 37 – 42

	37. There is collaboration with other firms to develop new products or processes.	38. The organization develops external networks with people who can provide specialist knowledge.	39. The organization works closely with 'lead users' and customers to develop innovative new products and services.	40. Human resource policies support a culture of innovation through stimulating a creative, problem-solving working environment.	41. The skills required for innovation are identified and they are fully resourced through recruitment and training.	42. Career structures support innovation through development of people across different functions.
Correlation Coefficient	1.000	.848**	.854**	.799**	.813**	.826**
	.	.000	.000	.000	.000	.000
	100	100	100	100	100	100
Correlation Coefficient	.848**	1.000	.822**	.881**	.772**	.896**
	.000	.	.000	.000	.000	.000
	100	100	100	100	100	100
Correlation Coefficient	.854**	.822**	1.000	.789**	.882**	.807**
	.000	.000	.	.000	.000	.000
	100	100	100	100	100	100
Correlation Coefficient	.799**	.881**	.789**	1.000	.769**	.905**
	.000	.000	.000	.	.000	.000
	100	100	100	100	100	100
Correlation Coefficient	.813**	.772**	.882**	.769**	1.000	.799**
	.000	.000	.000	.000	.	.000
	100	100	100	100	100	100
Correlation Coefficient	.826**	.896**	.807**	.905**	.799**	1.000
	.000	.000	.000	.000	.000	.
	100	100	100	100	100	100

Organizational Culture – Questions 43 – 48

43. Employee appraisals reward innovation activities by employees.	44. Innovation strategies are deployed to the employee level.	45. Staff can approach top management with ideas and get a fair hearing.	46. Clear innovation targets are set and known by all employees.	47. There is a system for screening and evaluating ideas in the organization.	48. The responsibility for screening decisions doesn't lie too high in the company hierarchy.
Correlation Coefficient 1.000	.792**	.841**	.765**	.869**	.819**
.	.000	.000	.000	.000	.000
100	100	100	100	100	100
Correlation Coefficient .792**	1.000	.828**	.967**	.875**	.941**
.000	.	.000	.000	.000	.000
100	100	100	100	100	100
Correlation Coefficient .841**	.828**	1.000	.804**	.881**	.815**
.000	.000	.	.000	.000	.000
100	100	100	100	100	100
Correlation Coefficient .765**	.967**	.804**	1.000	.877**	.939**
.000	.000	.000	.	.000	.000
100	100	100	100	100	100
Correlation Coefficient .869**	.875**	.881**	.877**	1.000	.907**
.000	.000	.000	.000	.	.000
100	100	100	100	100	100
Correlation Coefficient .819**	.941**	.815**	.939**	.907**	1.000
.000	.000	.000	.000	.000	.
100	100	100	100	100	100

Organizational Learning – Questions 49 – 54

49. The organization is good at understanding the needs of customers/end-users.	50. There is a strong and continuing commitment to the training and development of people.	51. Time is taken to review projects to improve performance next time around.	52. The organization learns from its mistakes.	53. The organization systematically compares its products and processes with other firms.	54. The organization meets and shares experiences with other firms to help it to learn.
Correlation Coefficient 1.000	.876**	.878**	.812**	.866**	.862**
.	.000	.000	.000	.000	.000
100	100	100	100	100	100
Correlation Coefficient .876**	1.000	.849**	.883**	.915**	.872**
.000	.	.000	.000	.000	.000
100	100	100	100	100	100
Correlation Coefficient .878**	.849**	1.000	.801**	.849**	.855**
.000	.000	.	.000	.000	.000
100	100	100	100	100	100
Correlation Coefficient .812**	.883**	.801**	1.000	.868**	.826**
.000	.000	.000	.	.000	.000
100	100	100	100	100	100
Correlation Coefficient .866**	.915**	.849**	.868**	1.000	.851**
.000	.000	.000	.000	.	.000
100	100	100	100	100	100
Correlation Coefficient .862**	.872**	.855**	.826**	.851**	1.000
.000	.000	.000	.000	.000	.
100	100	100	100	100	100

Organizational Learning – Questions 55 – 60

55. The organization is good at capturing what it has learned so that others in the organization can make use of it.	56. The firm is good at learning from other organizations.	57. The organization uses measurement to help identify where and when it can improve its innovation management.	58. The organization design enables creativity, learning and interaction.	59. There are high levels of proactive experimentation such as finding and solving problems.	60. There are high levels of knowledge capture and the communication and sharing of experiences.
Correlation Coefficient 1.000	.856**	.913**	.930**	.918**	.940**
.	.000	.000	.000	.000	.000
100	100	100	100	100	100
Correlation Coefficient .856**	1.000	.873**	.907**	.877**	.896**
.000	.	.000	.000	.000	.000
100	100	100	100	100	100
Correlation Coefficient .913**	.873**	1.000	.911**	.923**	.904**
.000	.000	.	.000	.000	.000
100	100	100	100	100	100
Correlation Coefficient .930**	.907**	.911**	1.000	.920**	.973**
.000	.000	.000	.	.000	.000
100	100	100	100	100	100
Correlation Coefficient .918**	.877**	.923**	.920**	1.000	.912**
.000	.000	.000	.000	.	.000
100	100	100	100	100	100
Correlation Coefficient .940**	.896**	.904**	.973**	.912**	1.000
.000	.000	.000	.000	.000	.
100	100	100	100	100	100

Organizational Idea Generation – Questions 61 – 66

	61. The organisation systematically searches for new product/service ideas.	62. Creative ideas are collected on a regular basis from all employees.	63. The number of ideas for new products, services and processes developed in the last 12 months is comparable to the best in class.	64. Ideas originate from all departments.	65. There is consistent scanning of customer surveys and market trend analysis.	66. The company sources for ideas externally e.g. from suppliers and customers.
Correlation Coefficient	1.000	.881**	.874**	.869**	.839**	.759**
	.	.000	.000	.000	.000	.000
	100	100	100	100	100	100
Correlation Coefficient	.881**	1.000	.869**	.923**	.824**	.830**
	.000	.	.000	.000	.000	.000
	100	100	100	100	100	100
Correlation Coefficient	.874**	.869**	1.000	.922**	.877**	.812**
	.000	.000	.	.000	.000	.000
	100	100	100	100	100	100
Correlation Coefficient	.869**	.923**	.922**	1.000	.836**	.832**
	.000	.000	.000	.	.000	.000
	100	100	100	100	100	100
Correlation Coefficient	.839**	.824**	.877**	.836**	1.000	.823**
	.000	.000	.000	.000	.	.000
	100	100	100	100	100	100
Correlation Coefficient	.759**	.830**	.812**	.832**	.823**	1.000
	.000	.000	.000	.000	.000	.
	100	100	100	100	100	100

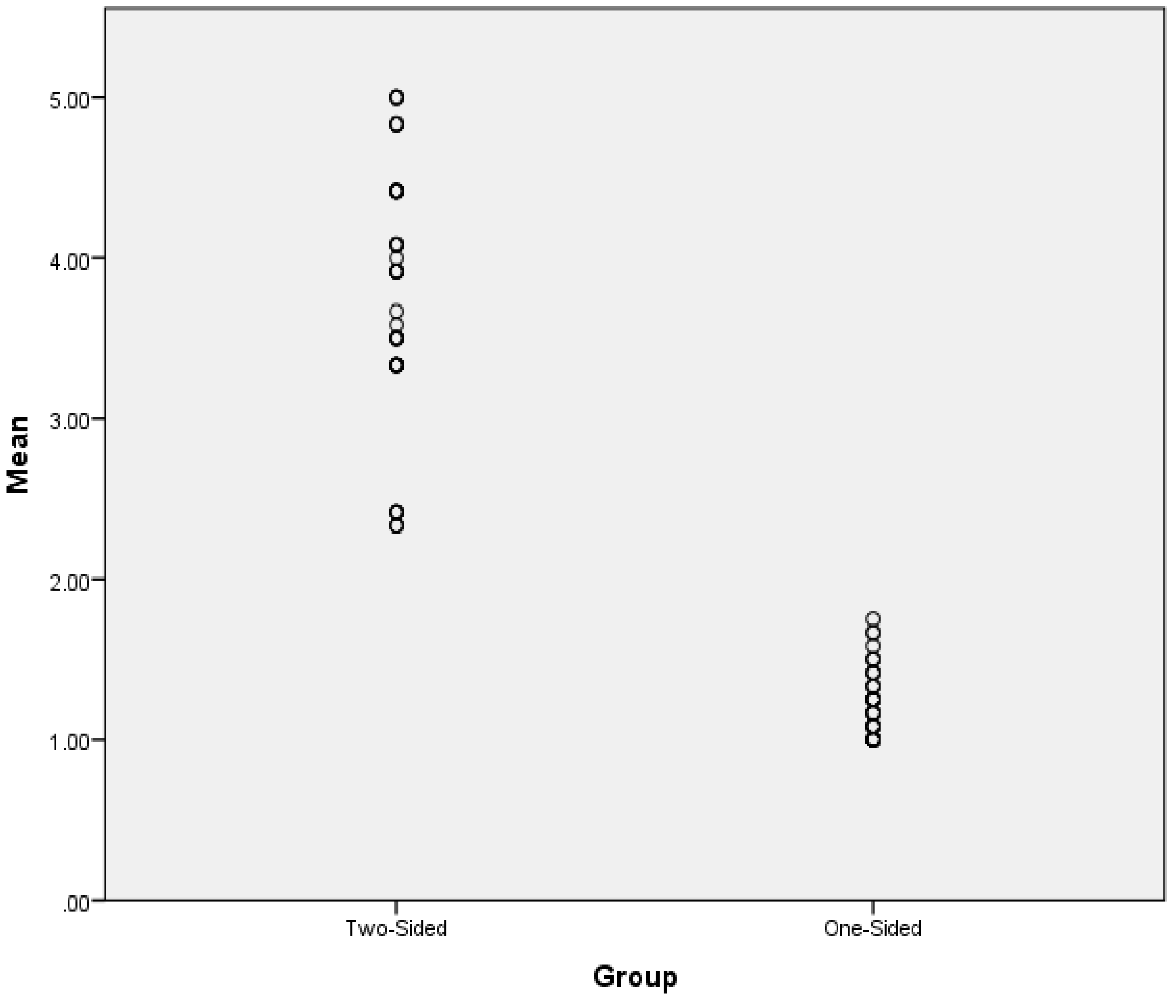
Organizational Idea Generation – Questions 67 – 72

67. The company belongs to a network i.e. it has close relationships with suppliers and customers and ongoing contacts with universities, government agencies, industry consortia etc.	68. There is extensive networking internal and external.	69. People in the organization know where to take their ideas.	70. Ideas are quickly developed into new product/service concepts.	71. Creativity techniques and workshops are effectively used.	72. There is a positive approach to creative ideas, supported by relevant motivation systems.
Correlation Coefficient 1.000	.734**	.824**	.814**	.844**	.803**
.	.000	.000	.000	.000	.000
100	100	100	100	100	100
Correlation Coefficient .734**	1.000	.760**	.813**	.833**	.843**
.000	.	.000	.000	.000	.000
100	100	100	100	100	100
Correlation Coefficient .824**	.760**	1.000	.894**	.892**	.844**
.000	.000	.	.000	.000	.000
100	100	100	100	100	100
Correlation Coefficient .814**	.813**	.894**	1.000	.920**	.923**
.000	.000	.000	.	.000	.000
100	100	100	100	100	100
Correlation Coefficient .844**	.833**	.892**	.920**	1.000	.938**
.000	.000	.000	.000	.	.000
100	100	100	100	100	100
Correlation Coefficient .803**	.843**	.844**	.923**	.938**	1.000
.000	.000	.000	.000	.000	.
100	100	100	100	100	100

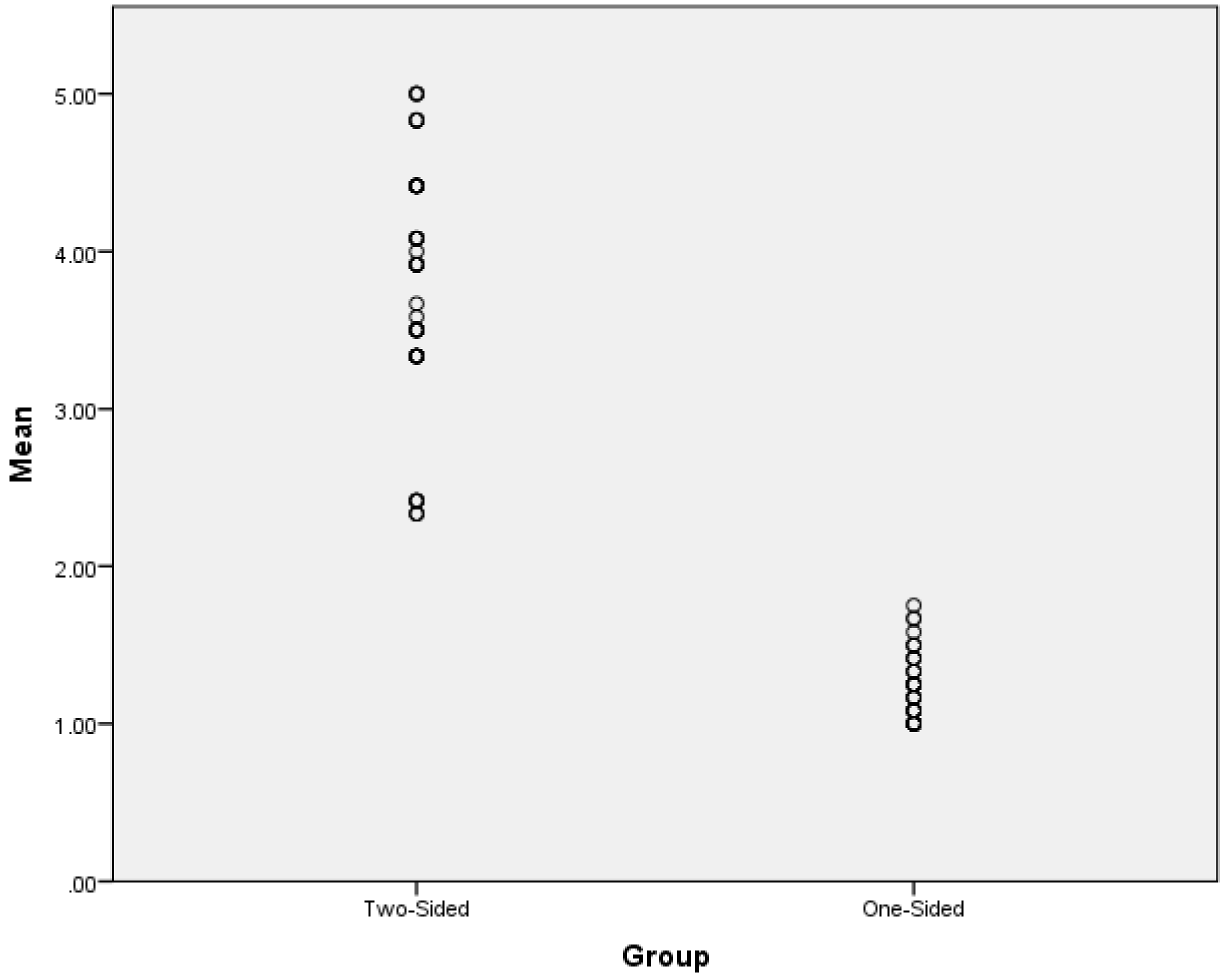
Appendix 9

Cluster Analysis (Scatter Plots)

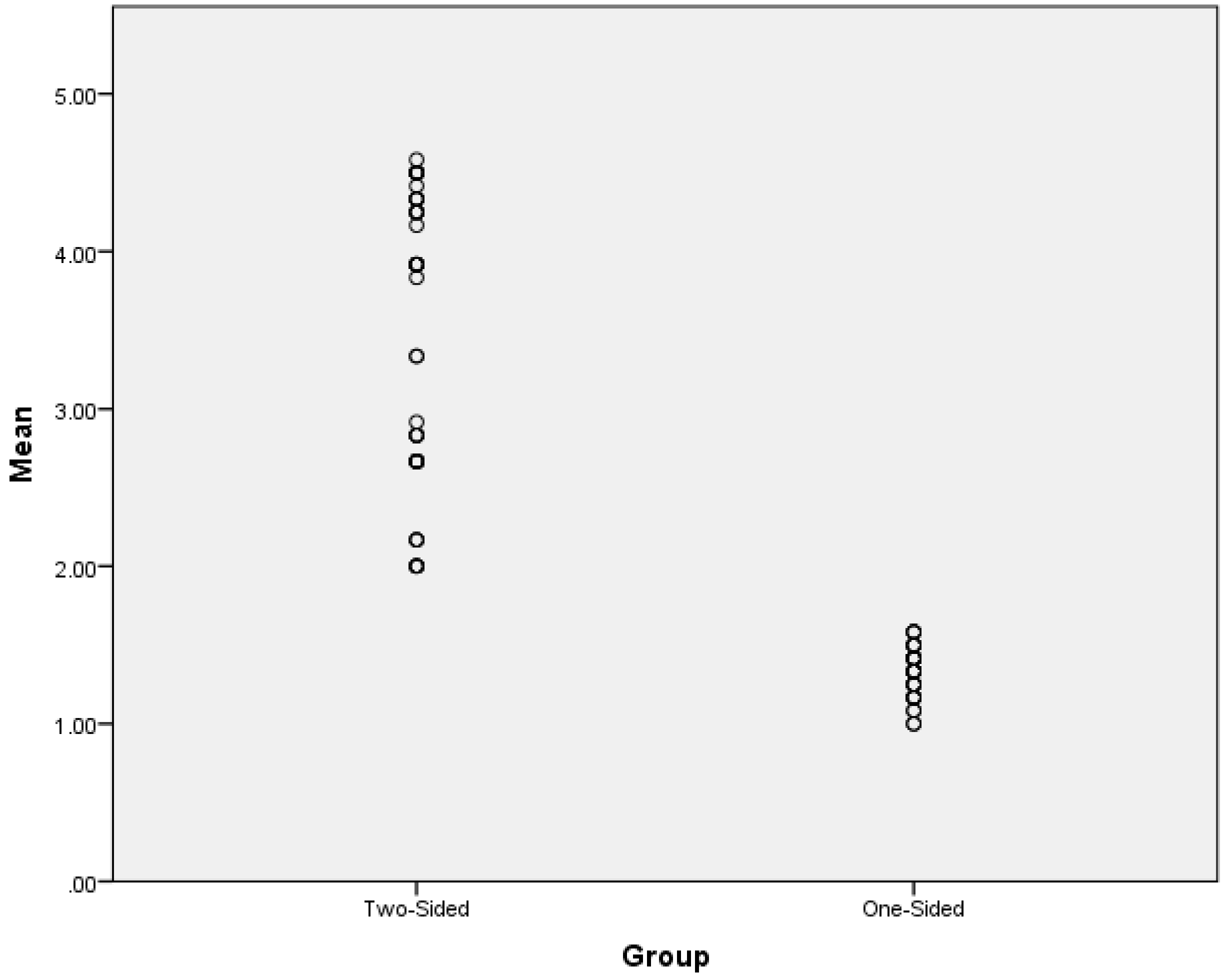
Scatter Plot for all Six Categories of the Questionnaire – Questions 1 - 72



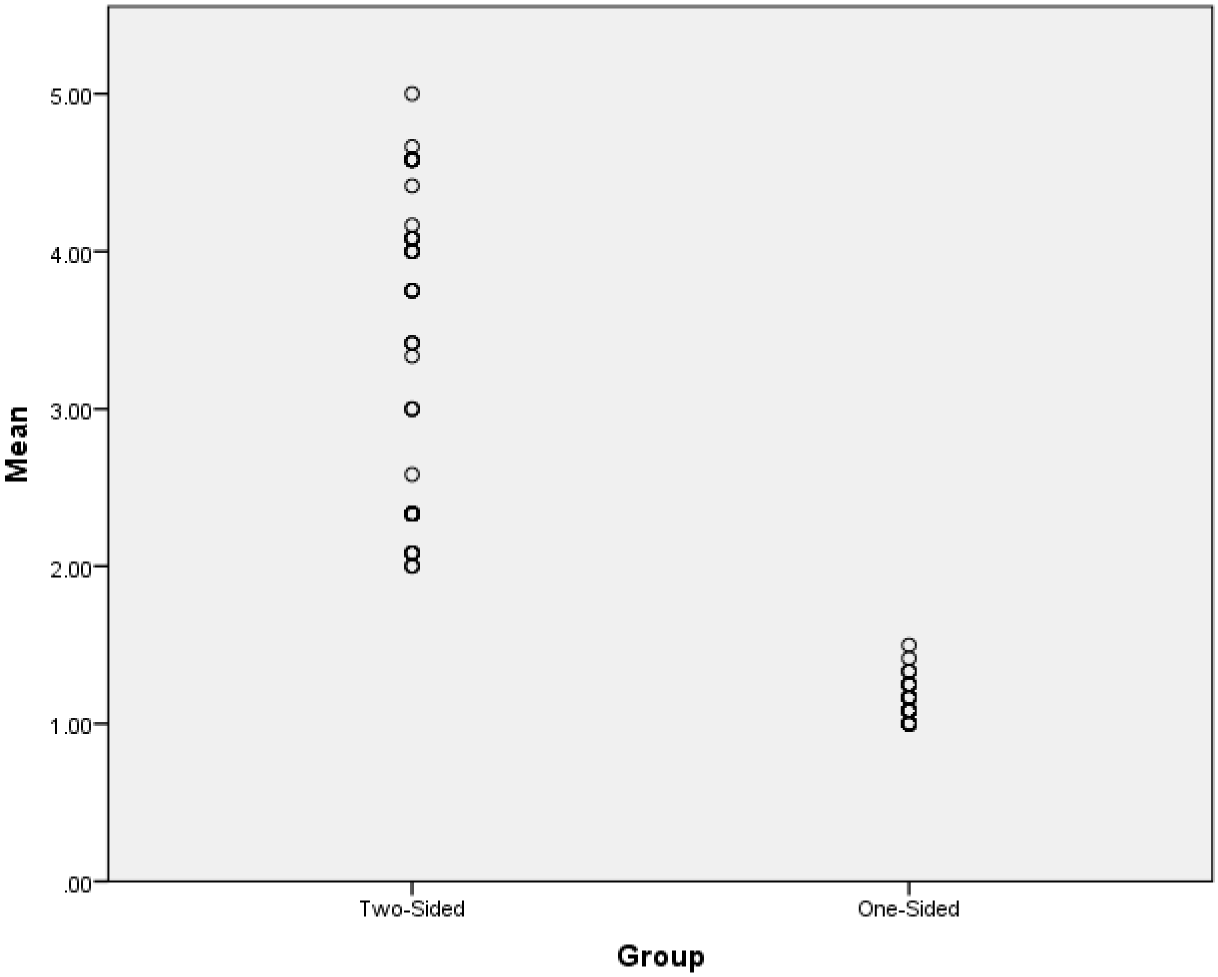
Scatter Plot for Organizational Strategy – Questions 1 – 12



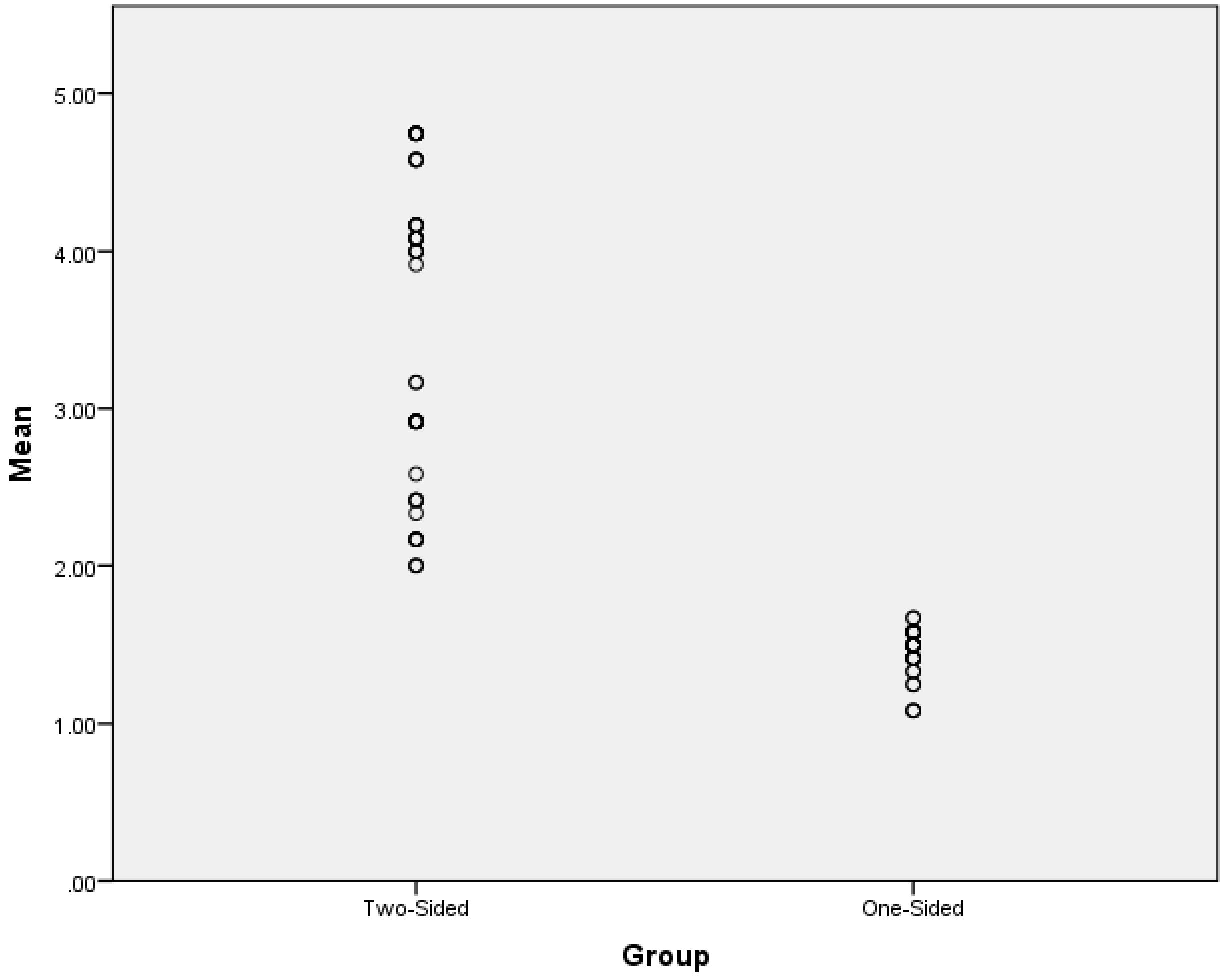
Scatter Plot for Organizational Processes – Questions 13 – 24



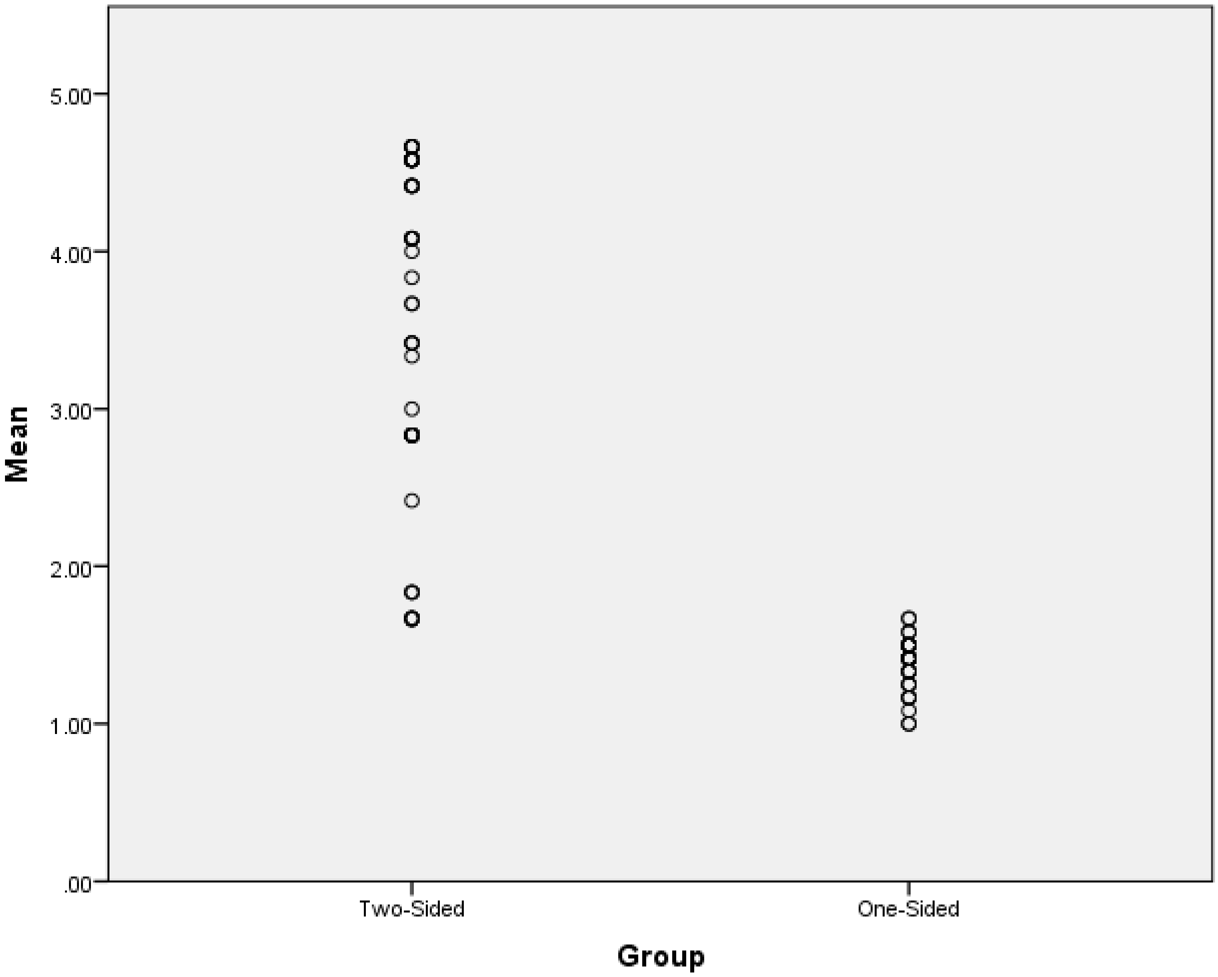
Scatter Plot for Organizational Structure – Questions 25 – 36



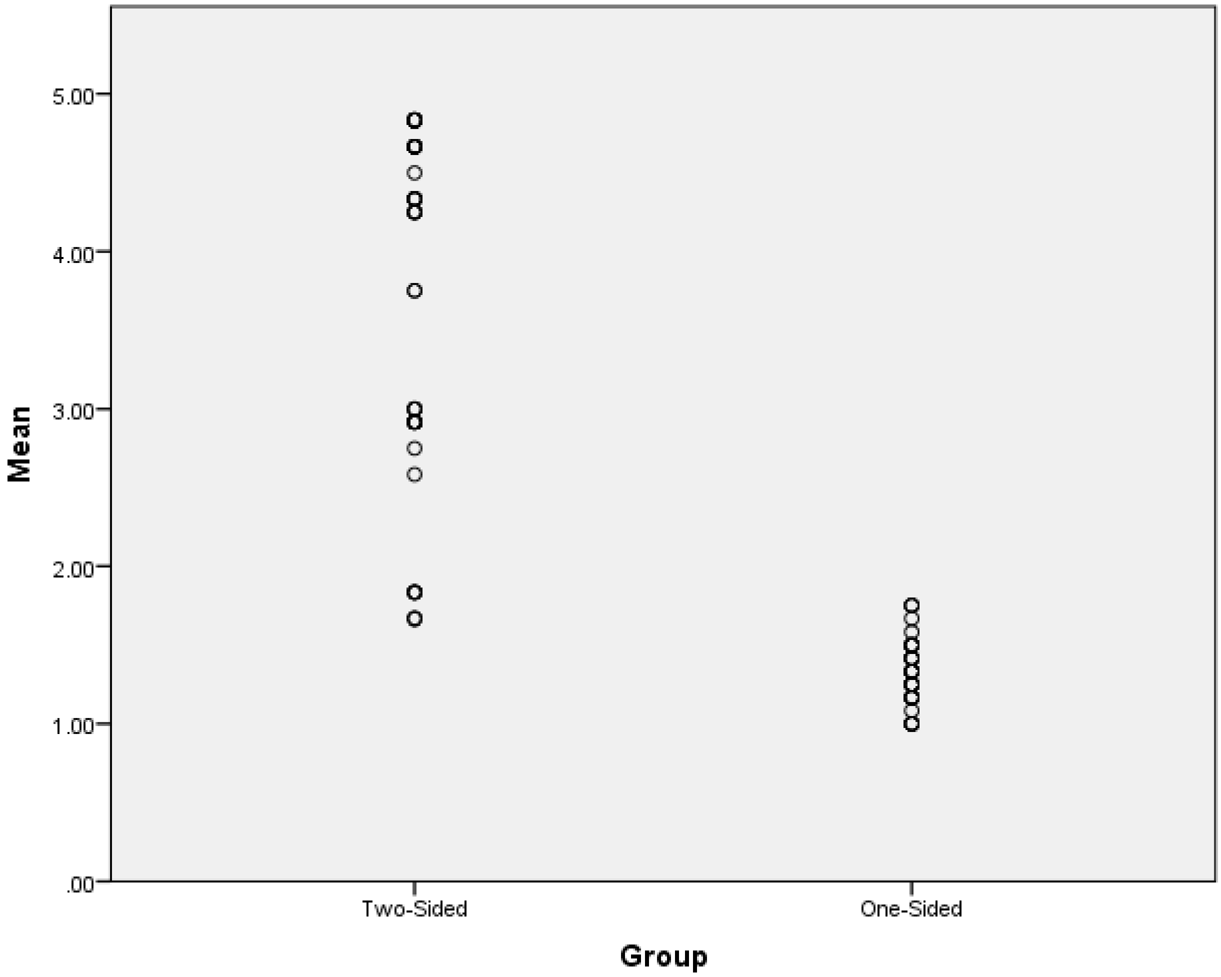
Scatter Plot for Organizational Culture – Questions 37 – 48



Scatter Plot for Organizational Learning – Questions 49 – 60



Scatter Plot for Idea Generation – Questions 61 – 72



Appendix 10

Mann-Whitney U Test – Two-Sided & One-Sided Firms

Organizational Strategy – Questions 1 - 12

Ranks

	Group	N	Mean Rank	Sum of Ranks
1. A technology strategy exists (i.e. an explicit policy for sourcing technologies) and there are mechanisms for understanding current and future technology needs.	Two-Sided	57	71.68	4086.00
	One-Sided	43	22.42	964.00
	Total	100		
2. Competitors' innovation rates are known/monitored.	Two-Sided	57	71.63	4083.00
	One-Sided	43	22.49	967.00
	Total	100		
3. Performance measures are in place for innovation including goals for new products, services and processes.	Two-Sided	57	71.91	4099.00
	One-Sided	43	22.12	951.00
	Total	100		
4. Risk taking is encouraged rather than penalized by management.	Two-Sided	57	71.26	4062.00
	One-Sided	43	22.98	988.00
	Total	100		
5. There is a formalized innovation programme in the organization.	Two-Sided	57	71.68	4086.00
	One-Sided	43	22.42	964.00
	Total	100		
6. The organization's innovation strategy/policy is promoted throughout the organization.	Two-Sided	57	71.63	4083.00
	One-Sided	43	22.49	967.00
	Total	100		
7. There is top management commitment and support for innovation.	Two-Sided	57	70.88	4040.00
	One-Sided	43	23.49	1010.00
	Total	100		
8. The organization looks ahead in a structured way (using forecasting tools and techniques) to try and imagine future threats and opportunities.	Two-Sided	57	71.26	4062.00
	One-Sided	43	22.98	988.00
	Total	100		
9. The top team have a shared vision of how the	Two-Sided	57	71.57	4079.50
	One-Sided	43	22.57	970.50

company will develop through innovation.	Total	100		
10. The percentage of revenue from products/services introduced in the last 3 years is high compared to competitors.	Two-Sided	57	71.75	4090.00
	One-Sided	43	22.33	960.00
	Total	100		
11. Market share has increased as a result of new products/services introduced in the last 3 years.	Two-Sided	57	71.68	4086.00
	One-Sided	43	22.42	964.00
	Total	100		
12. The number of new products/services in the portfolio has been increasing over the last 3 years	Two-Sided	57	71.69	4086.50
	One-Sided	43	22.41	963.50
	Total	100		

Organizational Processes – Questions 13 - 24

Ranks

	Group	N	Mean Rank	Sum of Ranks
13. There are processes in place to help manage new product development effectively from idea to launch.	Two-Sided	57	69.61	3967.50
	One-Sided	43	25.17	1082.50
	Total	100		
14. There are effective mechanisms for managing process change from idea through to successful implementation.	Two-Sided	57	69.98	3989.00
	One-Sided	43	24.67	1061.00
	Total	100		
15. There are mechanisms in place to ensure early involvement of all departments in developing new products/processes.	Two-Sided	57	71.32	4065.50
	One-Sided	43	22.90	984.50
	Total	100		
16. There is a clear system for choosing innovation projects.	Two-Sided	57	71.14	4055.00
	One-Sided	43	23.14	995.00
	Total	100		
17. Processes are constantly reviewed to identify areas for improvement.	Two-Sided	57	69.42	3957.00
	One-Sided	43	25.42	1093.00
	Total	100		
	Two-Sided	57	67.53	3849.00

18. There is a focus on process improvement rather than on maintenance of processes.	One-Sided	43	27.93	1201.00
	Total	100		
19. If it isn't broken, leave it alone is NOT an accepted philosophy in the organisation.	Two-Sided	57	66.04	3764.00
	One-Sided	43	29.91	1286.00
	Total	100		
20. There is a strong link between product innovation and process improvement to support the product.	Two-Sided	57	69.95	3987.00
	One-Sided	43	24.72	1063.00
	Total	100		
21. The organisation is at the leading edge of technology in our industry.	Two-Sided	57	71.89	4098.00
	One-Sided	43	22.14	952.00
	Total	100		
22. There is participation in organization-wide continuous improvement activity.	Two-Sided	57	71.54	4078.00
	One-Sided	43	22.60	972.00
	Total	100		
23. The time-to-market of new products is very short compared to our competitors.	Two-Sided	57	70.88	4040.00
	One-Sided	43	23.49	1010.00
	Total	100		
24. The organization is constantly developing and introducing new products/services.	Two-Sided	57	71.92	4099.50
	One-Sided	43	22.10	950.50
	Total	100		

Organizational Structure – Questions 25 - 36

Ranks

	Group	N	Mean Rank	Sum of Ranks
25. The organization structures are flexible and facilitate innovation to happen.	Two-Sided	57	72.00	4104.00
	One-Sided	43	22.00	946.00
	Total	100		
26. People work well together across departmental boundaries.	Two-Sided	57	70.68	4028.50
	One-Sided	43	23.76	1021.50
	Total	100		
27. People are involved in suggesting ideas for improvements to products or processes.	Two-Sided	57	69.52	3962.50
	One-Sided	43	25.29	1087.50
	Total	100		
	Two-Sided	57	71.62	4082.50

28. The structure facilitates rapid decision making.	One-Sided Total	43 100	22.50	967.50
29. Communication is effective and works top-down, bottom-up and across the organization.	Two-Sided One-Sided Total	57 43 100	71.25 23.00	4061.00 989.00
30. The reward and recognition system supports innovation	Two-Sided One-Sided Total	57 43 100	70.50 23.99	4018.50 1031.50
31. There is a supportive climate for new ideas - people don't have to leave the organization to make them happen.	Two-Sided One-Sided Total	57 43 100	71.75 22.33	4090.00 960.00
32. The employees work well in teams.	Two-Sided One-Sided Total	57 43 100	69.76 24.97	3976.50 1073.50
33. Individuals and teams have space and autonomy for idea generation and creative problem solving.	Two-Sided One-Sided Total	57 43 100	71.85 22.20	4095.50 954.50
34. Teams are diverse and heterogeneous in structure i.e. diverse educational, functional and industrial backgrounds.	Two-Sided One-Sided Total	57 43 100	71.02 23.30	4048.00 1002.00
35. There is an appropriate use of teams to solve problems (at local, cross-functional and inter-organizational level)	Two-Sided One-Sided Total	57 43 100	70.06 24.57	3993.50 1056.50
36. There are key individuals who energize and facilitate innovation within the organization i.e. promoters, sponsors and champions.	Two-Sided One-Sided Total	57 43 100	69.05 25.91	3936.00 1114.00

Organizational Culture – Questions 37 - 48

Ranks

	Group	N	Mean Rank	Sum of Ranks
37. There is collaboration with other firms to develop new products or processes.	Two-Sided	57	68.58	3909.00
	One-Sided	43	26.53	1141.00
	Total	100		
38. The organization develops external networks with people who can provide specialist knowledge.	Two-Sided	57	69.02	3934.00
	One-Sided	43	25.95	1116.00
	Total	100		
39. The organization works closely with 'lead users' and customers to develop innovative new products and services.	Two-Sided	57	71.50	4075.50
	One-Sided	43	22.66	974.50
	Total	100		
40. Human resource policies support a culture of innovation through stimulating a creative, problem-solving working environment.	Two-Sided	57	68.72	3917.00
	One-Sided	43	26.35	1133.00
	Total	100		
41. The skills required for innovation are identified and they are fully resourced through recruitment and training.	Two-Sided	57	67.62	3854.50
	One-Sided	43	27.80	1195.50
	Total	100		
42. Career structures support innovation through development of people across different functions.	Two-Sided	57	67.67	3857.00
	One-Sided	43	27.74	1193.00
	Total	100		
43. Employee appraisals reward innovation activities by employees.	Two-Sided	57	67.26	3834.00
	One-Sided	43	28.28	1216.00
	Total	100		
44. Innovation strategies are deployed to the employee level.	Two-Sided	57	71.62	4082.50
	One-Sided	43	22.50	967.50
	Total	100		
45. Staff can approach top management with ideas and get a fair hearing.	Two-Sided	57	69.54	3964.00
	One-Sided	43	25.26	1086.00
	Total	100		
	Two-Sided	57	71.25	4061.00

46. Clear innovation targets are set and known by all employees.	One-Sided	43	23.00	989.00
	Total	100		
47. There is a system for screening and evaluating ideas in the organization.	Two-Sided	57	70.99	4046.50
	One-Sided	43	23.34	1003.50
	Total	100		
48. The responsibility for screening decisions doesn't lie too high in the company hierarchy.	Two-Sided	57	71.23	4060.00
	One-Sided	43	23.02	990.00
	Total	100		

Organizational Learning – Questions 49 - 60

Ranks

	Group	N	Mean Rank	Sum of Ranks
49. The organization is good at understanding the needs of customers/end-users.	Two-Sided	57	68.79	3921.00
	One-Sided	43	26.26	1129.00
	Total	100		
50. There is a strong and continuing commitment to the training and development of people.	Two-Sided	57	68.72	3917.00
	One-Sided	43	26.35	1133.00
	Total	100		
51. Time is taken to review projects to improve performance next time around.	Two-Sided	57	69.19	3944.00
	One-Sided	43	25.72	1106.00
	Total	100		
52. The organization learns from its mistakes.	Two-Sided	57	65.69	3744.50
	One-Sided	43	30.36	1305.50
	Total	100		
53. The organization systematically compares its products and processes with other firms.	Two-Sided	57	68.00	3876.00
	One-Sided	43	27.30	1174.00
	Total	100		
54. The organization meets and shares experiences with other firms to help it to learn.	Two-Sided	57	70.82	4037.00
	One-Sided	43	23.56	1013.00
	Total	100		
55. The organization is good at capturing what it has learned so that others in the organization can make use of it.	Two-Sided	57	70.78	4034.50
	One-Sided	43	23.62	1015.50
	Total	100		
	Two-Sided	57	69.33	3952.00

56. The firm is good at learning from other organizations.	One-Sided	43	25.53	1098.00
	Total	100		
57. The organization uses measurement to help identify where and when it can improve its innovation management.	Two-Sided	57	69.66	3970.50
	One-Sided	43	25.10	1079.50
	Total	100		
58. The organization design enables creativity, learning and interaction.	Two-Sided	57	70.79	4035.00
	One-Sided	43	23.60	1015.00
	Total	100		
59. There are high levels of proactive experimentation such as finding and solving problems.	Two-Sided	57	71.16	4056.00
	One-Sided	43	23.12	994.00
	Total	100		
60. There are high levels of knowledge capture and the communication and sharing of experiences.	Two-Sided	57	70.87	4039.50
	One-Sided	43	23.50	1010.50
	Total	100		

Organizational Idea Generation – Questions 61 - 72

Ranks

	Group	N	Mean Rank	Sum of Ranks
61. The organisation systematically searches for new product/service ideas.	Two-Sided	57	70.46	4016.50
	One-Sided	43	24.03	1033.50
	Total	100		
62. Creative ideas are collected on a regular basis from all employees.	Two-Sided	57	69.18	3943.00
	One-Sided	43	25.74	1107.00
	Total	100		
63. The number of ideas for new products, services and processes developed in the last 12 months is comparable to the best in class.	Two-Sided	57	70.11	3996.50
	One-Sided	43	24.50	1053.50
	Total	100		
64. Ideas originate from all departments.	Two-Sided	57	70.04	3992.00
	One-Sided	43	24.60	1058.00
	Total	100		
65. There is consistent scanning of customer surveys and market trend analysis.	Two-Sided	57	68.42	3900.00
	One-Sided	43	26.74	1150.00
	Total	100		

66. The company sources for ideas externally e.g. from suppliers and customers.	Two-Sided	57	67.54	3850.00
	One-Sided	43	27.91	1200.00
	Total	100		
67. The company belongs to a network i.e. it has close relationships with suppliers and customers and ongoing contacts with universities, government agencies, industry consortia etc.	Two-Sided	57	67.86	3868.00
	One-Sided	43	27.49	1182.00
	Total	100		
68. There is extensive networking internal and external.	Two-Sided	57	69.92	3985.50
	One-Sided	43	24.76	1064.50
	Total	100		
69. People in the organization know where to take their ideas.	Two-Sided	57	68.37	3897.00
	One-Sided	43	26.81	1153.00
	Total	100		
70. Ideas are quickly developed into new product/service concepts.	Two-Sided	57	70.25	4004.50
	One-Sided	43	24.31	1045.50
	Total	100		
71. Creativity techniques and workshops are effectively used.	Two-Sided	57	70.45	4015.50
	One-Sided	43	24.06	1034.50
	Total	100		
72. There is a positive approach to creative ideas, supported by relevant motivation systems.	Two-Sided	57	71.39	4069.00
	One-Sided	43	22.81	981.00
	Total	100		

Appendix 11

Factor Analysis

Organizational Strategy Questions 1 - 12

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	10.502	87.516	87.516	10.502	87.516	87.516
2	.308	2.571	90.087			
3	.269	2.238	92.324			
4	.244	2.035	94.360			
5	.182	1.521	95.880			
6	.154	1.284	97.164			
7	.100	.834	97.998			
8	.075	.622	98.620			
9	.069	.573	99.193			
10	.056	.469	99.662			
11	.025	.211	99.873			
12	.015	.127	100.000			

Extraction Method: Principal Component Analysis.

Organizational Processes Questions 13 – 24

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
13	9.807	81.723	81.723	9.807	81.723	81.723
14	.572	4.765	86.488			
15	.454	3.783	90.271			
16	.292	2.432	92.703			
17	.225	1.878	94.581			
18	.156	1.299	95.880			
19	.128	1.064	96.944			
20	.103	.862	97.806			
21	.102	.853	98.659			
22	.078	.653	99.312			
23	.057	.473	99.785			
24	.026	.215	100.000			

Extraction Method: Principal Component Analysis.

Organizational Structure - Questions 25 – 36

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
25	10.431	86.926	86.926	10.431	86.926	86.926
26	.258	2.152	89.078			
27	.230	1.913	90.991			
28	.215	1.789	92.780			
29	.165	1.375	94.154			
30	.156	1.301	95.456			
31	.144	1.197	96.653			
32	.116	.969	97.622			
33	.091	.755	98.377			
34	.080	.668	99.045			
35	.065	.541	99.586			
36	.050	.414	100.000			

Extraction Method: Principal Component Analysis.

Organizational Culture - Questions 37 – 48

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
37	10.170	84.746	84.746	10.170	84.746	84.746
38	.513	4.272	89.018			
39	.393	3.275	92.293			
40	.218	1.813	94.106			
41	.174	1.449	95.555			
42	.117	.979	96.534			
43	.107	.892	97.427			
44	.091	.757	98.184			
45	.071	.588	98.772			
46	.069	.573	99.345			
47	.053	.440	99.785			
48	.026	.215	100.000			

Extraction Method: Principal Component Analysis.

Organizational Learning - Questions 49 – 60

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
49	10.625	88.545	88.545	10.625	88.545	88.545
50	.254	2.116	90.660			
51	.234	1.949	92.609			
52	.203	1.688	94.297			
53	.130	1.086	95.383			
54	.117	.974	96.358			
55	.102	.852	97.209			
56	.099	.826	98.035			
57	.083	.695	98.730			
58	.070	.585	99.315			
59	.059	.495	99.809			
60	.023	.191	100.000			

Extraction Method: Principal Component Analysis.

Organizational Idea Generation - Questions 61 – 72

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
61	10.444	87.032	87.032	10.444	87.032	87.032
62	.329	2.743	89.775			
63	.243	2.024	91.799			
64	.239	1.991	93.790			
65	.177	1.471	95.261			
66	.147	1.222	96.484			
67	.106	.885	97.369			
68	.096	.798	98.167			
69	.073	.608	98.775			
70	.063	.528	99.304			
71	.049	.406	99.710			
72	.035	.290	100.000			

Extraction Method: Principal Component Analysis.

Factor Analysis: All Six Categories of the Innovation Audit Questionnaire – Questions 1 – 72

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	60.319	83.777	83.777	60.319	83.777	83.777
2	1.203	1.671	85.448	1.203	1.671	85.448
3	.941	1.307	86.755			
4	.813	1.129	87.884			
5	.649	.901	88.785			
6	.587	.816	89.601			
7	.558	.775	90.376			
8	.521	.724	91.100			
9	.480	.667	91.767			
10	.422	.586	92.353			
11	.388	.538	92.892			
12	.345	.480	93.371			
13	.314	.436	93.807			
14	.308	.428	94.235			
15	.290	.403	94.638			
16	.274	.381	95.019			
17	.254	.353	95.372			

18	.235	.326	95.698			
19	.225	.313	96.011			
20	.209	.290	96.301			
21	.200	.278	96.579			
22	.181	.251	96.830			
23	.160	.223	97.052			
24	.154	.214	97.266			
25	.147	.204	97.470			
26	.138	.191	97.661			
27	.127	.176	97.837			
28	.121	.168	98.005			
29	.112	.156	98.161			
30	.100	.139	98.301			
31	.095	.131	98.432			
32	.090	.125	98.557			
33	.081	.113	98.671			
34	.076	.106	98.777			
35	.072	.099	98.876			
36	.064	.090	98.965			
37	.062	.086	99.051			
38	.057	.079	99.130			
39	.051	.070	99.201			
40	.049	.068	99.269			
41	.045	.062	99.331			
42	.042	.059	99.389			
43	.039	.055	99.444			
44	.037	.051	99.495			
45	.034	.047	99.543			
46	.032	.045	99.588			
47	.030	.041	99.629			
48	.028	.039	99.668			
49	.024	.034	99.701			
50	.023	.031	99.733			
51	.020	.028	99.761			
52	.019	.027	99.788			
53	.019	.026	99.814			
54	.017	.023	99.837			
55	.015	.021	99.859			
56	.013	.018	99.877			
57	.012	.017	99.894			
58	.010	.014	99.908			
59	.010	.013	99.921			
60	.009	.012	99.933			

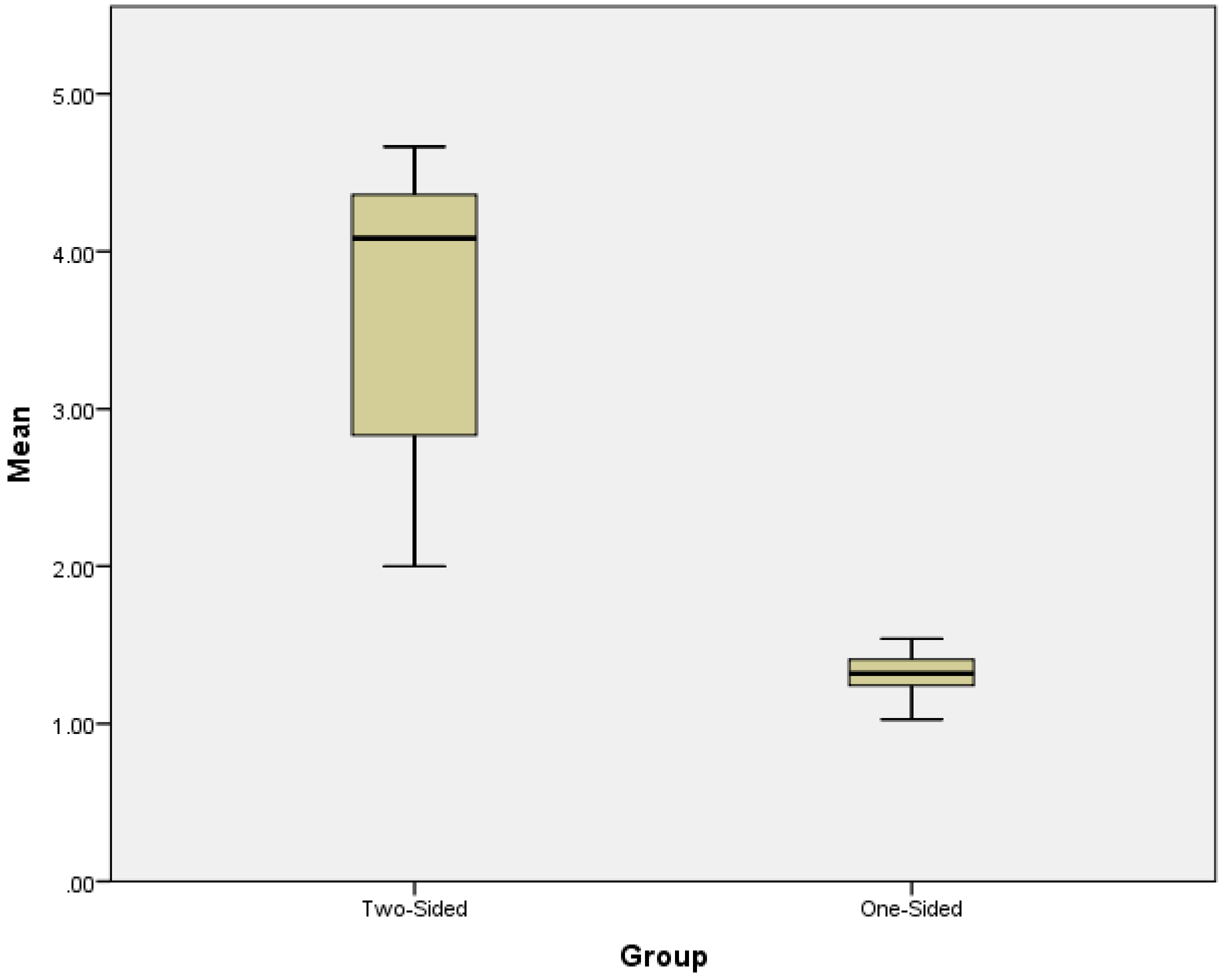
61	.008	.012	99.945			
62	.008	.011	99.956			
63	.006	.008	99.964			
64	.005	.007	99.971			
65	.004	.006	99.977			
66	.004	.006	99.983			
67	.003	.005	99.988			
68	.003	.004	99.991			
69	.002	.003	99.995			
70	.002	.003	99.997			
71	.001	.002	99.999			
72	.001	.001	100.000			

Extraction Method: Principal Component Analysis.

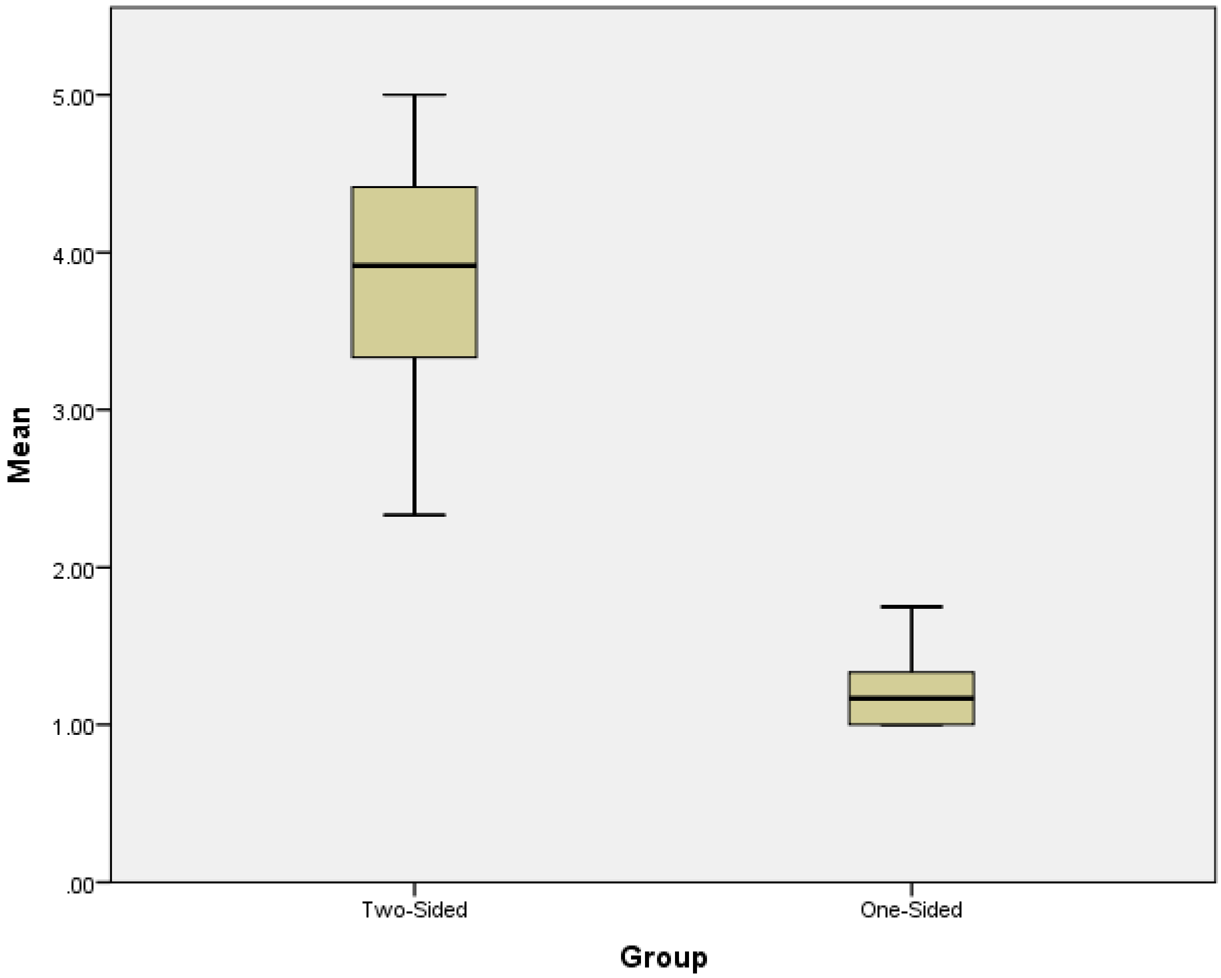
Appendix 12

Box Plots One-Sided and Two-Sided Firms

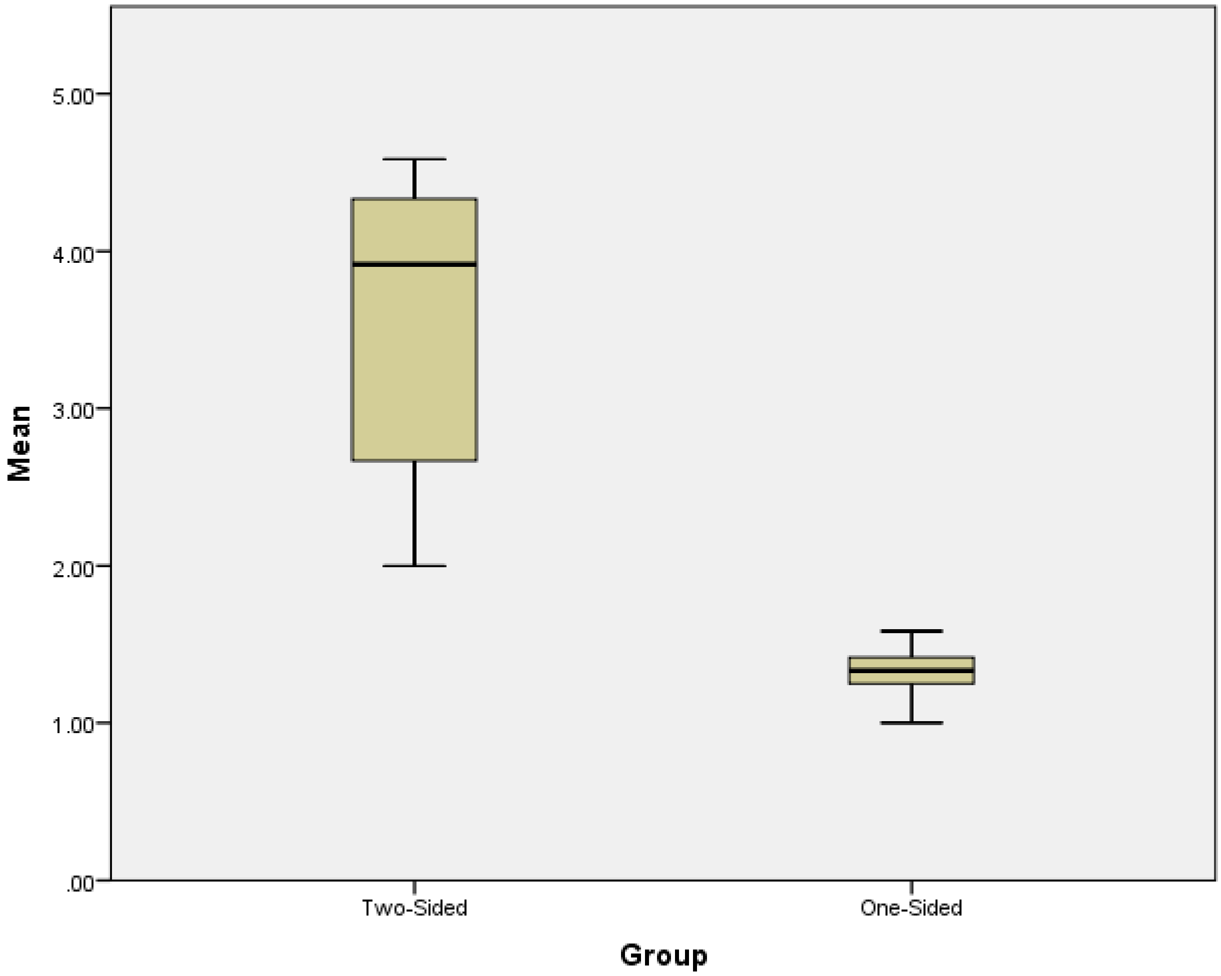
All Categories of the Audit Questionnaire (Questions 1 – 72)



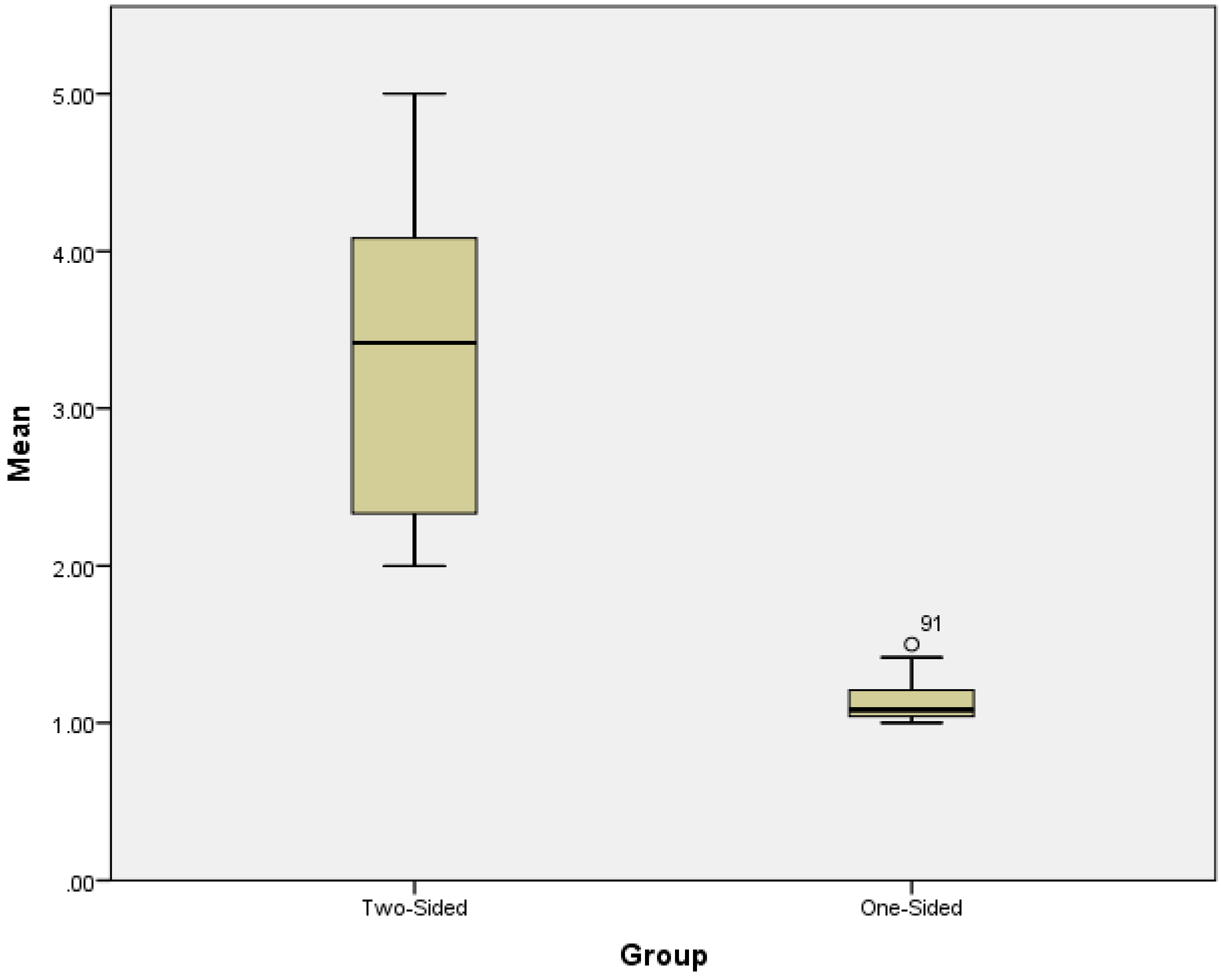
Organizational Strategy – Questions 1 – 12



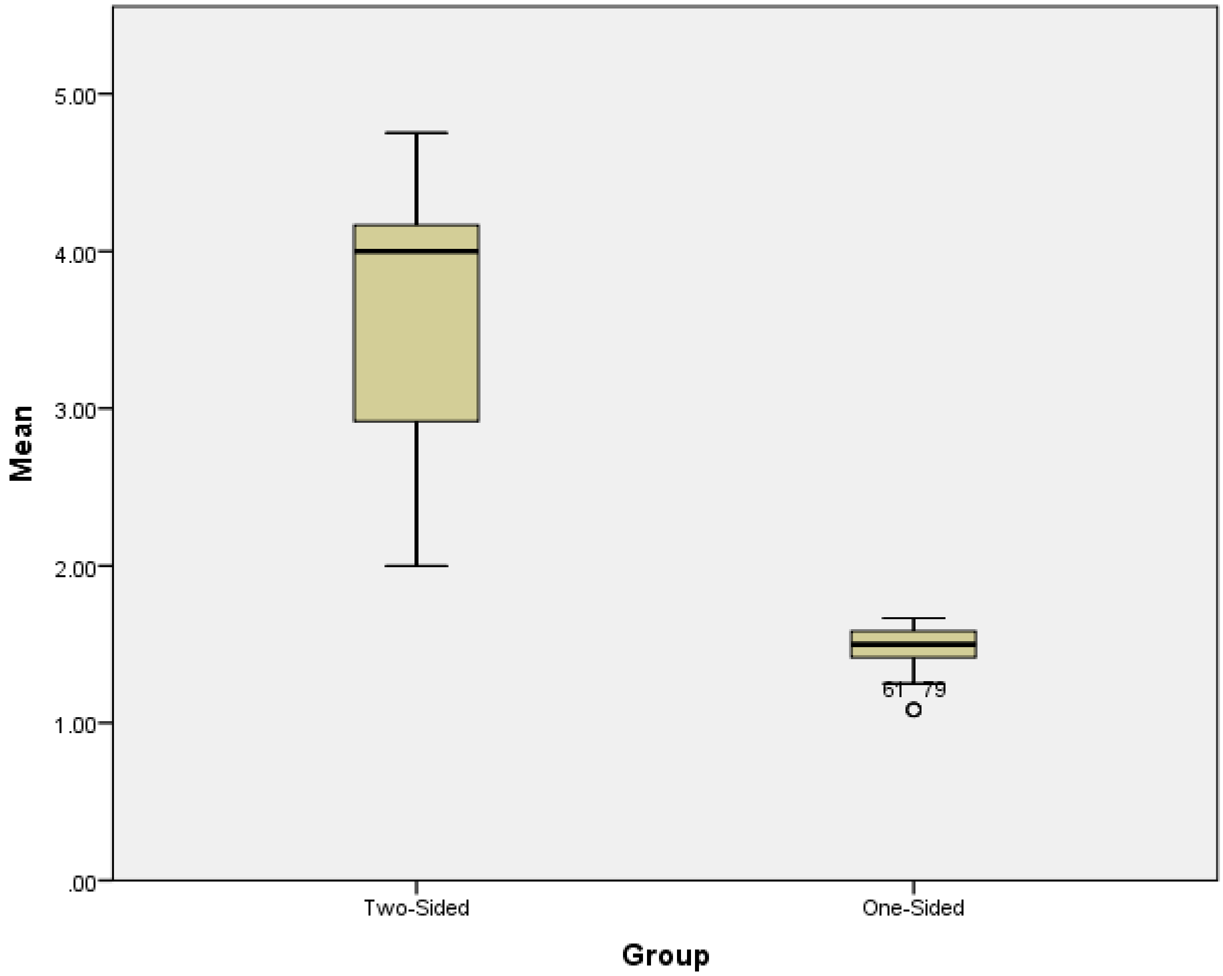
Organizational Processes – Questions 13 – 24



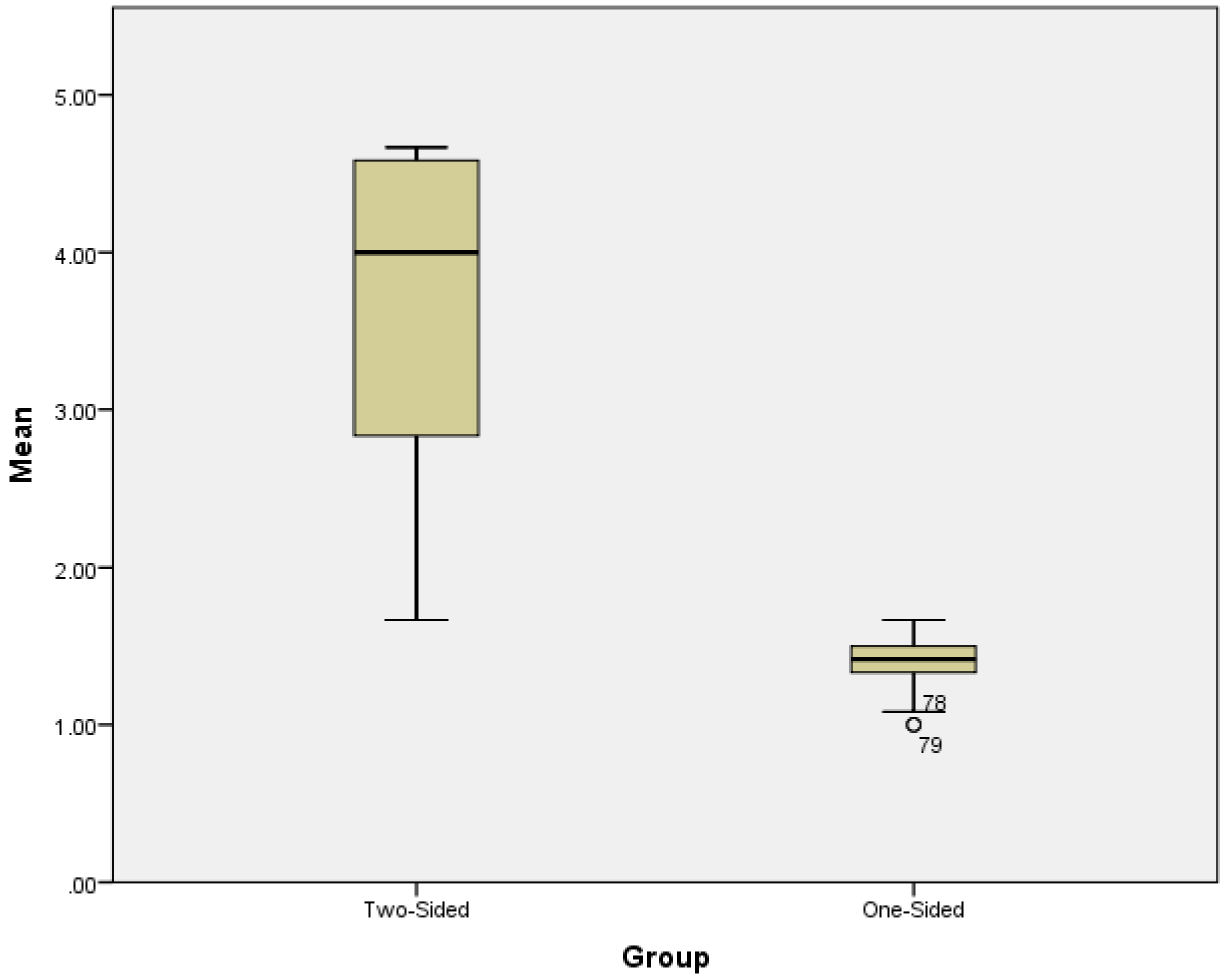
Organizational Structure – Questions 25 – 36



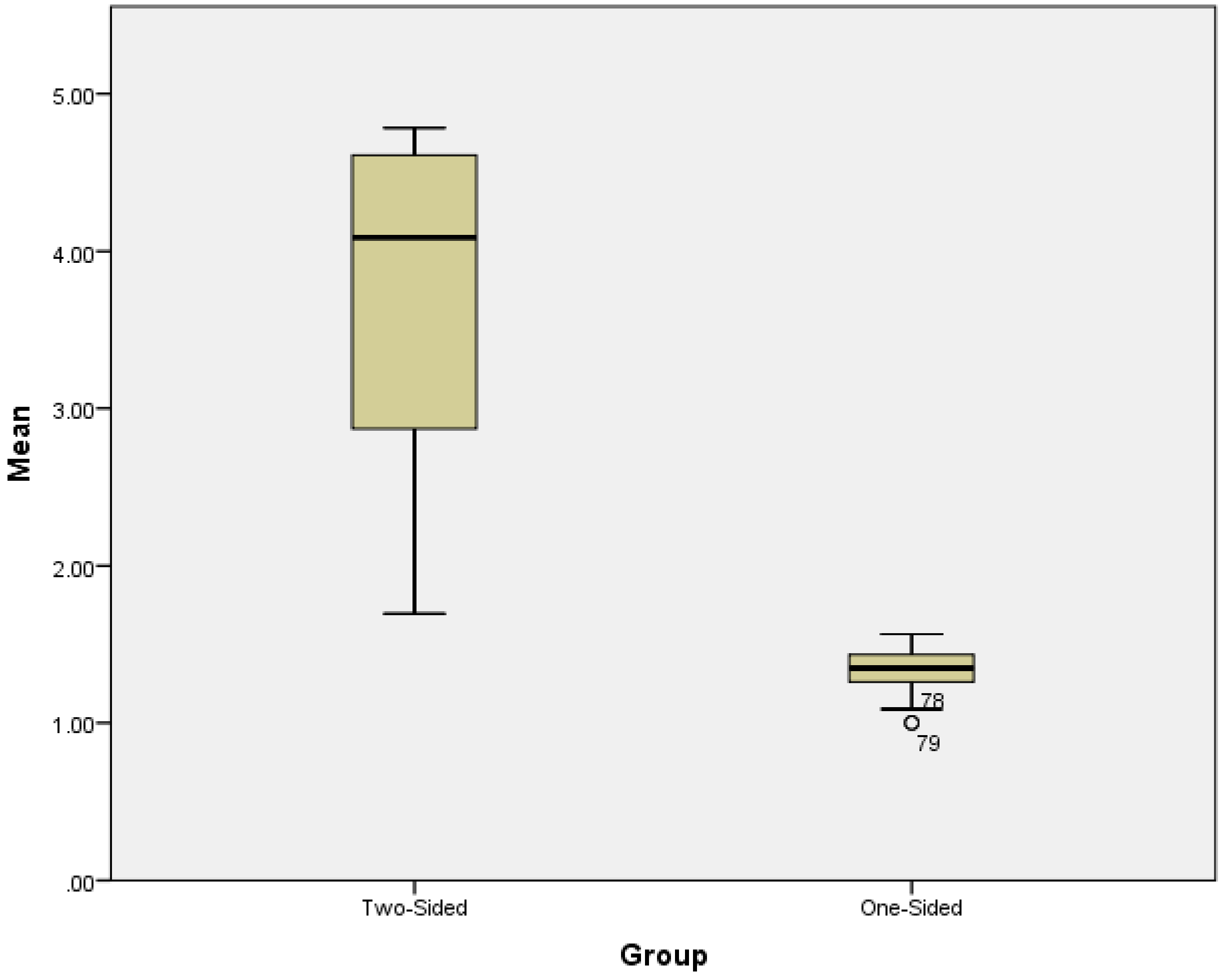
Organizational Culture – Questions 37 – 48



Organizational Learning – Questions 49 – 60



Organizational Idea Generation – Questions 50 – 72



Appendix 13

A Summary of the Innovation Audit Questionnaire Results - Two-Sided and One-Sided Firms Combined

Organizational Strategy

Question 1: A technology strategy exists (i.e. an explicit policy for sourcing technologies) and there are mechanisms for understanding current and future technology needs.

Rank value	Option	Count
1	1 Strongly Disagree	37
2	2 Disagree	12
3	3 Partially Agree	21
4	4 Agree	10
5	5 Strongly Agree	20
Mean rank	2.64	
Variance	2.37	
Standard Deviation	1.54	
Lower Quartile	1.0	
Upper Quartile	4.0	

Question 2: Competitors' innovation rates are known/monitored.

Rank value	Option	Count
1	1 Strongly Disagree	37
2	2 Disagree	13
3	3 Partially Agree	16
4	4 Agree	15
5	5 Strongly Agree	19
Mean rank	2.66	
Variance	2.4	
Standard Deviation	1.55	
Lower Quartile	1.0	
Upper Quartile	4.0	

Question 3: Performance measures are in place for innovation including goals for new products, services and processes.

Rank value	Option	Count
1	1 Strongly Disagree	41
2	2 Disagree	7
3	3 Partially Agree	24
4	4 Agree	12
5	5 Strongly Agree	16
Mean rank	2.55	
Variance	2.27	
Standard Deviation	1.51	
Lower Quartile	1.0	
Upper Quartile	4.0	

Question 4: Risk taking is encouraged rather than penalized by management.

Rank value	Option	Count
1	1 Strongly Disagree	22
2	2 Disagree	25
3	3 Partially Agree	22
4	4 Agree	14
5	5 Strongly Agree	17

Mean rank	2.79
Variance	1.91
Standard Deviation	1.38
Lower Quartile	2.0
Upper Quartile	4.0

Question 5: There is a formalized innovation programme in the organization.

Rank value	Option	Count
1	1 Strongly Disagree	34
2	2 Disagree	13
3	3 Partially Agree	17
4	4 Agree	14
5	5 Strongly Agree	22

Mean rank	2.77
Variance	2.46
Standard Deviation	1.57
Lower Quartile	1.0
Upper Quartile	4.0

Question 6: The organization’s innovation strategy/policy is promoted throughout the organization.

Rank value	Option	Count
1	1 Strongly Disagree	36
2	2 Disagree	13
3	3 Partially Agree	18
4	4 Agree	16
5	5 Strongly Agree	17

Mean rank	2.65
Variance	2.29
Standard Deviation	1.51
Lower Quartile	1.0
Upper Quartile	4.0

Question 7: There is top management commitment and support for innovation.

Rank value	Option	Count
1	1 Strongly Disagree	27
2	2 Disagree	24
3	3 Partially Agree	19
4	4 Agree	13
5	5 Strongly Agree	17

Mean rank	2.69
Variance	2.03
Standard Deviation	1.43
Lower Quartile	1.0
Upper Quartile	4.0

Question 8: The organization looks ahead in a structured way (using forecasting tools and techniques) to try and imagine future threats and opportunities.

Rank value	Option	Count
1	1 Strongly Disagree	22
2	2 Disagree	25
3	3 Partially Agree	11
4	4 Agree	28
5	5 Strongly Agree	14

Mean rank	2.87
Variance	1.95
Standard Deviation	1.4
Lower Quartile	2.0
Upper Quartile	4.0

Question 9: The top team have a shared vision of how the company will develop through innovation.

Rank value	Option	Count
1	1 Strongly Disagree	36
2	2 Disagree	14
3	3 Partially Agree	20
4	4 Agree	18
5	5 Strongly Agree	12

Mean rank	2.56
Variance	2.05
Standard Deviation	1.43
Lower Quartile	1.0
Upper Quartile	4.0

Question 10: The percentage of revenue from products/services introduced in the last 3 years is high compared to competitors.

Rank value	Option	Count
1	1 Strongly Disagree	36
2	2 Disagree	11
3	3 Partially Agree	27
4	4 Agree	7
5	5 Strongly Agree	19
Mean rank	2.62	
Variance	2.24	
Standard Deviation	1.5	
Lower Quartile	1.0	
Upper Quartile	4.0	

Question 11: Market share has increased as a result of new products/services introduced in the last 3 years

Rank value	Option	Count
1	1 Strongly Disagree	37
2	2 Disagree	12
3	3 Partially Agree	21
4	4 Agree	6
5	5 Strongly Agree	24
Mean rank	2.68	
Variance	2.52	
Standard Deviation	1.59	
Lower Quartile	1.0	
Upper Quartile	4.0	

Question 12: The number of new products/services in the portfolio has been increasing over the last 3 years

Rank value	Option	Count
1	1 Strongly Disagree	36
2	2 Disagree	12
3	3 Partially Agree	17
4	4 Agree	16
5	5 Strongly Agree	19
Mean rank	2.7	
Variance	2.39	
Standard Deviation	1.55	
Lower Quartile	1.0	
Upper Quartile	4.0	

Organizational Processes

Question 13: There are processes in place to help manage new product development effectively from idea to launch.

Rank value	Option	Count
1	1 Strongly Disagree	22
2	2 Disagree	34
3	3 Partially Agree	17
4	4 Agree	5
5	5 Strongly Agree	22

Mean rank	2.71
Variance	2.07
Standard Deviation	1.44
Lower Quartile	2.0
Upper Quartile	4.0

Question 14: There are effective mechanisms for managing process change from idea through to successful implementation.

Rank value	Option	Count
1	1 Strongly Disagree	20
2	2 Disagree	33
3	3 Partially Agree	27
4	4 Agree	8
5	5 Strongly Agree	12

Mean rank	2.59
Variance	1.52
Standard Deviation	1.23
Lower Quartile	2.0
Upper Quartile	3.0

Question 15: There are mechanisms in place to ensure early involvement of all departments in developing new products/processes.

Rank value	Option	Count
1	1 Strongly Disagree	42
2	2 Disagree	18
3	3 Partially Agree	14
4	4 Agree	8
5	5 Strongly Agree	18

Mean rank	2.42
Variance	2.32
Standard Deviation	1.52
Lower Quartile	1.0
Upper Quartile	4.0

Question 16: There is a clear system for choosing innovation projects.

Rank value	Option	Count
1	1 Strongly Disagree	36
2	2 Disagree	21
3	3 Partially Agree	17
4	4 Agree	12
5	5 Strongly Agree	14
Mean rank	2.47	
Variance	2.05	
Standard Deviation	1.43	
Lower Quartile	1.0	
Upper Quartile	4.0	

Question 17: Processes are constantly reviewed to identify areas for improvement

Rank value	Option	Count
1	1 Strongly Disagree	22
2	2 Disagree	35
3	3 Partially Agree	22
4	4 Agree	7
5	5 Strongly Agree	14
Mean rank	2.56	
Variance	1.67	
Standard Deviation	1.29	
Lower Quartile	2.0	
Upper Quartile	3.0	

Question 18: There is a focus on process improvement rather than on maintenance of processes.

Rank value	Option	Count
1	1 Strongly Disagree	9
2	2 Disagree	49
3	3 Partially Agree	17
4	4 Agree	6
5	5 Strongly Agree	19
Mean rank	2.77	
Variance	1.62	
Standard Deviation	1.27	
Lower Quartile	2.0	
Upper Quartile	3.25	

Question 19: If it isn't broken, leave it alone is NOT an accepted philosophy in the organisation

Rank value	Option	Count
1	1 Strongly Disagree	9
2	2 Disagree	54
3	3 Partially Agree	12
4	4 Agree	8
5	5 Strongly Agree	17
Mean rank	2.7	
Variance	1.57	
Standard Deviation	1.25	
Lower Quartile	2.0	
Upper Quartile	3.25	

Question 20: There is a strong link between product innovation and process improvement to support the product.

Rank value	Option	Count
1	1 Strongly Disagree	25
2	2 Disagree	31
3	3 Partially Agree	24
4	4 Agree	8
5	5 Strongly Agree	12
Mean rank	2.51	
Variance	1.63	
Standard Deviation	1.28	
Lower Quartile	1.75	
Upper Quartile	3.0	

Question 21: The organisation is at the leading edge of technology in our industry.

Rank value	Option	Count
1	1 Strongly Disagree	42
2	2 Disagree	13
3	3 Partially Agree	20
4	4 Agree	7
5	5 Strongly Agree	18
Mean rank	2.46	
Variance	2.31	
Standard Deviation	1.52	
Lower Quartile	1.0	
Upper Quartile	3.25	

Question 22: There is participation in organization-wide continuous improvement activity.

Rank value	**Option**	**Count**
1	1 Strongly Disagree	39
2	2 Disagree	17
3	3 Partially Agree	19
4	4 Agree	10
5	5 Strongly Agree	15

Mean rank	2.45
Variance	2.13
Standard Deviation	1.46
Lower Quartile	1.0
Upper Quartile	3.25

Question 23: The time-to-market of new products is very short compared to our competitors.

Rank value	**Option**	**Count**
1	1 Strongly Disagree	35
2	2 Disagree	24
3	3 Partially Agree	22
4	4 Agree	6
5	5 Strongly Agree	13

Mean rank	2.38
Variance	1.84
Standard Deviation	1.35
Lower Quartile	1.0
Upper Quartile	3.0

Question 24: The organization is constantly developing and introducing new products/services.

Rank value	**Option**	**Count**
1	1 Strongly Disagree	42
2	2 Disagree	10
3	3 Partially Agree	20
4	4 Agree	5
5	5 Strongly Agree	23

Mean rank	2.57
Variance	2.57
Standard Deviation	1.6
Lower Quartile	1.0
Upper Quartile	4.0

Organizational Structure

Question 25: The organization structures are flexible and facilitate innovation to happen.

Rank value	Option	Count
1	1 Strongly Disagree	43
2	2 Disagree	20
3	3 Partially Agree	13
4	4 Agree	14
5	5 Strongly Agree	10
Mean rank	2.28	
Variance	1.94	
Standard Deviation	1.39	
Lower Quartile	1.0	
Upper Quartile	3.0	

Question 26: People work well together across departmental boundaries.

Rank value	Option	Count
1	1 Strongly Disagree	45
2	2 Disagree	20
3	3 Partially Agree	10
4	4 Agree	14
5	5 Strongly Agree	11
Mean rank	2.26	
Variance	2.03	
Standard Deviation	1.43	
Lower Quartile	1.0	
Upper Quartile	3.25	

Question 27: People are involved in suggesting ideas for improvements to products or processes.

Rank value	Option	Count
1	1 Strongly Disagree	28
2	2 Disagree	30
3	3 Partially Agree	19
4	4 Agree	6
5	5 Strongly Agree	17
Mean rank	2.54	
Variance	1.95	
Standard Deviation	1.4	
Lower Quartile	1.0	
Upper Quartile	3.0	

Question 28: **The structure facilitates rapid decision making.**

Rank value	Option	Count
1	1 Strongly Disagree	44
2	2 Disagree	18
3	3 Partially Agree	16
4	4 Agree	8
5	5 Strongly Agree	14

Mean rank 2.3
Variance 2.09
Standard Deviation 1.45
Lower Quartile 1.0
Upper Quartile 3.0

Question 29: **Communication is effective and works top-down, bottom-up and across the organization.**

Rank value	Option	Count
1	1 Strongly Disagree	45
2	2 Disagree	16
3	3 Partially Agree	14
4	4 Agree	14
5	5 Strongly Agree	11

Mean rank 2.3
Variance 2.05
Standard Deviation 1.43
Lower Quartile 1.0
Upper Quartile 3.25

Question 30: **The reward and recognition system supports innovation.**

Rank value	Option	Count
1	1 Strongly Disagree	34
2	2 Disagree	28
3	3 Partially Agree	15
4	4 Agree	15
5	5 Strongly Agree	8

Mean rank 2.35
Variance 1.69
Standard Deviation 1.3
Lower Quartile 1.0
Upper Quartile 3.0

Question 31: There is a supportive climate for new ideas - people don't have to leave the organization to make them happen.

Rank value	Option	Count
1	1 Strongly Disagree	41
2	2 Disagree	16
3	3 Partially Agree	21
4	4 Agree	15
5	5 Strongly Agree	7
Mean rank	2.31	
Variance	1.75	
Standard Deviation	1.32	
Lower Quartile	1.0	
Upper Quartile	3.0	

Question 32: The employees work well in teams.

Rank value	Option	Count
1	1 Strongly Disagree	28
2	2 Disagree	32
3	3 Partially Agree	15
4	4 Agree	17
5	5 Strongly Agree	8
Mean rank	2.45	
Variance	1.63	
Standard Deviation	1.28	
Lower Quartile	1.0	
Upper Quartile	3.25	

Question 33: Individuals and teams have space and autonomy for idea generation and creative problem solving.

Rank value	Option	Count
1	1 Strongly Disagree	42
2	2 Disagree	18
3	3 Partially Agree	15
4	4 Agree	9
5	5 Strongly Agree	16
Mean rank	2.39	
Variance	2.22	
Standard Deviation	1.49	
Lower Quartile	1.0	
Upper Quartile	3.25	

Question 34: Teams are diverse and heterogeneous in structure i.e. diverse educational, functional and industrial backgrounds.

Rank value	Option	Count
1	1 Strongly Disagree	35
2	2 Disagree	22
3	3 Partially Agree	22
4	4 Agree	5
5	5 Strongly Agree	16
Mean rank	2.45	
Variance	2.01	
Standard Deviation	1.42	
Lower Quartile	1.0	
Upper Quartile	3.0	

Question 35: There is an appropriate use of teams to solve problems (at local, cross-functional and inter-organizational level)

Rank value	Option	Count
1	1 Strongly Disagree	42
2	2 Disagree	24
3	3 Partially Agree	10
4	4 Agree	13
5	5 Strongly Agree	11
Mean rank	2.27	
Variance	1.96	
Standard Deviation	1.4	
Lower Quartile	1.0	
Upper Quartile	3.0	

Question 36: There are key individuals who energize and facilitate innovation within the organization i.e. promoters, sponsors and champions.

Rank value	Option	Count
1	1 Strongly Disagree	29
2	2 Disagree	38
3	3 Partially Agree	10
4	4 Agree	11
5	5 Strongly Agree	12
Mean rank	2.39	
Variance	1.76	
Standard Deviation	1.33	
Lower Quartile	1.0	
Upper Quartile	3.0	

Organizational Culture

Question 37: There is collaboration with other firms to develop new products or processes.

Rank value	Option	Count
1	1 Strongly Disagree	17
2	2 Disagree	41
3	3 Partially Agree	14
4	4 Agree	9
5	5 Strongly Agree	19
Mean rank	2.72	
Variance	1.86	
Standard Deviation	1.36	
Lower Quartile	2.0	
Upper Quartile	4.0	

Question 38: The organization develops external networks with people who can provide specialist knowledge.

Rank value	Option	Count
1	1 Strongly Disagree	9
2	2 Disagree	44
3	3 Partially Agree	20
4	4 Agree	10
5	5 Strongly Agree	17
Mean rank	2.82	
Variance	1.55	
Standard Deviation	1.24	
Lower Quartile	2.0	
Upper Quartile	4.0	

Question 39: The organization works closely with 'lead users' and customers to develop innovative new products and services.

Rank value	Option	Count
1	1 Strongly Disagree	43
2	2 Disagree	14
3	3 Partially Agree	16
4	4 Agree	12
5	5 Strongly Agree	15
Mean rank	2.42	
Variance	2.24	
Standard Deviation	1.5	
Lower Quartile	1.0	
Upper Quartile	4.0	

Question 40: Human resource policies support a culture of innovation through stimulating a creative, problem-solving working environment.

Rank value	Option	Count
1	1 Strongly Disagree	9
2	2 Disagree	45
3	3 Partially Agree	15
4	4 Agree	19
5	5 Strongly Agree	12
Mean rank	2.8	
Variance	1.44	
Standard Deviation	1.2	
Lower Quartile	2.0	
Upper Quartile	4.0	

Question 41: The skills required for innovation are identified and they are fully resourced through recruitment and training.

Rank value	Option	Count
1	1 Strongly Disagree	6
2	2 Disagree	49
3	3 Partially Agree	21
4	4 Agree	8
5	5 Strongly Agree	16
Mean rank	2.79	
Variance	1.41	
Standard Deviation	1.19	
Lower Quartile	2.0	
Upper Quartile	3.0	

Question 42: Career structures support innovation through development of people across different functions.

Rank value	Option	Count
1	1 Strongly Disagree	5
2	2 Disagree	51
3	3 Partially Agree	15
4	4 Agree	16
5	5 Strongly Agree	13
Mean rank	2.81	
Variance	1.35	
Standard Deviation	1.16	
Lower Quartile	2.0	
Upper Quartile	4.0	

Question 43: Employee appraisals reward innovation activities by employees.

Rank value	Option	Count
1	1 Strongly Disagree	7
2	2 Disagree	51
3	3 Partially Agree	15
4	4 Agree	11
5	5 Strongly Agree	16
Mean rank	2.78	
Variance	1.49	
Standard Deviation	1.22	
Lower Quartile	2.0	
Upper Quartile	4.0	

Question 44: Innovation strategies are deployed to the employee level.

Rank value	Option	Count
1	1 Strongly Disagree	44
2	2 Disagree	12
3	3 Partially Agree	18
4	4 Agree	9
5	5 Strongly Agree	17
Mean rank	2.43	
Variance	2.33	
Standard Deviation	1.52	
Lower Quartile	1.0	
Upper Quartile	4.0	

Question 45: Staff can approach top management with ideas and get a fair hearing.

Rank value	Option	Count
1	1 Strongly Disagree	15
2	2 Disagree	38
3	3 Partially Agree	21
4	4 Agree	6
5	5 Strongly Agree	20
Mean rank	2.78	
Variance	1.79	
Standard Deviation	1.34	
Lower Quartile	2.0	
Upper Quartile	4.0	

Question 46: Clear innovation targets are set and known by all employees.

Rank value	Option	Count
1	1 Strongly Disagree	45
2	2 Disagree	14
3	3 Partially Agree	9
4	4 Agree	21
5	5 Strongly Agree	11
Mean rank	2.39	
Variance	2.22	
Standard Deviation	1.49	
Lower Quartile	1.0	
Upper Quartile	4.0	

Question 47: There is a system for screening and evaluating ideas in the organization.

Rank value	Option	Count
1	1 Strongly Disagree	38
2	2 Disagree	17
3	3 Partially Agree	20
4	4 Agree	6
5	5 Strongly Agree	19
Mean rank	2.51	
Variance	2.27	
Standard Deviation	1.51	
Lower Quartile	1.0	
Upper Quartile	3.25	

Question 48: The responsibility for screening decisions doesn't lie too high in the company hierarchy.

Rank value	Option	Count
1	1 Strongly Disagree	41
2	2 Disagree	17
3	3 Partially Agree	16
4	4 Agree	7
5	5 Strongly Agree	19
Mean rank	2.46	
Variance	2.35	
Standard Deviation	1.53	
Lower Quartile	1.0	
Upper Quartile	4.0	

Organizational Learning

Question 49: The organization is good at understanding the needs of customers/end-users.

Rank value	Option	Count
1	1 Strongly Disagree	10
2	2 Disagree	41
3	3 Partially Agree	18
4	4 Agree	12
5	5 Strongly Agree	19
Mean rank	2.89	
Variance	1.68	
Standard Deviation	1.3	
Lower Quartile	2.0	
Upper Quartile	4.0	

Question 50: There is a strong and continuing commitment to the training and development of people.

Rank value	Option	Count
1	1 Strongly Disagree	9
2	2 Disagree	42
3	3 Partially Agree	18
4	4 Agree	14
5	5 Strongly Agree	17
Mean rank	2.88	
Variance	1.59	
Standard Deviation	1.26	
Lower Quartile	2.0	
Upper Quartile	4.0	

Question 51: Time is taken to review projects to improve performance next time around

Rank value	Option	Count
1	1 Strongly Disagree	27
2	2 Disagree	29
3	3 Partially Agree	13
4	4 Agree	13
5	5 Strongly Agree	18
Mean rank	2.66	
Variance	2.1	
Standard Deviation	1.45	
Lower Quartile	1.0	
Upper Quartile	4.0	

Question 52: **The organization learns from its mistakes.**

Rank value	Option	Count
1	1 Strongly Disagree	12
2	2 Disagree	45
3	3 Partially Agree	13
4	4 Agree	16
5	5 Strongly Agree	14
Mean rank	2.75	
Variance	1.59	
Standard Deviation	1.26	
Lower Quartile	2.0	
Upper Quartile	4.0	

Question 53: **The organization systematically compares its products and processes with other firms.**

Rank value	Option	Count
1	1 Strongly Disagree	8
2	2 Disagree	45
3	3 Partially Agree	15
4	4 Agree	17
5	5 Strongly Agree	15
Mean rank	2.86	
Variance	1.52	
Standard Deviation	1.23	
Lower Quartile	2.0	
Upper Quartile	4.0	

Question 54: **The organization meets and shares experiences with other firms to help it to learn.**

Rank value	Option	Count
1	1 Strongly Disagree	41
2	2 Disagree	14
3	3 Partially Agree	15
4	4 Agree	17
5	5 Strongly Agree	13
Mean rank	2.47	
Variance	2.19	
Standard Deviation	1.48	
Lower Quartile	1.0	
Upper Quartile	4.0	

Question 55: The organization is good at capturing what it has learned so that others in the organization can make use of it.

Rank value	Option	Count
1	1 Strongly Disagree	45
2	2 Disagree	8
3	3 Partially Agree	19
4	4 Agree	16
5	5 Strongly Agree	12
Mean rank	2.42	
Variance	2.18	
Standard Deviation	1.48	
Lower Quartile	1.0	
Upper Quartile	4.0	

Question 56: The firm is good at learning from other organizations.

Rank value	Option	Count
1	1 Strongly Disagree	15
2	2 Disagree	37
3	3 Partially Agree	16
4	4 Agree	17
5	5 Strongly Agree	15
Mean rank	2.8	
Variance	1.7	
Standard Deviation	1.3	
Lower Quartile	2.0	
Upper Quartile	4.0	

Question 57: The organization uses measurement to help identify where and when it can improve its innovation management.

Rank value	Option	Count
1	1 Strongly Disagree	42
2	2 Disagree	20
3	3 Partially Agree	8
4	4 Agree	16
5	5 Strongly Agree	14
Mean rank	2.4	
Variance	2.24	
Standard Deviation	1.5	
Lower Quartile	1.0	
Upper Quartile	4.0	

Question 58: The organization design enables creativity, learning and interaction.

Rank value	Option	Count
1	1 Strongly Disagree	45
2	2 Disagree	7
3	3 Partially Agree	16
4	4 Agree	11
5	5 Strongly Agree	21
Mean rank	2.56	
Variance	2.63	
Standard Deviation	1.62	
Lower Quartile	1.0	
Upper Quartile	4.0	

Question 59: There are high levels of proactive experimentation such as finding and solving problems.

Rank value	Option	Count
1	1 Strongly Disagree	44
2	2 Disagree	9
3	3 Partially Agree	18
4	4 Agree	15
5	5 Strongly Agree	14
Mean rank	2.46	
Variance	2.27	
Standard Deviation	1.51	
Lower Quartile	1.0	
Upper Quartile	4.0	

Question 60: There are high levels of knowledge capture and the communication and sharing of experiences.

Rank value	Option	Count
1	1 Strongly Disagree	46
2	2 Disagree	4
3	3 Partially Agree	16
4	4 Agree	13
5	5 Strongly Agree	21
Mean rank	2.59	
Variance	2.68	
Standard Deviation	1.64	
Lower Quartile	1.0	
Upper Quartile	4.0	

Organizational Idea Generation

Question 61: The organisation systematically searches for new product/service ideas.

Rank value	Option	Count
1	1 Strongly Disagree	33
2	2 Disagree	22
3	3 Partially Agree	12
4	4 Agree	12
5	5 Strongly Agree	21
Mean rank	2.66	
Variance	2.38	
Standard Deviation	1.54	
Lower Quartile	1.0	
Upper Quartile	4.0	

Question 62: Creative ideas are collected on a regular basis from all employees.

Rank value	Option	Count
1	1 Strongly Disagree	32
2	2 Disagree	21
3	3 Partially Agree	19
4	4 Agree	9
5	5 Strongly Agree	19
Mean rank	2.62	
Variance	2.2	
Standard Deviation	1.48	
Lower Quartile	1.0	
Upper Quartile	4.0	

Question 63: The number of ideas for new products, services and processes developed in the last 12 months is comparable to the best in class.

Rank value	Option	Count
1	1 Strongly Disagree	48
2	2 Disagree	6
3	3 Partially Agree	19
4	4 Agree	6
5	5 Strongly Agree	21
Mean rank	2.46	
Variance	2.59	
Standard Deviation	1.61	
Lower Quartile	1.0	
Upper Quartile	4.0	

Question 64: **Ideas originate from all departments.**

Rank value	Option	Count
1	1 Strongly Disagree	47
2	2 Disagree	5
3	3 Partially Agree	18
4	4 Agree	8
5	5 Strongly Agree	22
Mean rank	2.53	
Variance	2.67	
Standard Deviation	1.63	
Lower Quartile	1.0	
Upper Quartile	4.0	

Question 65: **There is consistent scanning of customer surveys and market trend analysis.**

Rank value	Option	Count
1	1 Strongly Disagree	15
2	2 Disagree	37
3	3 Partially Agree	18
4	4 Agree	9
5	5 Strongly Agree	21
Mean rank	2.84	
Variance	1.87	
Standard Deviation	1.37	
Lower Quartile	2.0	
Upper Quartile	4.0	

Question 66: **The company sources for ideas externally e.g. from suppliers and customers.**

Rank value	Option	Count
1	1 Strongly Disagree	13
2	2 Disagree	45
3	3 Partially Agree	10
4	4 Agree	14
5	5 Strongly Agree	18
Mean rank	2.79	
Variance	1.79	
Standard Deviation	1.34	
Lower Quartile	2.0	
Upper Quartile	4.0	

Question 67: The company belongs to a network i.e. it has close relationships with suppliers and customers and ongoing contacts with universities, government agencies, industry consortia etc.

Rank value	Option	Count
1	1 Strongly Disagree	11
2	2 Disagree	45
3	3 Partially Agree	12
4	4 Agree	20
5	5 Strongly Agree	12

Mean rank	2.77
Variance	1.52
Standard Deviation	1.23
Lower Quartile	2.0
Upper Quartile	4.0

Question 68: There is extensive networking internal and external.

Rank value	Option	Count
1	1 Strongly Disagree	37
2	2 Disagree	18
3	3 Partially Agree	16
4	4 Agree	14
5	5 Strongly Agree	15

Mean rank	2.52
Variance	2.17
Standard Deviation	1.47
Lower Quartile	1.0
Upper Quartile	4.0

Question 69: People in the organization know where to take their ideas.

Rank value	Option	Count
1	1 Strongly Disagree	25
2	2 Disagree	29
3	3 Partially Agree	17
4	4 Agree	3
5	5 Strongly Agree	26

Mean rank	2.76
Variance	2.3
Standard Deviation	1.52
Lower Quartile	1.75
Upper Quartile	5.0

Question 70: **Ideas are quickly developed into new product/service concepts.**

Rank value	Option	Count
1	1 Strongly Disagree	39
2	2 Disagree	14
3	3 Partially Agree	18
4	4 Agree	5
5	5 Strongly Agree	24
Mean rank	2.61	
Variance	2.56	
Standard Deviation	1.6	
Lower Quartile	1.0	
Upper Quartile	4.0	

Question 71: **Creativity techniques and workshops are effectively used.**

Rank value	Option	Count
1	1 Strongly Disagree	40
2	2 Disagree	11
3	3 Partially Agree	21
4	4 Agree	3
5	5 Strongly Agree	25
Mean rank	2.62	
Variance	2.6	
Standard Deviation	1.61	
Lower Quartile	1.0	
Upper Quartile	4.25	

Question 72: **There is a positive approach to creative ideas, supported by relevant motivation systems.**

Rank value	Option	Count
1	1 Strongly Disagree	38
2	2 Disagree	19
3	3 Partially Agree	11
4	4 Agree	2
5	5 Strongly Agree	30
Mean rank	2.67	
Variance	2.82	
Standard Deviation	1.68	
Lower Quartile	1.0	
Upper Quartile	5.0	

Appendix 14

Mann-Whitney U Test – Two-Sided Firms & Industry Platform Firms

Organizational Strategy – Questions 1 - 12

Ranks

	Group	N	Mean Rank	Sum of Ranks
1. A technology strategy exists (i.e. an explicit policy for sourcing technologies) and there are mechanisms for understanding current and future technology needs.	Two Sided	29	36.53	1059.50
	Industry Platform	28	21.20	593.50
	Total	57		
2. Competitors' innovation rates are known/monitored.	Two Sided	29	40.53	1175.50
	Industry Platform	28	17.05	477.50
	Total	57		
3. Performance measures are in place for innovation including goals for new products, services and processes.	Two Sided	29	38.88	1127.50
	Industry Platform	28	18.77	525.50
	Total	57		
4. Risk taking is encouraged rather than penalized by management.	Two Sided	29	38.41	1114.00
	Industry Platform	28	19.25	539.00
	Total	57		
5. There is a formalized innovation programme in the organization.	Two Sided	29	40.47	1173.50
	Industry Platform	28	17.13	479.50
	Total	57		
6. The organization's innovation strategy/policy is promoted throughout the organization.	Two Sided	29	37.24	1080.00
	Industry Platform	28	20.46	573.00
	Total	57		
7. There is top management commitment and support for innovation.	Two Sided	29	38.59	1119.00
	Industry Platform	28	19.07	534.00
	Total	57		
8. The organization looks ahead in a structured way (using forecasting tools and techniques) to try and imagine future threats and opportunities.	Two Sided	29	38.29	1110.50
	Industry Platform	28	19.38	542.50
	Total	57		
9. The top team have a shared vision of how the	Two Sided	29	38.26	1109.50
	Industry Platform	28	19.41	543.50

company will develop through innovation.	Total	57		
10. The percentage of revenue from products/services introduced in the last 3 years is high compared to competitors.	Two Sided Industry Platform Total	29 28 57	39.41 18.21	1143.00 510.00
11. Market share has increased as a result of new products/services introduced in the last 3 years.	Two Sided Industry Platform Total	29 28 57	40.53 17.05	1175.50 477.50
12. The number of new products/services in the portfolio has been increasing over the last 3 years	Two Sided Industry Platform Total	29 28 57	36.24 21.50	1051.00 602.00

Organizational Processes – Questions 13 - 24

Ranks

	Group	N	Mean Rank	Sum of Ranks
13. There are processes in place to help manage new product development effectively from idea to launch.	Two Sided Industry Platform Total	29 28 57	40.74 16.84	1181.50 471.50
14. There are effective mechanisms for managing process change from idea through to successful implementation.	Two Sided Industry Platform Total	29 28 57	38.02 19.66	1102.50 550.50
15. There are mechanisms in place to ensure early involvement of all departments in developing new products/processes.	Two Sided Industry Platform Total	29 28 57	41.53 16.02	1204.50 448.50
16. There is a clear system for choosing innovation projects.	Two Sided Industry Platform Total	29 28 57	40.78 16.80	1182.50 470.50
17. Processes are constantly reviewed to identify areas for improvement.	Two Sided Industry Platform Total	29 28 57	38.47 19.20	1115.50 537.50
	Two Sided	29	39.78	1153.50

18. There is a focus on process improvement rather than on maintenance of processes.	Industry Platform Total	28 57	17.84	499.50
19. If it isn't broken, leave it alone is NOT an accepted philosophy in the organisation.	Two Sided Industry Platform Total	29 28 57	38.78 18.88	1124.50 528.50
20. There is a strong link between product innovation and process improvement to support the product.	Two Sided Industry Platform Total	29 28 57	37.95 19.73	1100.50 552.50
21. The organisation is at the leading edge of technology in our industry.	Two Sided Industry Platform Total	29 28 57	40.97 16.61	1188.00 465.00
22. There is participation in organization-wide continuous improvement activity.	Two Sided Industry Platform Total	29 28 57	41.47 16.09	1202.50 450.50
23. The time-to-market of new products is very short compared to our competitors.	Two Sided Industry Platform Total	29 28 57	38.98 18.66	1130.50 522.50
24. The organization is constantly developing and introducing new products/services.	Two Sided Industry Platform Total	29 28 57	40.90 16.68	1186.00 467.00

Organizational Structure – Questions 25 - 36

Ranks

	Group	N	Mean Rank	Sum of Ranks
25. The organization structures are flexible and facilitate innovation to happen.	Two Sided Industry Platform Total	29 28 57	41.43 16.13	1201.50 451.50
26. People work well together across departmental boundaries.	Two Sided Industry Platform Total	29 28 57	40.45 17.14	1173.00 480.00
27. People are involved in suggesting ideas for improvements to products or processes.	Two Sided Industry Platform Total	29 28 57	40.83 16.75	1184.00 469.00
	Two Sided	29	40.21	1166.00

28. The structure facilitates rapid decision making.	Industry Platform	28	17.39	487.00
	Total	57		
29. Communication is effective and works top-down, bottom-up and across the organization.	Two Sided	29	39.60	1148.50
	Industry Platform	28	18.02	504.50
	Total	57		
30. The reward and recognition system supports innovation.	Two Sided	29	41.55	1205.00
	Industry Platform	28	16.00	448.00
	Total	57		
31. There is a supportive climate for new ideas - people don't have to leave the organization to make them happen.	Two Sided	29	40.31	1169.00
	Industry Platform	28	17.29	484.00
	Total	57		
32. The employees work well in teams.	Two Sided	29	41.14	1193.00
	Industry Platform	28	16.43	460.00
	Total	57		
33. Individuals and teams have space and autonomy for idea generation and creative problem solving.	Two Sided	29	41.83	1213.00
	Industry Platform	28	15.71	440.00
	Total	57		
34. Teams are diverse and heterogeneous in structure i.e. diverse educational, functional and industrial backgrounds.	Two Sided	29	39.41	1143.00
	Industry Platform	28	18.21	510.00
	Total	57		
35. There is an appropriate use of teams to solve problems (at local, cross-functional and inter-organizational level).	Two Sided	29	41.26	1196.50
	Industry Platform	28	16.30	456.50
	Total	57		
36. There are key individuals who energize and facilitate innovation within the organization i.e. promoters, sponsors and champions.	Two Sided	29	42.22	1224.50
	Industry Platform	28	15.30	428.50
	Total	57		

Organizational Culture – Questions 37 - 48

Ranks

	Group	N	Mean Rank	Sum of Ranks
37. There is collaboration with other firms to develop new products or processes.	Two Sided	29	41.10	1192.00
	Industry Platform	28	16.46	461.00
	Total	57		
38. The organization develops external networks with people who can provide specialist knowledge.	Two Sided	29	40.36	1170.50
	Industry Platform	28	17.23	482.50
	Total	57		
39. The organization works closely with 'lead users' and customers to develop innovative new products and services.	Two Sided	29	41.55	1205.00
	Industry Platform	28	16.00	448.00
	Total	57		
40. Human resource policies support a culture of innovation through stimulating a creative, problem-solving working environment.	Two Sided	29	39.48	1145.00
	Industry Platform	28	18.14	508.00
	Total	57		
41. The skills required for innovation are identified and they are fully resourced through recruitment and training.	Two Sided	29	41.12	1192.50
	Industry Platform	28	16.45	460.50
	Total	57		
42. Career structures support innovation through development of people across different functions.	Two Sided	29	40.86	1185.00
	Industry Platform	28	16.71	468.00
	Total	57		
43. Employee appraisals reward innovation activities by employees.	Two Sided	29	41.66	1208.00
	Industry Platform	28	15.89	445.00
	Total	57		
44. Innovation strategies are deployed to the employee level.	Two Sided	29	41.76	1211.00
	Industry Platform	28	15.79	442.00
	Total	57		
45. Staff can approach top management with ideas and get a fair hearing.	Two Sided	29	39.76	1153.00
	Industry Platform	28	17.86	500.00
	Total	57		
	Two Sided	29	41.03	1190.00

46. Clear innovation targets are set and known by all employees.	Industry Platform	28	16.54	463.00
	Total	57		
47. There is a system for screening and evaluating ideas in the organization.	Two Sided	29	40.55	1176.00
	Industry Platform	28	17.04	477.00
	Total	57		
48. The responsibility for screening decisions doesn't lie too high in the company hierarchy.	Two Sided	29	41.53	1204.50
	Industry Platform	28	16.02	448.50
	Total	57		

Organizational Learning – Questions 49 - 60

Ranks

	Group	N	Mean Rank	Sum of Ranks
49. The organization is good at understanding the needs of customers/end-users.	Two Sided	29	41.10	1192.00
	Industry Platform	28	16.46	461.00
	Total	57		
50. There is a strong and continuing commitment to the training and development of people.	Two Sided	29	40.38	1171.00
	Industry Platform	28	17.21	482.00
	Total	57		
51. Time is taken to review projects to improve performance next time around.	Two Sided	29	41.28	1197.00
	Industry Platform	28	16.29	456.00
	Total	57		
52. The organization learns from its mistakes.	Two Sided	29	41.74	1210.50
	Industry Platform	28	15.80	442.50
	Total	57		
53. The organization systematically compares its products and processes with other firms.	Two Sided	29	40.62	1178.00
	Industry Platform	28	16.96	475.00
	Total	57		
54. The organization meets and shares experiences with other firms to help it to learn.	Two Sided	29	41.62	1207.00
	Industry Platform	28	15.93	446.00
	Total	57		
55. The organization is good at capturing what it has learned so that others in the organization can make use of it.	Two Sided	29	40.28	1168.00
	Industry Platform	28	17.32	485.00
	Total	57		
	Two Sided	29	41.14	1193.00

56. The firm is good at learning from other organizations.	Industry Platform	28	16.43	460.00
	Total	57		
57. The organization uses measurement to help identify where and when it can improve its innovation management.	Two Sided	29	41.91	1215.50
	Industry Platform	28	15.63	437.50
	Total	57		
58. The organization design enables creativity, learning and interaction.	Two Sided	29	42.59	1235.00
	Industry Platform	28	14.93	418.00
	Total	57		
59. There are high levels of proactive experimentation such as finding and solving problems.	Two Sided	29	40.16	1164.50
	Industry Platform	28	17.45	488.50
	Total	57		
60. There are high levels of knowledge capture and the communication and sharing of experiences.	Two Sided	29	41.72	1210.00
	Industry Platform	28	15.82	443.00
	Total	57		

Organizational Idea Generation – Questions 61 - 72

Ranks

	Group	N	Mean Rank	Sum of Ranks
61. The organisation systematically searches for new product/service ideas.	Two Sided	29	40.64	1178.50
	Industry Platform	28	16.95	474.50
	Total	57		
62. Creative ideas are collected on a regular basis from all employees.	Two Sided	29	41.24	1196.00
	Industry Platform	28	16.32	457.00
	Total	57		
63. The number of ideas for new products, services and processes developed in the last 12 months is comparable to the best in class.	Two Sided	29	41.55	1205.00
	Industry Platform	28	16.00	448.00
	Total	57		
64. Ideas originate from all departments.	Two Sided	29	41.02	1189.50
	Industry Platform	28	16.55	463.50
	Total	57		
65. There is consistent scanning of customer	Two Sided	29	40.95	1187.50
	Industry Platform	28	16.63	465.50

surveys and market trend analysis.	Total	57		
66. The company sources for ideas externally e.g. from suppliers and customers.	Two Sided Industry Platform Total	29 28 57	40.64 16.95	1178.50 474.50
67. The company belongs to a network i.e. it has close relationships with suppliers and customers and ongoing contacts with universities, government agencies, industry consortia etc.	Two Sided Industry Platform Total	29 28 57	37.43 20.27	1085.50 567.50
68. There is extensive networking internal and external.	Two Sided Industry Platform Total	29 28 57	38.98 18.66	1130.50 522.50
69. People in the organization know where to take their ideas.	Two Sided Industry Platform Total	29 28 57	41.81 15.73	1212.50 440.50
70. Ideas are quickly developed into new product/service concepts.	Two Sided Industry Platform Total	29 28 57	40.91 16.66	1186.50 466.50
71. Creativity techniques and workshops are effectively used.	Two Sided Industry Platform Total	29 28 57	41.83 15.71	1213.00 440.00
72. There is a positive approach to creative ideas, supported by relevant motivation systems.	Two Sided Industry Platform Total	29 28 57	42.50 15.02	1232.50 420.50

Appendix 15

Innovation Audit Questionnaire - Sample Companies

Two-Sided Firms		
1	Google	Internet (Search)
2	Apple	Internet (Mobile Computing)
3	Amazon	Internet (Ecommerce)
4	Facebook	Internet (Social Media)
5	Microsoft	Internet (Software)
6	Alibaba	Internet (Ecommerce)
7	Tencent	Internet (Social Media)
8	Baidu	Internet (Search)
9	JD.com	Internet (Ecommerce)
10	Ebay	Internet (Online Auctions)
11	Yahoo	Internet (General)
12	Twitter	Internet (Social Media)
13	Netflix	Internet (Media)
14	Spotify	Internet (Media)
15	Uber	Internet (Taxis)
16	Airbnb	Internet (Accommodation)
17	Deliveroo	Internet (Food Delivery)
18	Salesforce.com	Internet (Cloud Computing)
19	Transferwise	Internet (Fintech)
20	Alfresco	Internet (Enterprise Content)
21	Blablacar	Internet (Ride Sharing)
22	VMware	Internet (Cloud Computing)
23	Rackspace	Internet (Cloud Computing)
24	Linkedin	Internet (Social Media)
25	Instacart	Internet (Food Delivery)
26	Rakuten	Internet (Ecommerce)
27	Asos	Internet (Ecommerce)
28	Expedia	Internet (Travel)
29	Workday	Internet (Cloud Computing)
Industry Platform Firms		
1	IBM	Technology (General)
2	Hewlett Packard	Technology (General)
3	Intel	Technology (Microprocessors)
4	Qualcomm	Technology (Microprocessors)
5	Arm	Technology (Microprocessors)
6	EMC/Dell	Technology (General)
7	Sony	Technology (General)
8	Samsung	Technology (General)
9	Lenovo	Technology (General)
10	Oracle	Technology (Enterprise Software)

11	Symantec	Technology (Software)
12	AT&T	Telecoms Operator
13	Sprint	Telecoms Operator
14	Verizon	Telecoms Operator
15	Vodafone	Telecoms Operator
16	O2	Telecoms Operator
17	Orange	Telecoms Operator
18	China Mobile	Telecoms Operator
19	Telecom Italia	Telecoms Operator
20	DT	Telecoms Operator
21	BT	Telecoms Operator
22	China Telecom	Telecoms Operator
23	Cisco	Technology (Network Equipment)
24	Ericsson	Telecoms Equipment
25	Alcatel Lucent	Telecoms Equipment
26	Huawei	Telecoms Equipment
27	ZTE	Telecoms Equipment
28	Xiaomi	Technology (General)
One-Sided Firms		
1	Cording Group	Real Estate Sector
2	EDF Energy	Utilities Sector
3	Enel	Utilities Sector
4	British Gas	Utilities Sector
5	Npower (RWE)	Utilities Sector
6	Balfour Beatty	Construction Sector
7	Carillion	Construction Sector
8	Mitie	Construction Sector
9	Amey	Construction Sector
10	HSBC Bank	Banking Sector
11	Lloyds Bank	Banking Sector
12	Royal Bank of Scotland (RBS)	Banking Sector
13	WH Smith	High Street Retail Sector
14	Morrison`s	High Street Retail Sector
15	Matalan	High Street Retail Sector
16	Co-operative Group	High Street Retail Sector
17	Aviva	Insurance Sector
18	RSA Insurance Group	Insurance Sector
19	Axa Insurance	Insurance Sector
20	Holiday Inn	Hotel Sector
21	Travelodge	Hotel Sector
22	Hotel Ibis	Hotel Sector
23	De Vere Hotels	Hotel Sector
24	Compass Group	Food Services Sector
25	Aramark	Food Services Sector
26	Sutcliffe Catering	Food Services Sector
27	Ryanair	Airline Sector
28	Flybe	Airline Sector
29	Ethiopian Airlines	Airline Sector
30	Arriva	Transportation Sector (Rail & Bus)
31	Stagecoach	Transportation Sector (Bus)

32	National Express	Transportation Sector (Bus)
33	Addison Lee	Transportation Sector (Taxi)
34	Wincanton Group	Logistics Sector
35	Parcelforce	Logistics Sector
36	Kuehne & Nagel	Logistics Sector
37	Harvester	Restaurant Sector
38	Brewers Fayre	Restaurant Sector
39	Subway	Restaurant Sector
40	TGI Fridays	Restaurant Sector
41	Tate & Lyle	Food and Beverage Sector
42	Premier Foods	Food and Beverage Sector
43	Northern Foods	Food and Beverage Sector

Appendix 16

Ethics Approval Confirmation

Content removed on data protection grounds

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