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A Multidimensional Perspective on Agile Product Innovation and Factors Affecting Its Performance

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by

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This thesis is dedicated to my lovely parents,
Mina Poorghobadi and Ali Najafi Tavani

Abstract

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The successful introduction of new products is argued to be the lifeblood of most organisations in the pertinent literature. In current dynamic competitive situation, product innovation is intensely becoming an important strategic goal for firms, mainly as a result of three co-emerging trends: intense international competition, fragmented and demanding markets, and diverse and rapidly changing technologies. Dealing with this situation has obliged entrepreneurs and researchers to examine and employ different mechanisms and strategies that can facilitate successful achievement of innovations characterised with high levels of novelty.

Despite extensive body of literature on product innovation, concerns exist related to inconsistent results regarding the impact of different factors such as market orientation dimensions, supplier involvement, absorptive capacity, and environmental turbulence elements on firms' new product performance. Such limitations in the existing knowledge and literature of the subject are partly associated with the adopted measures for new product performance. New emerging theories suggest that such measures should be extended to include other intermediate and innovation and agility related measures in order to accommodate for uncertainties in the firm's business environment. Such necessities call for adoption of new theories and perspectives to address the problems and inform the body of the knowledge. This research is an original attempt to fill this gap to some degrees.

Adopting the agility concept and consequently agile supply chain framework, this research attempts to address the gap first by developing a multidimensional perspective on product innovation, and second by introducing multiple and two dimensional measure for new product performance (i.e. general and agility), which is termed as Agile Product Innovation (API). In this scenario, a firm's agility in product innovation is entered as one dimension of the product performance to accommodate a multidimensional perspective. The main purpose of this research therefore is to employ agility concept to develop a contingency perspective of relationships between market orientation dimensions (i.e. responsive and proactive), supplier involvement, absorptive capacity, environmental turbulence factors and agile product innovation performance.

By adopting a quantitative research method, a survey of manufacturing sector companies with innovation characteristics was conducted. The results while reaffirm some of the existing theories of the subject, provide some differing views on the issues allowing projection of new insight on the approach to product innovation. The key findings and contributions of this research are three-fold:

Firstly, this study examined the impact of environmental turbulence factors (technological turbulence and competitive intensity). In particular, market turbulence was introduced as a new addition to the study of market orientation-product performance relationships stemming from agility theory. The results reveal a complex set of relationships between the two dimensions of market orientation and API depending on the intensity of the environmental turbulence factors. The results show that in turbulent environment proactive market orientation strategy should not exceed some levels as it begins to fall into a negative effect. Also a fixed strategy for market orientation is proven ineffective and instead firms should develop their market orientation strategy based on environmental turbulence factors.

Secondly, the research also examined the relationship between absorptive capacity and agile product innovation performance. Research findings suggest absorptive capacity as a competitive factor that can provide the grounds for proactively winning in the product innovation game through increasing agility capabilities.

Thirdly, the study further investigated the contingent relationship between supplier involvement and API performance. As a result the research suggests that complex relationship between supplier involvement and product innovation performance is varied depending on factors such as innovation life-cycle, technological turbulence, and absorptive capacity.

Generally the results from the research support the proposition of product innovation performance multidimensionality where achievements beyond financial and market related factors play a critical role. The results also shows that any approach to study the strategy and process of innovation in firms and the effects of collaboration with suppliers and other external sources of knowledge should regard the strategies adopted by the firm regarding their business environment particularly the market in terms of agile capabilities.

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Chapter 1: Introduction

1.1. Introduction

This chapter begins by presenting an overview of the research background in order to identify the potential gaps and limitation in the pertinent literature. Then, the research objectives and questions are detailed, followed by a brief description on the employed research methodology. The chapter ends with describing the outline of the thesis.

1.2. Research Background

Running a sustainable business and making it future-proof in the increasingly turbulent business environment of today requires certain capabilities including operating in an agile and proactive manner so as to respond to market needs and changes (Brown and Bessant, 2003, Narasimhan et al., 2006), and also pursuing diversification-based strategies (Narasimhan and Kim, 2002, Sharifi et al., 2006). In the same context achieving agile characteristics to create sustainable competitive advantage through innovation and product diversification has become increasingly dependent on supply chain (Qi et al., 2011). Firms therefore need to align their supply chain strategies with their competitive strategies through proactively seeking efficient linkages or integration among internal functions as well as with their suppliers and customers comprising their supply chain (Qi et al., 2011, Narasimhan and Kim, 2002). In this scenario, product is considered as one of the main constituting elements of the supply chain (Sharifi et al., 2006) in which bringing innovation into the product development is argued to be the winning strategy to achieve valuable competitive advantages in a current volatile business environment (Nieto and Santamaria, 2007). As a result, performance in new product introduction has been gradually become the centre of attention (Alegre et al., 2006) and widely referred to as a major indicator of firms' success (Balachandra and Friar, 1997, Tsai, 2009). A review of relevant literature shows that various disciplines have attended the product innovation subject and in particular, dynamic capability- here absorptive capacity- (Stock et al., 2001, Kostopoulos et al., 2011), market orientation (Atuahene-Gima et al., 2005, Tsai et al., 2008), and supplier involvement and integration (Cousins et al., 2011, Song and Benedetto, 2008) are identified as the most influential factors on product innovation performance.

Absorptive capacity (AC) refers to the set of organisational routines by which firms acquire, assimilate, transform, and exploit knowledge to generate a dynamic organisational capacity (Zahra and George, 2002). Although a large body of the relevant literature has widely studied the relationship between AC and other business research spectrums, however studies on a relationship between absorptive capacity and new product development and innovation are relatively limited (e.g. Atuahene-Gima, 1992, Kumar and Nti, 1998, Stock et al., 2001, Tsai, 2009). While AC is argued to impact on product innovation and development performance (Stock et al., 2001, Kostopoulos et al., 2011), however a question raised considering previous research whether the relationship between AC and product performance is a linear or non-linear form which ultimately can tolerate the level of importance of the absorptive capacity role in product innovation process. Furthermore, to date, the concept of absorptive capacity in product innovation and development context is only highlighted by the emphasis on external knowledge and information (e.g. Lichtenthaler and Lichtenthaler, 2009, Cohen and Levinthal, 1990), while generally assume that internal knowledge and information are sufficiently explored and utilised (Tu et al., 2006). However, it is argued that companies may not be aware of their existing knowledge, particularly tacit knowledge (Tu et al., 2006); thus, a deployment of appropriate mechanisms is also necessary for the internal dispersion of new knowledge and technology (Jones and Craven, 2001).

Involvement (and integration) of suppliers in firm's competitive strategies, particularly in innovation and diversification strategies, has also become a major topic of research around which a considerable literature has taken shape. Researchers have attended the subject from a variety of perspectives and arrived at various results and conclusions. The literature however is inconsistent in outcomes. A lack of consensus on supplier involvement (SI) and its impacts on product development, innovation process and performance, and company capabilities exists (Faems et al., 2005, Nieto and Santamaria, 2007, Tsai, 2009, Belderbos et al., 2004). For instance, a number of studies have found positive impact of supplier involvement on turnover (Faems et al., 2005), product innovativeness (e.g. Nieto and Santamaria, 2007), and other key performance criteria such as product costs and quality, and faster time to market (Ragatz et al., 1997, Clark and Fujimoto, 1991). There are however others who have approached cautiously to agree with such results (Sanchez and Pérez, 2003, Freel, 2003, Belderbos et al., 2004). While it remains to be further investigated why such differences in results and opinions exist and how some researchers find negative effects from suppliers' involvement on firm's performance, a review of relevant literature shows the inconsistency to be associated with factors such as the perspective adopted by researchers, the context of study, and the approach, method and measures applied in the research (e.g. Johnsen et al., 2006, Knudsen, 2007, Koufteros et al., 2005, Petersen et al., 2005). For instance, The literature as reviewed so far shows that most studies (e.g. Tsai, 2009, Petersen et al., 2003, Takeishi, 2001, Eisenhardt and Tabrizi, 1995) rely on general performance of firm (related to a new product performance), or mixed with product innovation capabilities as one set of measures without specific emphasis on capability approach. Furthermore, it is evident that contingent situations argued in previous research (e.g. Koufteros et al., 2005, Primo and Amundson, 2002) also contribute to the mixed results reported, hence highlighting the importance of attention to conditions in market and business environment, supply chain structure and operations, and firm's internal processes and competencies.

Some recent studies have partially addressed these concerns by adopting a contingency approach in modelling the relationships between factors and the analysis and interpretation of results. Tsai (2009) presents insights on contingent links between factors determining the success of product development including suppliers' collaboration, not direct involvement, and firm's absorptive capacity. Ragatz et al. (2002) also considered the technological turbulence as a moderator element and addressed potential benefits associated with supplier integration into new product development under conditions of technology uncertainty. Wong et al. (2011) and Jayaram (2008) have also studied effects of suppliers integration from a contingency point of view, however they find multidimensionality of effects and outcomes critical to explaining the situation and testing new theories from that point of view. From the above discussion, it can be concluded that both contingency view and multidimensionality of measures of performance are key to explain the relationships between supplier involvement (SI) and new product performance.

Furthermore, the pertinent literature also shows the lack of consensus among scholars who have even found the positive relationship between supplier involvement and product development/innovation performance with regards to when suppliers exactly need to be involved in product innovation process. In other words, the question is whether suppliers of a firm are always the important actors during the innovation process. For instance, it is argued that early supplier involvement is a key coordinating process in supply chain design, product design and process design (Petersen et al., 2005, Handfield et al., 1999). In contrast, it is also claimed that early involvement of suppliers can generates serious problems as well as increasing the complexity of managing new product innovation projects (Mikkola and Skjoett-Larsen, 2003). Moreover, others have discussed that the timing of involvement depends on the situation such as the predictability or complexity of the project (Eisenhardt and Tabrizi, 1995, Monczka et al., 2000). It is mostly due to the fact that the technological context for the theories of the association between supplier integration and (product) innovation is predominantly vague (Johnsen et al., 2006). To address this concern, "Innovation Life Cycle Theory" (Abernathy and Utterback, 1978, Utterback, 1994, Tidd et al., 2005), which defines three stages for innovation namely as emerging, growth, and mature phases, is suggested as a key concept to address this issue and verify the degree and type of the relationship between firms and suppliers (Johnsen et al., 2006). However, to date, only one study (Johnsen et al., 2006) examined the position of supplier involvement in innovation life cycle which however has potential limitations due to the small sample study (12 UK-based healthcare organisations). Since the sample study was fairly small and more importantly the focus of the above-mentioned study was not on the product innovation due to the scope of study and the chosen sample, the findings may not be generalisable and an investigation regarding the impact of innovation life-cycle on the relationship between supplier involvement and product innovation seems to be necessary.

Marketing, here *market orientation* (MO), is also among various disciplines which have attended the new product innovation subject and in particular, its relations with product performance have been studied extensively (e.g. Carbonell and Escudero, 2010, Gotteland and Boule', 2006, Sandvik and Sandvik, 2003). As examined by Baker and Sincula (2005) over 100 studies have been reported from 1990 on this topic which seem to have continued at the same rate since their report. Market orientation, from general perspective, is commonly accepted as a key determinant of product performance and success (Baker and Sinkula, 2005, Tsai et al., 2008) as well as a significant predictor of business performance (Lai, 2003, Lin et al., 2010)

The importance of the subject has attracted criticism too, among which two observations of inconsistencies and paradoxical understandings in the presented thoughts and works have been significant. First was the view that MO is overly used (i.e. Hamel and Prahalad, 1994) in response to which two dimensions of responsive and proactive (R&P) market orientation were introduced by academics led by Narver et al. (2004). Responsive market orientation (RMO) describes skills and routines to create, spread and employ market intelligence concerning existing customer's requirements in the market (Tsai et al., 2008, Narver et al., 2004, Atuahene-Gima et al., 2005). Contrarily, in proactive market orientation (PMO) a business puts in some efforts to expose and satisfy the latent needs of customers (Narver et al., 2004). The other was reported in a study by Baker and Sincula (2005) who revealed paradoxical conclusions in the subject literature to be partly associated with the type and form of measures and also use of singular measures for new product performance. In particular Baker and Sincula (2005) show that the strength of the market orientation and performance relationship would decay as the measure of performance shifts from new product success to profitability and then to market share.

More recent studies have mainly focused on the two dimensional view of MO (i.e. Narver et al., 2004, Atuahene-Gima et al., 2005, Tsai et al., 2008, Voola and O'Cass, 2010), among which only a few have undertaken empirical research. The recent empirical works by Atuahene-Gima et al. (2005) and Tsai et al. (2008) while provide a more comprehensive view of the MO dimensions and new product performance (NPP) relationships, still do lead to some inconsistent results. For instance, it is mostly believed that market orientation is an essential antecedent of product innovation process behaviours, activities, and performance (e.g. Slater and Narver, 1994a, Baker and Sinkula, 2005, Atuahene-Gima, 1995). However, some scholars (e.g. Tsai et al., 2008) argue that responsive and proactive market orientations may increase the potential negative effects on the product development/ innovation process and become detrimental to its performance should they surpass certain level. A review of the literature also shows that, as pointed out by Baker and Sincula (2005), limited attention has been paid to refining the measures for NPP. Although some authors have suggested intermediate performance measures to mediate the effect of market orientation on terminal performance measures (i.e. Homburg and Pflesser, 2000, Matear et al., 2002), or found a mediating role of new product innovation on the market orientation–performance relationship (see Atuahene-Gima, 1995) such measures have not been considered in the existing studies.

Theories related to product innovation and development strategies typically consider change and uncertainty as a principle which should be taken into consideration in devising and adjusting such strategies (Koufteros et al., 2005). As a result strategies such as agility (Ismail and Sharifi, 2006, Sharifi et al., 2009) are proposed to not only respond to changes and uncertainties in the market but to proactively approach markets and exploit opportunities by developing products for latent requirements of customers. Such views are also shared by theories of market oriented strategies (Harris, 2001). Some studies have therefore adopted a contingency approach and attended the impact of environmental turbulence factors (i.e. technological turbulence and competitive intensity) on the relationships between MO dimensions and NPP (e.g. Gotteland and Boule′, 2006, Tsai et al., 2008). In this context however two shortcomings can be traced in the existing literature. First, no empirical studies yet have investigated the potential effect of market turbulence on the relationship between the two dimensions of MO and product innovation performance. With the view that changes in customer set and preference, similar to other environmental factors (technological turbulence and competitive intensity), can manipulate a strategy and orientation of a firm towards the market (see Harris, 2001), employing the market turbulence as an essential element in the study of the relationship between MO dimensions and product innovation performance is deemed to be necessary. The second issue relates to the adopted measures for NPP as mentioned before. To address this aspect of the subject appropriate measures of performance of NP and innovations should be introduced. Such measures should therefore be multidimensional and include factors representing non-financial performance in delivering new products and innovation to market.

1.3. Research Objectives

Against this background, the aims of this study are explored as follows. Dealing with contingency effects of supplier involvement, market orientation, and absorptive capacity as discussed above, together with the explanation of current inconsistent views need hiring better explaining theories. For that purpose agility theory (Sharifi et al., 2009), as the widely accepted strategy for competing in changing business environment, will be considered to develop a more comprehensive perspective and in particular will be used to set the multidimensional measures for product innovation performance. An examination of agility concept and theories in the light of dynamic capability theory (DCT) (see Teece et al., 1997), as part of strategic management literature, leads to two important insights on the matter: 1) first, agility and agile supply chain, from a DCT point of view, are capabilities which enable a firm to respond to uncertain and changing business environment and sustain its position in the market. Diversification and product innovation are of core importance in this relation (Teece et al., 1997). Agility is therefore a capability possessing of which is an important indication of success for the firm beside or as opposed to performance (as suggested by Braunscheidel and Suresh (2009)). Performance here means financial and market related achievements. In addition, agility not only prepares the firm for responding to marketplace changes (Braunscheidel and Suresh, 2009) but provides the ability to proactively approach markets and achieve competitive position (Zhang and Sharifi, 2007); 2) Agility, as a dynamic capability, entails the exploitation of existing internal and external firm-specific capabilities, developing new ones, and renewing them to respond to shifts in the business environment. Two factors are closely tied up with developing these organisational capabilities which are extending relationships with external partners and suppliers, that may be referred to as integration (see Petersen et al., 2005), and learning (Teece et al., 1997). Learning, as an organisational process will support enhancement of internal competencies and absorption of external knowledge. Braunscheidel and Suresh (2009) found learning as an antecedent for integration and hence agility of the supply chain. More recent theories of organisational learning have employed the concept and theory of absorptive capacity to explain the learning process in the organisation (Tu et al., 2006, Fosfuri and Tribó, 2008).

Furthermore, the examination of the relationship between market orientation and product innovation performance would also gain benefits from adopting agility theory through introducing the multidimensional factor for product innovation performance. This perspective while is not previously addressed in the literature resonates with the following aspects of the existing theories of MO-NPP relationships:

- R&P MO encompass aspects which relate to fast and first-to-market introduction of new products. These elements to be considered shall be measured when examining the MO relationship with product innovation performance.
- Effects of environmental factors, studied by Tsai et al. (2008), is among the principles of agility theory as drivers for agility strategy (Sharifi and Zhang, 2001).
- Mediating factors pointed to in the literature (Homburg and Pflesser, 2000, Matear et al., 2002, Pelham, 1997), and moderating effect of NPI suggested by some (Atuahene-Gima, 1995, Han et al., 1998) also reflect the importance of agility related factors.

Built on these premises and employing agility as new perspective in the context of product innovation, this research is set to:

a) Conceptualise and model the Product Innovation Performance as a multidimensional construct, called, "Agile Product Innovation Performance" in this study against the typical single factor applied in previous researches (e.g. Tsai, 2009), in order to include both general (financial and market related factors) performance of the firms and its agility capabilities which is reflected in its product innovation performance.

b) Examine the relationship between supplier involvement and agile product innovation (API) performance to provide theoretical grounds to explain some of the inconsistencies and mixed findings in previous research.

c) Adopt the innovation life cycle theory (Abernathy and Utterback, 1978, Utterback, 1994, Tidd et al., 2005), into the study as a first attempt in the product innovation subject to examine whether suppliers of a firm are always the important actors during the product innovation process.

d) Re-examine the moderating effect of technological turbulence factor on the relationship between supplier involvement and API performance in line with the agility theory (Sharifi et al., 2009) and the pertinent literature (Ragatz et al., 2002).

e) Consider the absorptive capacity, AC, (Tu et al., 2006) as an organisational mechanism which considers both internal and external knowledge, representing the dynamic capability, which influences the performance, both general and agility capability, and also shapes the potential interplay between SI and agile product innovation performance. The approach not only contributes to an extension of the limited literature on the relationships between supplier involvement, absorptive capacity, and product innovation performance, but may offer theoretical grounds to cover some of the inconsistencies and mixed findings in the literature.

f) Revisit the relationship between two dimensions (responsive and proactive) of market orientation and product innovation performance under impact of the environmental turbulence factors. To this end the study builds on works by Atuahene-Gima et al. (2005) and Tsai et al. (2008), who have empirically examined the R&P-MO and NPP relationships with consideration of organisational strategies and environmental turbulence (i.e. technological turbulence and competitive intensity) as moderating factors. While this study re-examines the relationship between the impact of technological turbulence and competitive intensity on the association between MO dimensions and product innovation performance, the moderating effect of market turbulence is also considered as a new addition to the study of MO-NPP relationships stemming from agility theory (Sharifi and Zhang, 2001). This study expects that the examination of the MO-NPP relationship with environment turbulence factors as moderators extends the literature by revisiting the existing works and providing new insight on the inconsistencies as well as the nature of relationships between MO-NPP.

1.4. Research Questions

Based on the research objective presented earlier, this research endeavours to contribute to the literature on product innovation by addressing the following questions:

1. What are the associations between market orientation dimensions (responsive and proactive) and agile product innovation performance (i.e. general and agility)? [1]
2. Do environmental turbulence factors (i.e. technological turbulence, competitive intensity, and market turbulence) moderate the relationship between supplier involvement and agile product innovation performance (i.e. general and agility)?
3. What is the association between supplier involvement and agile product innovation performance (i.e. general and agility)?
4. What is the association between supplier involvement and agile product innovation (i.e. general and agility) in different stages of innovation life-cycle?
5. Does technological turbulence moderate the relationship between supplier involvement and agile product innovation performance (i.e. general and agility)?
6. What is the association between absorptive capacity and agile product innovation performance (i.e. general and agility)?
7. Does absorptive capacity moderate the relationship between supplier involvement and agile product innovation performance (i.e. general and agility)?

[1] Since, the impact of market orientation dimensions on product innovation is widely attended in the pertinent literature; in this study no hypothesis was established to address this issue. However, based on the statistical analysis (i.e. hierarchical regression), the association between MO dimensions and API performance was explained in the discussion chapter (see Section 6.2.1).

1.5. Research Methodology

In conceptualising the research model, an in-depth review of the pertinent literature was done in order to first select an appropriate research reference model (i.e. agile supply chain) and secondly to identify the key factors impacting on the product innovation performance (see Chapter 2). The process resulted in the development of research hypotheses as can be seen in Chapter 3.

This study employed a quantitative approach to test the conceptual framework through the administration of online questionnaire survey method which is in line with relevant studies reported in the literature (e.g. Tsai, 2009, Tsai et al., 2008, Song and Benedetto, 2008, Baker and Sinkula, 2007, Rothaermel and Alexandre, 2009). While all measures for the research construct were adopted from the relevant literature, a questionnaire was designed in accordance with the extant literature and through a number of iterations. To test the proposed hypotheses companies in manufacturing sectors located in the UK were examined. Following a pre-test of the questionnaire through consultation with a number of selected academics and research peers as well as a pilot study, a sample of 1200 units was drawn from the FAME database of registered UK firms. The survey was conducted over the internet by using web-based survey in June 2010 and as a result 233 usable responses were received representing a response rate of 31.3 percent. Participating firms span diversely across manufacturing sector industries which would enable the research for generalising the findings (Gatignon and Xuereb, 1997). Representations included from Electrical and Electronics (21.5%), Automotive (15.9%), Engineering and machinery equipment (13.7%), Food (11.2%), Aerospace (10.7%), Plastic (9.9%), Chemical (9%), and Medical/pharmaceutical (8.2%). The responding firms' age was between 5 and 250 years while their sizes ranged from 25 to 50,000 employees (see Chapter 4).

1.6. Structure of the Thesis

As illustrated in Figure 1.1 the thesis is organised into seven chapters. Chapter one presents the research background (i.e. limitation and gaps in the relevant literature), research objectives, research questions, and a brief description on the research methodology. Chapter two initially introduces the research reference model and then provides an in-depth review of the pertinent literature on product innovation as well as the factors impacting on the product innovation performance. Chapter three is dedicated to the research conceptual framework. In this chapter also the related hypotheses are developed, wherein the relationship between agile product innovation performance, market orientation dimensions, supplier involvement, absorptive capacity, innovation life-cycle, and environmental turbulence factors are discussed thoroughly.

Chapter four explains the research epistemological standpoint, research method containing information on the online survey application, sample, and key informants of the study. In addition, the measurements adopted for each research construct are well described. The chapter then focuses on the process of questionnaire development and pre-testing followed by the explanation on data collection procedure. Finally this chapter ends with some explanations on response rate and respondent sample demographics.

Chapter five is devoted to the analysis of the data. This chapter begins by explaining preliminary concerns regarding the survey research such as outliers, normality, non-response bias and common method bias. Subsequently, the results of Confirmatory Factor Analysis are described, accompanied by the details of measurements' purification and construct validity. Then the results of hypothesis testing are discussed in details using hierarchical regression and group analysis.

Chapter six presents the comprehensive discussion of the results of the hierarchical regression and group analysis. The thesis is concluded in Chapter seven. This chapter provides an overview of the research findings and theoretical contributions of this study. Moreover, the managerial implications, the limitations of this research, and the directions of future studies are well discussed. Figure 1.1 presents the outline of thesis.

1.7. Chapter Summary

The chapter was dedicated to present an overview of the research background with the aim of identifying current gaps and limitations in the relevant literature. The chapter began with introducing potential gaps in the literature. Furthermore, based on the identified gaps in the pertinent literature, the research objectives and questions were explained, Moreover, the research methodology employed in this research was also briefly discussed. Finally, the chapter ended by presenting the structure of the thesis.

Figure 1. 1: Outline of Thesis

Chapter 1 **Introduction**	• Research Background • Research Objectives • Research Questions • Research Methodology • Structure of Thesis
Chapter 2 **Literature Review**	• The Study's Reference Model • Product Innovation • Supplier Involvement and Product Innovation • Absorptive Capacity • Market Orientation • Environmental Turbulence Factors
Chapter 3 **Conceptual Framework and Hypothesis Development**	• Research Conceptual Framework: Agile Product Innovation • Hypothesis Development
Chapter 4 **Research Methodology**	• Epistemological Stance • Research Methodology • Sample and Key Informants • Measurement • Questionnaire Development Procedure • Sampling and Data Collection Procedure • Description of the Survey Responses
Chapter 5 **Data Analysis**	• Data Screening • Non-response Bias • Common Method Bias: Procedural and Statistical remedies • Confirmatory Factor Analysis (CFA) • Explanatory Factor Analysis • Hypothesis Testing
Chapter 6 **Discussion of Results**	• Market Orientation Dimensions and Agile Product Innovation Performance • Supplier Involvement and Agile Product Innovation Performance • Absorptive capacity and Agile Product Innovation Performance
Chapter 7 **Conclusions, Limitations, and Future Research**	• Confronting Research questions with Research findings • Contributions of This Research • Limitations and Future Research Directions

Chapter 2: Literature Review

2.1. Introduction

This chapter is devoted to the review of an extensive body of literature on product innovation. The chapter begins by presenting the "Agile Supply Chain framework" as the research reference model. Section 2.3.1 reviews the pertinent literature on product innovation process. Then section 2.3.2 introduces main influential factors on the process of developing innovate products namely as market orientation, supplier involvement, absorptive capacity, innovation life cycle, and environmental turbulence factors. The remainder of this chapter is dedicated to fist further explain the abovementioned influential factors on product innovation process and performance, and more importantly to identify the potential gaps and current limitation in the relevant literature.

2.2. The Study's Reference Model

2.2.1. Supply Chain Management

At the beginning of the twenty-first century, the world confronted significant changes in various aspects, mainly in terms of market competition, technological innovations and customer demands (Lin et al., 2006). As a result, the competition has been gradually shifted from the firms level to the supply chain level (Christopher, 2000) and organisations have been motivated to highly invest in extending their chains of activities in order to gain competitive advantages and survive in risky global business situations (Bolstorff and Rosenbaum, 2007). Supply chains/networks are defined as "*entities developed from the interactive collaboration of a number of companies shaped in a particular way to fulfil a business objective through delivering value to customers and the companies by appropriation. These networks can be either created based on a predetermined design and plan or emerge as the result of spontaneous needs in the course of companies' operations which still is subject to planning and design*" (Ismail and Sharifi, 2006, p. 433).

Several factors such as short product life cycle, increase in outsourcing, escalation of products variety, and advances in information technology make the mission of managing supply chain activities complex and complicated (Cooper et al., 1997, Bowersox et al., 2002). Responding to these challenges thus requires innovative strategies and practices (Lin et al., 2006). To deal with the complexity within the supply chain activities, the concept of supply chain management (SCM) was originally initiated by consultants in the early 1980s (Oliver and Webber, 1992) and has been gradually become as the most popular operations strategy in the current century (Gunasekaran et al., 2008). Supply chain management issues span a large range of a firm's activities (Simchi-Levi et al., 2003), and is viewed as "*the integration and management of supply chain organisations and activities through cooperative organisational relationships, effective business processes, and high levels of information sharing to create high-performing value systems that provide member organisations a sustainable competitive advantage*" (Bolstorff and Rosenbaum, 2007, p. 8). In fact, SCM exploits a variety of approaches and techniques to efficiently integrate suppliers, manufacturers, and distributors in executing the functions related to the a) procurement of raw materials, b) transformation of raw materials into semi-finished and/or finished products, and c) distribution of products to the targeted customers in the right quantities, to the right places, and at the right time in order to satisfy the required needs with minimal cost (Chandra and Grabis, 2007).

The development of supply chain management philosophy can create business advantages for organisations such as lower inventories, improvement of supplier relations, reduction of lead times and reduction of delivery time, higher utilization of equipment, production capacity enhancement, risk reduction, developing new market opportunities, enrichment of quality, increased innovation, and efficiency improvement (Christopher, 1996, Cooper et al., 1997, Simchi-Levi et al., 2000, Bowersox et al., 2002, Waters, 2003). Poirier (2003), however, argued that the development of supply chain management is not a straightforward activity and discussed 12 major obstacles to successfully managing a firm's supply chain activities as: lack of leadership vision; using the wrong metrics; aversion to external advice; focusing only on the bottom line; poor customer relationship management; not focusing on the customer; misunderstanding the internet; lack of collaboration across the extended enterprise; weak global concepts; absence of advanced sourcing applications; dealing incorrectly with the existing culture; and not trusting the people and/or organisations that a firm needs to trust.

Several forms of supply chain have been introduced by scholars (e.g. Sharifi et al., 2006, Gunasekaran et al., 2008, Simchi-Levi et al., 2000) in recent years to enhance the implementation of business activities in organisations. For instance, Simchi-Levi et al. (2000)

argued four common ways to complete functions and activities of supply chain including: Internal activities; Acquisitions; Arm's-length transactions; and strategic alliances. "*As firms debate the adoption of the supply chain concept to manage their business operations in the extended enterprise, an obvious question arises as to what alternative forms of supply chain to implement i.e., should it be product focused, or should customer focus be important? The answer lies in the fact that the type of supply chain to be implemented should be a function of both product characteristics and customer expectations*" (Chandra and Grabis, 2007, p. 19). Indeed, the employment of a particular form of supply chain that does not cover the needs of the product and its potential customer cannot be justified (Fisher, 1997). To deal with this concern, the agile supply chain was introduced as an appropriate form of supply chain that meets these criteria (Vonderembse et al., 2006).

2.2.2. Agile Supply Chain

Agility as a new paradigm for developing and improving competitiveness has been widely studied since it was introduced in the early 1990s (Ismail and Sharifi, 2006). According to Christopher and Towill (2000) the origin of agility, as a business concept, lies on flexible manufacturing systems and it is defined as a business-wide capability that contains organisational structures, information systems, logistics processes, and mindsets. A core principle of the agile organisations is flexibility (Ismail et al., 2006). A review of relevant literature (e.g. Naylor et al., 1999, Chandra and Grabis, 2007, Gunasekaran et al., 2008, Christopher, 2000, Sharifi et al., 2009) suggests "agility" in the context of supply chain as the ability of organisations to flourish in uncertain business atmospheres. Supply chain agility is defined to be "*the ability of the supply chain as a whole and its members to rapidly align the network and its operations to the dynamic and turbulent requirements of the demand network. The main focus is in running businesses in network structures with an adequate level of agility to respond to changes as well as proactively anticipate changes and seek new emerging opportunities*" (Ismail and Sharifi, 2006, p. 431). Thus, "Responsiveness" is a focal point of agility concept in SCM (Lee and Lau, 1999, Sharp et al., 1999, Christopher and Towill, 2000). The parallel development in the area of agility and SCM has encouraged the introduction of the "*Agile Supply Chain*" (ASC) perspective to assimilate the winning strategy of agility to the supply chain as the commonly acknowledged units of business and competition (Ismail and Sharifi, 2006). Slightly different from other forms of supply chain (i.e. lean supply chain which is based on the development of a value stream within the supply chain activities) agile supply chain, stemming from the agility concept is more focused on capturing the potential opportunities in the volatile business environment by employing and assimilating the virtual enterprise and pertinent market knowledge respectively (Naylor et al., 1999, Baramichai et al., 2007). According to Vonderembse et al. (2006), "*an agile supply chain profits by responding to rapidly changing, continually fragmenting global markets by being dynamic and context specific, aggressively changing, and growth oriented. They are driven by customer designed products and services.*"

A Review of the relevant literature depicts that the main driver of agility in SCM is the high level of change and uncertainties in the business environment (Chandra and Grabis, 2007) which is also argued to be a common driver for the introduction of agile manufacturing concept (Sharifi et al., 2006, Sharifi et al., 2009, Sharifi and Zhang, 2001). Xu et al. (2003) similarly summarised complexity, uncertainty and heterogeneity as the factors behind the need for agility in supply chain. Lin et al. (2006) argued that firms who employ ASC strategy should be able to respond efficiently to changes taking places in volatile marketplace to exceed customer and employees satisfaction as the main goal of the agile supply chain concept. Giachetti et al. (2003) introduced responsiveness, competency, flexibility/adaptability and quickness/ speed as the essential elements of capabilities needed for agile supply chain to react and respond to changes in dynamic business environment. Furthermore, Van Hoek et al. (2001) discussed marketing/ customer sensitivity, cooperative relationship, process integration, and information integration as the essential characteristics of agile supply chain. Similarly, Christopher (2000) defines four key characteristics for agile supply chain as market sensitive, virtual supply chain, process integration between partners, and finally network based supply chain with shared target. Abair (1997) also argued that agility in supply chain can be reached through customer-integrated multidisciplinary teams, supply chain partners, a network of collaborative enterprises/partners, and knowledge and information systems. Lee (2004) summarised the findings of prior studies and presented the key principles through agility implementation in supply chain as:

- Promote flow of information with suppliers and customers;
- Developing collaborative relationships with suppliers;
- Designing for postponement;

- Building inventory buffers by maintaining a stockpile of inexpensive but key components;
- Having a dependable logistics system or partner; and
- Drawing up contingency plans and develop crisis management teams.

As mentioned in the introduction chapter, this study employs the "agile supply chain" and/or "future-proof supply chain" framework (Sharifi et al., 2006) as the research reference model. While "product" and "supply chain operation" are considered as the main constituting elements of the supply chain in this framework, Sharifi and his colleagues argued that an agile supply chain would be developed and implemented effectively through merging the Supply Chain Design (SCD) with design for Supply Chain (DFSC) concept (Sharifi et al, 2006). Thus, based on the integrated model of simultaneous SCD and DfSC, Sharifi et al. (2006) proposed the agile supply chain development framework which is presented in Figure 2.1.

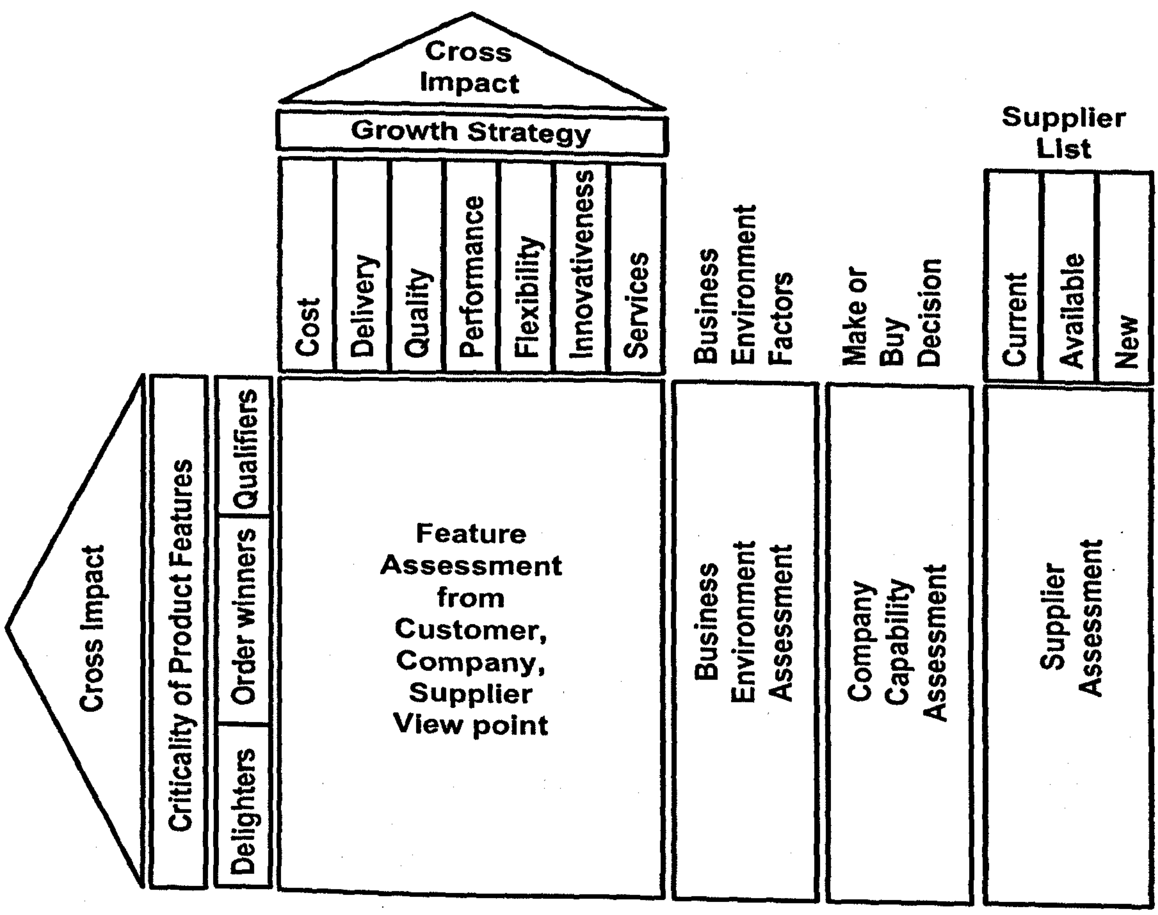

Figure 2. 1: Agile Supply Chain Framework (Sharifi et al., 2006)

The balanced approach of merging SCD and DfSC, ensures that the essential circumstance to develop agility in demand networks are being looked into SCD emphasises on determining the network's strategy, design of its structure, operations and processes and aligning its focal component, while DFSC is considered as a part of new product development process which taking into account the success and performance of supply chain through designing a product (Sharifi et al., 2009). Sharifi et al. (2006) argued that the integration of two aforementioned viewpoints is influenced by several key internal and external players such as market, business environment, product, company, and supply chain factors. The structure of agile supply chain framework is derived from the principles of quality function deployment introduced by Hauser and Clausing (1988). The main elements of this framework are summarised as follows (Sharifi et al., 2006, p. 1095):

- *Feature extraction and classification*: where product features are identified and grouped based on their criticality into order qualifiers, order winners and delighters.
- *Feature assessment*, where features are assessed in terms of how they are aligned to one or more possible strategic product differentiators.
- *Business environment assessment*: which addresses all non product feature based factors that could impact on the current and future potential of the product.
- *Company capability assessment: which* involves matching the product features to company capabilities with the aim of constructing a company view of the ideal product.
- *Supply chain assessment:* This involves assessing the existing and potential supply members across the product feature requirements and building an ideal supplier profile for each.
- *Feature clustering and alignment:* This is subsequently carried out in terms of supply chain capabilities to ascertain what can be achieved immediately if time is critical and what is possible to achieve if cost is not a constraint.

2.3. Product Innovation

2.3.1. General Literature on Product Innovation and Development Process

Innovation is increasingly considered as a critical factor in firms' performance and survival as a consequence of the evolution of the competitive and turbulent environment (Wheelwright and Clark, 1992, Bueno and Ordóñez, 2004, Alegre and Chiva, 2008, Zhou and Wu, 2010). In current dynamic competitive situation, product innovation is intensely becoming an important strategic goal of firms, mostly as a result of three main trends (Alegre et al., 2006): intense international competition, fragmented and demanding markets, and diverse and rapidly changing technologies (Wheelwright and Clark, 1992). Coping with this situation has obliged entrepreneurs, researchers and even politicians to examine and employ different mechanisms and strategies that can facilitate the successful achievement of innovations characterising with high levels of novelty (Green et al., 1995, Danneels and Kleinschmidt, 2001, Nieto and Santamaria, 2007).

The successful introduction of new products is argued to be the lifeblood of most organisations (Balachandra and Friar, 1997). Firms that introduce higher-quality products faster and more cheaply than competitors in market are in a superior position to create a sustainable competitive advantage (Prahalad and Hamel, 1990, Amit and Schoemaker, 1993, Nonaka and Takeuchi, 1995, Calantone et al., 1995) and thus earn higher economic returns (Datar et al., 1997, Tsai, 2009). In fact, superior competitive advantage is derived from valuable knowledge and technological skills and experience in the creation of new products (Teece et al., 1997, Tidd et al., 1997 , Alegre et al., 2006).

Development of a new product engages many innovation activities (OECD-EUROSTAT, 1997) and needs very strong coordination between different units and functions in a firm such as R&D, engineering, operations, and marketing (Nonaka and Takeuchi, 1995, Alegre et al., 2004). Product innovation is a "*core process for creating superior customer value through new products*" (Day, 1994, Srivastava et al., 2001, Kok and Biemans, 2009) and is defined as the process of adopting new technology into use (Galbraith, 1973). Product innovation can be separated into three basic categories: "*(1) line extensions, (2) me-too products, and (3) new-to-the-word products. Line extensions are products still familiar to the business organisation but new to the market. Me-too products are considered new to the business* organis*ation but* *familiar to the market;.. that is, imitations of competitors' products. New-to-the-world products are considered new to both the business organisation and the market*" (Lukas and Ferrell, 2000, p. 240).

Earlier studies in product innovation have discussed the factors that helps firm to achieve successful product innovation. For instance, Maidique and Zirger (1984, p. 192) suggested eight main categories of circumstances which facilitates product innovation process.

1. Great understanding of the customers and the marketplace leading to an introduction of a product with a high performance-to-cost ratio;

2. Proficiency in marketing and commitment of resources to selling and promoting the product;

3. A high contribution margin provided by the product to the firm;

4. Good planning and execution of the R&D process;

5. Good coordination of the create, make, and market functions;

6. Early introduction of the product into the market;

7. Significant benefits to the markets and technologies of the new product from the existing strengths of the developing business unit;

8. And a high level of management support for the product from the development stage through its launch to the market place.

In contrast, some factors are discussed in the literature that can inhibit the process of product innovation. For example, Dougherty (1992) discussed two interpretive barriers for successful product innovation. *"(1) departments are like different "thought worlds," each focusing on different aspects of technology-market knowledge, and making different sense of the total; and (2) organisational routines separate rather than coordinate the thought worlds, further constraining joint learning"* (Dougherty, 1992, p. 179). To cope with these barriers, they suggest that firms should: *"(1) use and build on the unique insights of each thought world, (2) develop collaborative mechanisms that deal directly with the interpretive as well as* *structural barriers to collective action, and (3) develop an organisational context for collective action that enables both*" (Dougherty, 1992, p. 195).

Various theories, in recent studies, have attempted to explore and disentangle factors and drivers that may advance product innovation, of which the supplier involvement/integration (Song and Benedetto, 2008, Petersen et al., 2005, Jayaram, 2008), absorptive capacity perspective (Zahra and George, 2002, Tu et al., 2006, Abecassis-Moedas and Mahmoud-Jouini, 2008), and market orientation (Narver et al., 2004, Atuahene-Gima et al., 2005, Tsai et al., 2008) were argued to be the most influential in the pertinent literature. These factors will be later discussed and explored in the following sections 2.4, 2.5, and 2.6 respectively.

2.3.2. Product Innovation Performance

Innovation performance is widely addressed as an indicator of performance at the firm level (e.g. Verona, 1999, Yeoh and Roth, 1999, Alegre et al., 2006, Zahra and Das, 1993, Calantone et al., 1995, Tsai, 2009, Alegre and Chiva, 2008, Zhang and Duan, 2010, Wang et al., 2011). Product innovation performance is suggested to include both financial and non-financial outcomes of a company's product innovation efforts (Cooper and Kleinschmidt, 1987, Hollenstein, 1996). In this vein, two main groups of factors, namely process efficiency and product effectiveness (Verona, 1999), have been broadly discussed as indicators of a firm's performance. Process efficiency factor contains elements such as speed, productivity, and flexibility (Clark and Fujimoto, 1991, Verona, 1999) while product effectiveness represents elements such as profitability of the product, market share of the product, product revenue, and product quality (Cooper and Kleinschmidt, 1987, Verona, 1999).

Furthermore, several measurement scales have been used in literature to determine the product innovation performance (PIP). Generally, customer acceptance (e.g. meeting sales goals), financial performance (e.g. profitability), and firm-level measures (e.g. firm sales volume) are considered as critical factors regularly used to measure new product performance among practitioners and academics (Griffin and Page, 1993, Im et al., 2003). For instance, Griffin and Page (1993) and Carbonell and Rodriguez (2006) attended to employ three main indicators namely as: profits, sales and market share to measure new product performance. Similarly, Cooper and Kleinschmidt (1993) and Moorman and Miner (1997) explained new product performance as a new product's outcomes concerning sales, market share and profitability during the first 12 months of its life in the marketplace. In the same vein, some authors (e.g. Gatignon and Xuereb, 1997, Li and Calantone, 1998) have considered several factors such as evaluating the sales growth, return on investment, profit level, and market share of the new product relative to major competitors' products to evaluate performance.

More recently, Narver et al. (2004) assessed the success level of the new product by simply employing a single item "New-product success compared to the firm's major competitor is good" or Atuahene-Gima et al. (2005) considered new product program performance as a single financial dimension containing five sub-items. Furthermore, Zhang et al. (2009) adopted measures for subjective product innovation performance from the study of Im et al. (2003). The scale was conducted to determine management's perception of market performance of a new product by evaluating its contribution to sales volume, profitability, and customer satisfaction in a comparison with key competitors (Zhang et al., 2009). Tsai (2009) also measures product innovation performance by innovative sales productivity and *"operationalises this measure as the sales generated by new products per employee (i.e., the ratio of sales attributed to new products divided by the total number of employees). These sales include (1) technologically new or technologically improved products introduced to the market within the past 3 years, and (2) marginally changed products within the same time period*" (Tsai, 2009, p. 768).

Although several critical factors are considered as the indicators of product innovation performance in the pertinent literature, the majority of previous studies have however considered PIP with only a single dimension (e.g. Tsai, 2009, Narver et al., 2004, Atuahene-Gima et al., 2005, Zhang and Duan, 2010, Tsai et al., 2008) which is captured in more than 90% of studies by financial and market measures (Im et al., 2003). In contrary, few studies (e.g. Alegre and Chiva, 2008, Alegre et al., 2006) viewed product innovation performance as a multidimensional factor. For instance, Alegre et al. (2006) defined product innovation performance as an accumulation of two main dimensions of innovation efficacy (the degree of success of an innovation) and innovation efficiency (the effort carried out to achieve that degree of success). They suggest that innovation performance can be signified as an intermediate variable between business processes and general firm performance to get a clearer picture of actions and effects at the firm level.

2.4. Supplier Involvement and Product Innovation

2.4.1. Collaborative Networks

The intense current technological changes oblige firms to rely on external technological knowledge, skills and resources by employing strategies such as technology licensing and collaborative agreements (Tsai, 2009). Inter-firm collaboration is one of the main antecedents of achieving technological competencies (Schoenmakers and Duysters, 2006) and is argued to be a practical solution to the problem of resources and capabilities that not always being available within a firm and difficult to acquire efficiently in the market (Das and Teng, 2000). A number of previous studies have investigated the potential impact of different types of collaborative networks on product innovation performance (Lööf and Heshmati, 2002, Miotti and Sachwald, 2003, Belderbos et al., 2004, Faems et al., 2005, Nieto and Santamaria, 2007, Tsai, 2009) and as a result they suggested that firms can enhance their ability to produce new and innovative product by interacting with different collaborators namely as suppliers, customers, competitors, and research organisations.

Supplier collaboration enables firms to utilise the expertise and different perspective of a supplier to generate new methods for product development (Bonaccorsi and Lipparini, 1994, Eisenhardt and Tabrizi, 1995) since suppliers usually own comprehensive and fruitful knowledge regarding the parts and components which may be critical to a firm's new product innovation. Supplier integration would also facilitates companies to recognise potential technical problems, thus speeding up new product development and responses to market demands (Kessler and Chakrabarti, 1996) and consequently increases the firm's agility capabilities (Sharifi et al., 2006). Miotti and Sachwald (2003) assert the positive relationship between collaboration with suppliers and the share of innovative product turnover by employing the French CIS-2 survey. In a similar fashion, based on a study of Belgian manufacturing industry Faems et al. (2005) claimed a positive impact of supplier integration on a proportion of turnover associated with improved products. More recently, Nieto and Santamaria (2007) investigated the Spanish manufacturing industry and found a positive association between supplier collaboration and a degree of innovativeness. In contrast, a study of Spanish manufacturing companies by Sanchez and Pérez (2003) summarised that collaboration with suppliers may not enhance new product performance. In the same vein, results of UK based studies by Freel (2003) and Ledwith and Coughlan (2005) also did not find significant linkage between supplier collaboration and new product performance. A literature on supplier involvement in product innovation will be further reviewed in Section 2.4.2.

Collaborating with customers was argued to be another vital approach for companies to enhance performance associated with their product innovation (Gupta et al., 2000, Fritsch and Lukas, 2001, Brockhoff, 2003) since "*working with customers not only provides benefits in identifying market opportunities for technology development, but also reduces the likelihood of poor design in the early stages of development*" (Tsai, 2009, p. 766). Moreover, recognising and assimilating the (expressed or latent) customer needs would facilities firms to generate new ideas about solutions and more importantly to effectively envisage market trends, thus enhancing the degree of success associated with new product innovation (von Hippel et al., 1999). The previous empirical studies by scholars such as Miotti and Sachwald (2003), Freel (2003), and Faems et al. (2005) claimed the positive relationship between customer involvement and product innovation performance. However, some other studies disagree with such findings. For instance, a study of Swedish manufacturing industry by Lööf and Heshmati (2002) revealed a negative impact of customer collaboration on product innovation performance. Furthermore, Nieto and Santamaria (2007) suggested that customer involvement may positively affect product innovation with only marginal changes, while it cannot result in significant innovation with new functions. Similarly, Belderbos et al. (2004) found that relationship between collaboration with customers and a rate of new product is not significant. A study of French manufacturing firms by Monjon and Waelbroeck (2003) also did not find the significant impact of customer collaboration on product innovation.

Collaboration with competitors is suggested to be another significant way to enhance product innovation (Bayona et al., 2001, Nieto and Santamaria, 2007) while it is argued to be the least frequent type of collaborative network (Tsai, 2009). "*Firms involved in a cooperative agreement may share technological knowledge and skills with each other, producing a synergistic effect on solving common problems outside the competitor's area of influence*" (Tether, 2002, p. 947). Competitors collaboration facilitates firms to speed up their capability development as it enables them to decrease the time and risk associated with technological innovation (Belderbos et al., 2004), which in turn results in achieving more successful innovation (Inkpen and Pien, 2006). In addition, working with key competitors allows firms to discover technological levels and strategies of their competitors; firms with good levels of information about competitors' technological strategies are capable of efficiently differentiating themselves in the market (Linn, 1994). Prior studies had shown a lack of consensus on the impact of competitor collaboration on product innovation performance. For instance, Lööf and Heshmati (2002) suggested that competitor collaboration positively impacts on new product sales. In contrast, Monjon and Waelbroeck (2003), Miotti and Sachwald (2003), and Belderbos et al. (2004) claimed that collaboration with suppliers has a negative but insignificant relationship with product innovation performance. Nieto and Santamaria (2007) found a more complex relationship and revealed that working with competitor does not affect product innovation with marginal modifications, while it negatively impacts product innovations with new functions.

At last, *collaboration with research organisations* is also suggested as an important approach to improve product innovation performance. As a result of "*governments' encouragement, more and more firms are pursuing product innovations by collaborating with universities and research institutions*" (Tsai, 2009, p. 766). Since universities and research institutes are the vital centres for the generation of scientific knowledge (Hemmert, 2004), companies can interact formally and informally with them to assimilate fruitful scientific knowledge to enhance their product/process innovations (Caloghirou et al., 2004). A review of the relevant literature shows lack of consensus on the association between collaboration with research organisations and product innovation performance. For instance, several studies claimed that technological innovation strongly depends on knowledge acquired from universities and research institutions (Bozeman, 2000, McMillan et al., 2000, Vuola and Hameri, 2006). Furthermore, Belderbos et al. (2004), Faems et al. (2005), and Nieto and Santamaria (2007) suggested that collaboration with research institutes and universities is positively associated with product innovation performance. In contrast, Monjon and Waelbroeck (2003), Caloghirou et al. (2004), and Ledwith and Coughlan (2005) argued that collaboration with universities and research institutes may negatively affect product innovation performance. In the same vein, statistical findings of the study by Lööf and Heshmati (2002) also determined an insignificant relationship between collaboration with research organisations and product innovation performance.

2.4.2. The Role of Suppliers in Product Innovation Process

Over the last three decades an extensive body of literature has evolved on involving suppliers into new product development and innovation (e.g. Johnsen et al., 2006, Benton and Maloni, 2005, Chen et al., 2004, Handfield et al., 1999, Petersen et al., 2003, Petersen et al., 2005, Prahinski and Benton, 2004, Ragatz et al., 1997) mostly suggesting that early and close relationship with suppliers is critical for companies to succeed in new product development process (e.g. Carr and Kaynak, 2007, Cousins et al., 2011) and innovation (Afuah, 2000).

Several definitions of supplier involvement in product innovation/development have been suggested; it is commonly referred to the integration of capabilities that potential suppliers can embed into the new product development (NPD) process (Dowlatshahi, 1998). In other words, *"supplier involvement refers to the resources (capabilities, investments, information, knowledge, ideas) that suppliers provide, the tasks they carry out and the responsibilities they assume regarding the development of a part, process or service for the benefit of a buyer's current or future product development projects"* (Van Echtelt et al., 2008, p. 182).

Extensive literature review shows that the first two studies emphasised on supplier involvement was the research by Imai et al. (1985) and Takeuchi and Nonaka (1986). These two early researches were focused on seven in-depth case studies within the five giant Japanese companies; explaining the superior performance of Japanese companies which extensively affected by involving suppliers in NPD program. Research on supplier involvement was continued in the 1990s with the focus on the automotive industry (Cusumano and Takeishi, 1991, Lamming, 1993, Nishiguchi, 1994, Kamath and Liker, 1994), to investigate the performance gap between Japanese and Western companies (Johnsen, 2009) through employing theories such as transaction cost economics (Williamson, 1975), agency theory (Eisenhardt, 1989), and resource dependence theory (Pfeffer and Salancik, 1978). From the start of new millennium, the research on supplier involvement has been further expanded with the main focus on investigating the need for relationship development and adoption, especially in conditions of technological turbulence[2] (Johnsen, 2009).

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[2] The relationship between technological turbulence and supplier involvement is explained in the environmental turbulence section (2.7.1.1).

The importance of supplier involvement in product development and innovation process has been attempted extensively in the pertinent literature (e.g. Cousins et al., 2011, Petersen et al., 2005, Jayaram, 2008, Song and Benedetto, 2008). It is argued that in the internal value chain, the preliminary step for companies to produce quality products is the acquirement of quality materials and parts from suppliers (Ou et al., 2010). Supplier involvement in NPD signifies the utilisation of joint capabilities stemming from the strategic integration of the buyer–supplier relationship and the combination of the buyer's and supplier's R&D (Wagner and Hoegl, 2006). The competition necessity to shorten the product life cycle and increase in the quantity of new product launches, together with the need to employ richer technology into new products, have motivated companies in many industries to embed supplier involvement practices into their NPD projects (De Toni and Nassimbeni, 1999).

Song and Bendetto (2008) suggest that collaborating with suppliers at the product design and development stage not only reduces the possibilities of design errors, but offers benefits at testing and prototyping phases by sharing technical information in early stages. Thus, the benefits of involving suppliers into the design and development stage include: (a) reduction in development costs stemming from early availability of prototypes, consistency between design and supplier's capabilities, and reduced engineering changes (De Toni and Nassimbeni, 1999); (b) improvement in product quality (Bonaccorsi and Lipparini, 1994, Monczka et al., 2000); (c) reduction in overall development time due to early identification of the supplier's technical problems (Nijssen et al., 1995, De Toni and Nassimbeni, 1999); (d) enhancement of innovation process by improving knowledge transfer between supplier's engineers and technical staff (Song and Benedetto, 2008, Cousins et al., 2011); and last but not least (e) improvement in manufacturer's financial performance (Carr and Pearson, 1999).

In addition to the aforementioned project related and short-term benefits, according to Van Echtelt et al. (2008) firms can also achieve long-term and strategic benefits through collaborating with suppliers. These long-term benefits can be categorised as follows:

- A long-term relationship with an accumulation of fruitful experiences between partners can facilitate the development of more efficient and effective collaboration in future projects (Dyer and Ouchi, 1993, Ragatz et al., 1997, Sobrero and Roberts, 2002). Indeed, Supplier can offer better suggestions to a firm to improve the design and performance of parts and entire products (Van Echtelt et al., 2008), as parties learn more about each other's processes, requirements, and capabilities over the period of time (Dyer and Ouchi, 1993). Supplier involvement therefore may enhance the capabilities of a firm to differentiate products in the market in order to achieve unique competitive advantages (Gadde and Snehota, 2000, Rubenstein and Ettlie, 1979, Von Hippel, 1988).

- A second long-term benefit suggested in the relevant literature is the formation of permanent access to suppliers' new technologies, which can be strategically vital for a firm to succeed in future new product development and innovation activities (Bonaccorsi, 1997, Monczka et al., 1998, Wynstra et al., 2001).

- A third long-term benefit derived from the literature is "*the alignment of technology strategies with key suppliers through roadmaps and the like*" (Van Echtelt et al., 2008, p.182). Handfield et al. (1999) and Monczka et al. (2000) suggested that to take advantage of new market opportunities, firms must align their future products and technological needs with the technological opportunities stemming from supplier markets. Technology roadmap which enables a firm to strategically plot broader technological trends, would also facilitate a creation of an efficient discussion regarding the timing and direction of future technological investments (Van Echtelt et al., 2008).

- At last, the exploit and transfer of valuable solutions (e.g. relevant to technical glitches) developed through the collaboration with other projects can be listed as a fourth long-term benefit associated with the supplier collaboration in new product innovation and development (Sobrero and Roberts, 2001).

However, prior studies had shown a lack of consensus on the impact of supplier involvement on company's situation. While scholars have found positive impact of supplier involvement on turnover (Faems et al., 2005) and product innovativeness (e.g. Nieto and Santamaria, 2007), and other key performance criteria such as product costs and quality, and faster time to market (Ragatz et al., 1997, Clark and Fujimoto, 1991), some have approached cautiously to agree with such remarks (Sanchez and Pérez, 2003, Freel, 2003, Belderbos et al., 2004). Sceptic views suggest that integration and involvement of suppliers into product development process may lead to considerable increase in development time (Zirger and Hartley, 1994) and development costs due to the need of greater coordination (Ittner and Larcker, 1997).

Some other studies have arrived at mixed or contingent results when investigating the impacts from supplier involvement. Johnsen et al. (2006) used a case study approach and concluded that suppliers may be a less important factor in fluid and emerging phases than mature (specific) stage of innovation. Knudsen (2007) finds that partnership with own industry may endanger new knowledge generation and radical product developments. Koufteros et al. (2005) also conducted a study of supplier product integration under equivocality condition and found the impact of supplier product integration on product innovation to be negative in a low equivocality environment and positive (on quality) under high equivocality condition. Petersen et al. (2005) undertook a study of some global organisations and found that involving carefully selected suppliers in NPD program may lead to financial returns and product design performance of a firm. Koufteros et al. (2007) provides a contingent model of gray versus black box to represent level of integration with suppliers and finds supplier gray-box integration (suppliers working alongside the customer's engineers for product development) is more valuable to product innovation. Van Echtelt, et al. (2008) study the role of suppliers in NPD by taking into the account long-term strategic processes and short-term operational objectives, and find product innovation strategy of the firm to rely on the firm's capability to achieve both short-term and long-term benefits.

The literature as reviewed so far shows that most studies (e.g. Tsai, 2009, Petersen et al., 2003, Takeishi, 2001, Eisenhardt and Tabrizi, 1995) rely on general performance of firm (related to a new product performance), or mixed with product innovation capabilities as one set of measures without specific emphasis on capability approach (except perhaps for Van Echtelt et al. (2008)). On the other hand, while it takes further analysis to identify the reasons some studies have considered negative or mixed effects from supplier involvement, it can be seen that such results mainly are emanated from studies adopting a contingent view of the impacts from suppliers (e.g. Koufteros et al., 2005). This approach has helped arriving at results relating circumstances and conditions of the firm and its supply chain to the level of supplier involvement, hence projecting a clearer picture of realities in supply chains. Thus it can be concluded that factors such as the perspective adopted by researchers, i.e. contingency view (e.g. Koufteros et al., 2005, Wong et al., 2011), context of the study (e.g. Koufteros et al., 2007), and measures and units of analysis employed (e.g. Tsai, 2009) have influenced the results and hence conclusions of the studies.

2.4.3. Supplier Involvement and Innovation Life-Cycle Theory

As mentioned earlier, an extensive body of literature has evolved on involving suppliers in product innovation (e.g. Johnsen et al., 2006, Benton and Maloni, 2005, Chen et al., 2004, Handfield et al., 1999, Petersen et al., 2003, Petersen et al., 2005, Prahinski and Benton, 2004, Ragatz et al., 1997, Azadegan and Dooley, 2010, Song and Benedetto, 2008, Cousins et al., 2011) mostly concluding that interaction between a firm and its suppliers is a key factor for the successful management of innovation (Afuah, 2000, Cousins et al., 2011) since this interaction is significantly beneficial for knowledge development, resource mobilization and co-ordination (Takeishi, 2001). However, the industrial and technological context for the theories of the association between supplier integration and (product) innovation is principally unclear (Johnsen et al., 2006). "*The theories are of most relevance to mature technologies that companies apply in specific product/service offerings. In comparison, the relevance of customers and suppliers in emerging technologies, in which the tangible part of the product/service offering is less significant or at least still to be developed, may be less significant*" (Johnsen et al., 2006, p. 671).

Innovation life cycle theory (Abernathy and Utterback, 1978, Utterback, 1994) is suggested as a key factor to address this issue and verify the degree and type of the relationship between firms and suppliers (Johnsen et al., 2006), since "*innovation life-cycle models shed light on differences in the rate of innovation activity* [...] *commonly observed for different technologies and sectors and different innovation stages*" (Powell and Moris, 2004, p. 128).

There are a number of studies regarding the life cycle theories of innovation (Abernathy and Utterback, 1978, Utterback, 1994, Powell and Moris, 2004, Tidd et al., 2005). Abernathy and Utterback (1978) described the pattern of industrial innovation in terms of three phases: 'fluid phase' (emerging phase), 'Transitional phase' (growth phase), and 'specific phase' (mature phase). Table 2.1 summarizes the key aspects of each phase.

Table 2. 1: Three Phases of Industrial Innovation

	Fluid, emerging phase	Transitional,growth phase	Specific, mature phase
Type of innovation	Radical product innovation, high technological uncertainty	Enhancing process Innovation	Mainly process innovation, mostly incremental product innovation

Product line	Diverse, frequently customized	Emergence of a stable dominant design	Mainly undifferentiated, standardized products
Number of competitors	Number of actors primarily low however amplifies fast as market opportunities become apparent	Decreasing number of actors, following emergence of dominant design	Subjected to a few large actors
Barriers to entry	Low — flexible production in close proximity to research centres	Medium- becoming more rigid, some automation and specialized equipment	High- capital intensive, mostly specialized automated equipment
Competitive emphasis	Technical performance: innovation	Product differentiation: e.g. quality, design	Price/cost

Source: adopted from Utterback (1994), Powell and Moris (2004), Tidd et al. (2005), and Johnsen et al. (2006)

In the "fluid phase" the intensity of innovation is high derived from the rapidly entrance of science-based small and medium-sized entrepreneurial enterprises who are prepared to grasp new business opportunities (Powell and Moris, 2004). This phase is characterised by a high degree of uncertainty and experimentation which results in range of different products and the appearance of new industrial sectors (Johnsen et al., 2006). Firms in this phase mostly develop highly customised products for a target niche markets and a small group of customers (Powell and Moris, 2004) "until gradually a dominant design emerges with innovation occurring along a defined technological trajectory" (Dosi, 1982), in which the appearance of an industry-wide standard signs the begging of the "transitional phase" (Johnsen et al., 2006).

In the "transitional phase" a number of competing firms diminishes (Powell and Moris, 2004), investment in recourses and capital increases, and product differentiation becomes important along with the emergence of stable dominant design (Johnsen et al., 2006). The final "mature phase" is characterised by higher investment in resources and capital which turns out to be important barriers for the entrance of new firms (Tidd et al., 2005). In this stage innovation is centred on cost diminution and quality enhancement to increase productivity (Johnsen et al., 2006). "*In the mature phase, a few companies dominate major markets; innovation aims at new processes; volume and cost are key drivers; and process changes and disruptive new technologies are costly, ultimately causing the pace of change to slow*" (Powell and Moris, 2004, p. 128).

To date only one study has considered the position of supplier involvement in innovation life cycle which has potential limitations due to the small sample study. In a study of twelve UK-based healthcare organisations, Johnsen et al. (2006) explored the question of whether suppliers of a firm are always the important actors during the innovation process. They employed an innovation life cycle approach introduced by Utterback (1994) and as a result they argued that the relevance of relationships between firms and their suppliers is relied on the essence and maturity of the developed technology. In this scenario, a relationship between a firm and its suppliers may be less important factor at the earlier stage of innovation process (fluid and emerging phases) in comparison with mature (specific) stage. An explanatory reason is that firms "*may be reluctant to share knowledge openly with suppliers during the early stages, as they may be concerned of losing valuable knowledge or technology, for example via suppliers that supply their competitors*" (Johnsen et al., 2006, p. 676). Table 2.2 summarises key recent studies on supplier involvement context.

Table 2. 2: Key Recent Studies on Supplier Involvement

Study	*Method and Context*	*Focus*	*Performance measure*	*Key results and contribution*
Koufteros et al. (2005)	Survey of 244 US manufacturing firms (Cross-industry)	Internal and External Integration for Product Development: The Contingency Effects of Equivocality,	Quality, Profitability	Impact of supplier product integration on product innovation is negative particularly in a low equivocality environment.
Petersen *et al* .(2005)	Survey of 134 North American firms (Cross-industry)	Early Supplier Involvement strategies: supplier selection & assessment, supplier involvement in setting performance metrics & targets, project team effectiveness, timing of involvement	Financial performance (e.g. return on investment); Design performance (e.g. ease and cost of design)	Importance of supplier involvement in agreeing technical metrics & targets especially grey box suppliers. Financial returns and product design performance of a firm can be significantly improved by involving suppliers in NPD program
Johnsen et al. (2006)	*Case study: 12 UK-based healthcare organisations*	Customer and supplier interaction in innovation	*n/a*	A relationship between a firm and its suppliers may be less important factor at the earlier stage of innovation process (fluid and emerging phases) in comparison

				with mature stage.
Knudsen (2007)	Survey of 632 European manufacturing and service industries (international)	The Relative Importance of Inter-firm Relationships and Knowledge Transfer for New Product Development Success	Innovative performance	Firms from their own industry are more likely to contribute similar knowledge, which may imperil the development of new knowledge and consequently more radical product developments
Koufteros et al. (2007)	Survey of 157 US manufacturing firms (Cross-industry)	Black-box and gray-box supplier integration in NPD	Product innovation; external quality	Supplier gray-box integration is more beneficial to product innovation than supplier black-box integration
Van Echtelt et al. (2008)	Case study: A Dutch firm in copier and printer industry	Distinguishes between short-term project-related operational processes and long-term strategic processes. Prioritizing, mobilizing and coordinating supplier resources.	Technical performance, cost, development cost, lead time/speed,	Importance of long-term development of a willing and capable supplier base, learning routines, capability alignment and adaptation, and spin offs from individual projects, across individual NPD projects
Cousins et al. (2011)	Survey: 111 UK-based procurement firms	Supplier-buyer relationship: Breakthrough Scanning, Supplier Knowledge Exchange,	Financial performance: (i.e. return on investment) NPD performance: (i.e. pre-launch and launch activities)	A combination of a firm's technical capabilities and knowledge exchange with suppliers results in improved new product development performance and financial performance.

2.5. Absorptive Capacity and Product Innovation

2.5.1. General Literature on Absorptive Capacity

The concept of absorptive capacity (AC) initiated in macroeconomics and it originally addresses the ability of an economy to absorb and exploit external resources, information, and knowledge (Adler, 1965). Based on this view, original research on absorptive capacity recognised it as a potential source of competitive advantage (Zahra and George, 2002). Cohen and Levinthal (1990, p. 128) employed this macroeconomic conception into organisations, and defined AC as "*the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends*". They relate absorptive capacity with achieving dynamic organisational capability, which in turn depends on organisations' prior relevant knowledge and information, and concluded that AC is an organisational learning concept and is the cumulative effect of continuous learning. Following the definition by Cohen and Levinthal (1990), Zahra and George (2002) further delineated the concept as a set of organisational routines by which firms acquire, assimilate, transform, and exploit knowledge to generate a dynamic organisational capacity. Zahra and George (2002) explained distinguishing four elements of absorptive capacity namely as acquisition, assimilation, transformation and exploitation, each performs different but complementary roles in exploring how absorptive capacity may impact on organisations outcomes such as innovation performance:

- Acquisition is a firm's capability to identify pertinent information from different available information and knowledge generated in external environment.

- Assimilation dimension is addressing a firm's routines and processes that enables a firm to analyse, understand, and interpret the information acquired from external sources.

- Transformation refers to an ability of a firm to embed, adapt, and combine the achieved external knowledge with those internally generated.

- At last, exploitation is a potential ability of a firm to successfully convert the obtained knowledge into competitive advantage.

Zahra and George (2002) also categorised absorptive capacity similar to Arora and Gambardella (1994) into two main subsets: potential and realised. "*Potential absorptive capacity (PAC) enables a firm's receptiveness to external knowledge, while realised absorptive capacity (RAC) reflects a firm's capacity to leverage absorbed knowledge and transform it into innovation outcome*" (Fosfuri and Tribó, 2008, p.174). A study of 2464 innovative Spanish firms by Fosfuri and Tribó (2008) suggested that R&D cooperation, external knowledge acquisition and experience with knowledge search are important antecedents of a firm's PAC. Also, they found that potential absorptive capacity is a source of competitive advantage in innovation, particularly in the condition of enhanced internal knowledge flows that assist a firm to further diminish the distance between potential and realized capacity.

Above argument raises question on most of definitions for AC which in principal puts emphasis on external knowledge and information (e.g. Lichtenthaler and Lichtenthaler, 2009, Cohen and Levinthal, 1990), while generally assumes that internal knowledge and information are sufficiently recognised and utilised (Tu et al., 2006). In other words, these definitions imply that companies are not only acquainted with the existence of internal information but also have access to it (Rothaermel and Alexandre, 2009). However, in some cases, firms may not be enlightened with their existing knowledge, in particular tacit knowledge, which can only be approached via direct social interactions (Tu et al., 2006); therefore, the deployment of formal and informal communication mechanisms are essential for the internal dispersion of new knowledge and technology (Jones and Craven, 2001).

Based on the above argument, Tu *et al* (2006) and Rothaermel and Alexandre (2009) suggest that any view of absorptive capacity of companies should also contain the ability of firms to develop knowledge internally. This in practice means a need for organisational mechanisms which can deal with both internal and external knowledge, information, and technology. Tu et al. (2006) addressed this and suggested a more comprehensive definition for absorptive capacity (AC) as "*the organisational mechanisms that help to identify, communicate, and assimilate relevant external and internal knowledge. The elements of absorptive capacity are considered to be the firm's existing knowledge base, the effectiveness of systems that scan the environment, and the efficacy of the firm's communication processes*" (Tu et al., 2006, p. 694).

Besides Tue et al. (2006) provided a detail view of AC in terms of the elements that shape it. These elements include the firm's existing knowledge base (including managers' and workers' knowledge); the effectiveness of systems that scans the environment for new knowledge, and the efficacy of the firm's communication processes. These elements can be detailed as follows (definitions and literature of Absorptive Capacity and its dimensions are summarised in Table 2.3):

1. *Prior relevant knowledge* (manager knowledge (MK) and worker knowledge (WK)): it is defined as the understanding of job related skills, technology, and management practices

held by the workers and managers in a firm (Brown, 1997, Tu et al., 2006). Organisational learning is based on the learning of the individual members (Nicolini and Meznar, 1995) and the ideas held by these individuals can influence the innovation development and process (Tu et al., 2006). Adequate level of prior relevant knowledge is a key determinant of absorptive capacity (Cohen and Levinthal, 1990), which assists a firm to proactively picture future technological advances (Cohen and Levinthal, 1994). In contrast, a limited prior knowledge of a firm may cause vagueness in the envisaged frame of future technological advances and its direction which in turn can hamper a process of exploiting and assimilating future knowledge and technology (Tu et al., 2006). Boer et al. (1990) in their longitudinal study argued that lack of a proper knowledge base in a firm may result in technical glitches which are considered as important barriers for operation of flexible manufacturing systems and processes. Relevant knowledge base of a firm is also vital for developing a firm's ability to absorb information technology (Boynton et al., 1994) and achieve success in terms of a firm's goals and objects (Shenkar and Li, 1999, Lane et al., 2001).

2. *Communications network (CN):* A communications network is considered as the capacity and capability of a firm's structural connections that facilitate flow of information and knowledge among different organisational department (Brown, 1997, Liao et al., 2010). Well-built internal communications decrease the barriers to information-sharing process and increase the efficiency of assimilation and transformation capabilities (Boer et al., 1999), thus improving absorptive capacity. In other words, effective communication is a fundamental dimension for improving absorptive capacity because it binds the organisation by integrating functional units (Cohen and Levinthal, 1990). A study by Aletan (1991) also suggest that integration of functional units is an essential activity to employ complex technology (i.e. computer-integrated manufacturing), since it facilitates a firm to work in an ideal environment which all functional units well worked together for accomplishing a pre-defined organisational objectives and goals. In addition, Goldhar and Lei (1994) argue that using cross-functional integration team is an important antecedent of a firm's process such as implementing automated manufacturing technology. Similarly, Chen and Small (1994) stated that the employment of multi-disciplinary implementation team is a key factor to successfully adopt a product production related activities (i.e. manufacturing technology). Bessant (1994) further expanded the scope of this issue from functional team to the organisational level and claimed that an integrated manufacturing

organisation is required to implement manufacturing technology process (e.g. product design and development) successfully. "*For many manufacturers, this involves several fundamental changes, including moving from vertical communication to network communication, and from sharp line/staff boundaries to blurred boundaries*" (Tu et al., 2006, p. 695). A study by Tsai (2001) is also asserted that an intra-organisational network play a vital role in enhancing knowledge transfer and organisational learning capabilities.

3. *Communications climate (CC)*: A frequently employed definition of communication climate is the one suggested by of Dennis (1974, p. 29) as "*a subjective experienced quality of the internal environment of an organisation: the concept embraces a general cluster of inferred predispositions, identifiable through reports of members perceptions' of messages and message-related events occurring in the organisation*". Communication climate can be therefore interpreted as the atmosphere within a firm that defines accepted communication behaviour, which in turn either improves or hampers the communication processes (Liao et al., 2010, Brown, 1997). An open and supportive climate can enhance the ability of employees in learning and consequently result in successful creation and implementation of new ideas (Tu et al., 2006). This issue is widely addressed in the relevant literature. For instance, Nevis et al. (1995) suggested a "climate of openness" among the important factors smoothing the progress of organisational learning. In the same vein, Levinson and Asahi (1995) argued an "open culture", that regards change as a positive phenomenon, could also improve organisational learning. Last but not least, "safe-failing" is another important dimension of open climate that promote risk-taking (Roth et al., 1994) in which learning is a trial and error process that needs an experimental mind-set (Nevis et al., 1995).

4. *Knowledge scanning (KS):* Knowledge scanning is addressing an organisational mechanism that allows firms to recognise and capture potential and pertinent external and internal knowledge and technology (Tu et al., 2006). Boynton et al. (1994) argued that an essential element of absorptive capacity is the management process containing different routines that are employed by firms to recognise and possibly capture practical and efficient type of knowledge. Several effective activities indicate the existence of this examination mechanism in a firm (Liao et al., 2010), such as employee training (Cohen and Levinthal, 1994) and inter-organisational learning (Levinson and Asahi, 1995). Furthermore, Levinson and Asahi (1995) named benchmarking of best practises, strategic

alliances, and customer and supplier surveys (Inter-organisational learning activities) as employable routes and approaches of knowledge scanning. "*Knowledge is likely to be acquired as a by-product of research and development activities, especially when the knowledge domain is closely related to the firm's current knowledge base*" (Tu et al., 2006, p. 696). Thus, investment in research and development can also enhance the ability of a firm in recognising and utilising external knowledge and resources (Cohen and Levinthal, 1990).

Table 2. 3: Definition and Literature of Absorptive Capacity and its Dimensions

Name	Definition	Literature
Absorptive capacity	Organisational mechanisms to identify, communicate, and assimilate relevant external and internal knowledge	(Adler, 1965, Brown, 1997, Cohen and Levinthal, 1990, Zahra and George, 2002, Tu et al., 2006)
Prior relevant knowledge	Understanding of job skills, technology, and management practices possessed by the workers and manager in the organisation	(Boer et al., 1990, Boynton et al., 1994, Cohen and Levinthal, 1990, Nicolini and Meznar, 1995, Fiol, 1996, Lane and Lubatkin, 1998)
Communication network	Scope and strength of structural connections that bring flows of information and knowledge to different organisational units	(Aletan, 1991, Bessant, 1994, Chen and Small, 1994, Cohen and Levinthal, 1990, Goldhar and Lei, 1994, Tsai, 2001)
Communication climate	Atmosphere within the organisation that defines accepted communication behaviour	(Levinson and Asahi, 1995, Nevis et al., 1995, Roth et al., 1994)
Knowledge scanning	Mechanism that enables firms to identify and capture relevant external and internal knowledge and technology	(Boynton et al., 1994, Cohen and Levinthal, 1990, Cohen and Levinthal, 1994, Levinson and Asahi, 1995, Roth et al., 1994, Ettlie, 2000)

Note: Adopted from Tu et al. (2006)

2.5.2. The Role of Absorptive Capacity in Product Innovation Process

According to Stock et al. (2001), absorptive capacity has been studied widely across a different ranges of research in the 1990s, including investment in research and development (Cohen and Levinthal, 1990, Cohen and Levinthal, 1994, Joglekar et al., 1997), research productivity in pharmaceutical companies (Cockburn and Henderson, 1998), innovation in banking services (Buzzachi et al., 1995), information technology use (Boynton et al., 1994), inward technology licensing (Atuahene-Gima, 1992), strategic alliances (Koza and Lewin, 1998, Kumar and Nti, 1998, Lane and Lubatkin, 1998, Shenkar and Li, 1999), knowledge transfer (Szulanski, 1996), and organisational learning (Cohen and Levinthal, 1990, Lane and Lubatkin, 1998, Shenkar and Li, 1999).

Studies have been furthered from 2000 to investigate the relationship between AC and other relevant research area. For instance, Tu et al. (2006) examined the impact of absorptive capacity on the organisation's ability to assimilate innovative manufacturing technology and management practice and found the positive relationship between AC and time-based manufacturing practices. Fosfuri and Tribó (2008) explored the antecedents of potential absorptive capacity and suggested potential absorptive capacity as a source of competitive advantage which positively impacts on innovation performance of firms. Lichtenthaler and Lichtenthaler (2009) developed a "Capability-Based" Framework for open innovation process by complementing the concept of absorptive capacity. They merged research into absorptive capacity, knowledge management, and dynamic capabilities, and introduced an integrative perspective with a focal consideration on knowledge exploration, retention, and exploitation inside and outside of a firm's boundaries. As a result they identified six 'knowledge capacities' as a firm's key capabilities of controlling and administrating internal and external knowledge in open innovation processes namely as inventive, absorptive, transformative, connective, innovative, and desorptive capacity. A study of Taiwanese manufacturing industry by Chen et al. (2009) suggest that AC has a positive relationship with innovation performance, and further has a positive influence on competitive advantages of firms. In a similar fashion, Kostopoulos et al. (2011) examined the role of absorptive capacity as both a mechanism to exploit and transform external knowledge inflows into tangible benefits, as well as key player of achieving superior innovation and time-lagged financial performance. Based on the statistical analysis they found that "*absorptive capacity contributes, directly and indirectly, to innovation and financial performance but in different time spans*" (Kostopoulos et al., 2011, p. 1335).

It is argued that a firms' absorptive capacity is not just a goal (Fosfuri and Tribó, 2008), but it also moderates some organisation outcomes as well. In fact, absorptive capacity is increasingly regarded as a moderator- a key explanatory factor for contingent relationship in recent studies (e.g. Rothaermel and Alexandre, 2009, Tsai, 2009). For instance, Rothaermel and Alexandre (2009) examined the moderating effect of AC, as a contingency element, on the curvilinear relationship between a firm's technology sourcing mix and its performance in a study of multi-industry US manufacturing companies. Based on the empirical findings, they argued that higher levels of AC facilitate a firm to successfully capture the benefits stemming from ambidexterity in technology sourcing.

Another example is the study of Taiwanese firms by Tsai (2009) which investigates a potential moderating influence of absorptive capacity on the collaboration with different types of partners (e.g. supplier, competitor, customer, research organisations) and product innovation performance. His finding shows a mixed effect of AC on different types of partners. For instance, while the impact of AC on the relationship between supplier collaboration and the new product performance varies depending on factors such as firm size and industry type, its impact on the relationship between collaboration with research organisations and the performance of completely new and/or significantly improved products is negative (Tsai, 2009).

Although a large body of the pertinent literature has focused on the relationship between AC and other business research spectrums, however studies on a potential relationship between absorptive capacity and new product development and innovation are relatively limited (e.g. Atuahene-Gima, 1992, Kumar and Nti, 1998, Stock et al., 2001, Tsai, 2009).

A single-industry-focused study by Stock et al. (2001) can be considered as a first empirical research which examines the relationship between absorptive capacity and NPD performance. Their findings asserted the existence of an inverted-U shaped relationship between new product performance and absorptive capacity in which this curvilinear association suggests diminishing returns for absorptive capacity. Abecassis-Moedas and Mahmoud-Jouini (2008) investigated "*the type of the external knowledge sourced from outside the organisation and the process through which it is used by the recipient firm and the effect on NPD performance*" and concluded that "*complementarity between the recipient and the source knowledge is a critical aspect of the absorption process and therefore of the NPD performance*" (Abecassis-Moedas and Mahmoud-Jouini, 2008, p. 473). As mentioned above, Tsai (2009) also examined a moderating influence of absorptive capacity on the collaboration with supplier and product innovation performance and found that the impact of AC on the relationship between supplier collaboration and the new product performance is different based on a firm size and industry type.

2.6. Market Orientation and Product Innovation

2.6.1. General Literature on Market Orientation

The enhancement and development of market orientation (MO) strategies are widely discussed as one of the major issues for organisations (Zhang and Duan, 2010). Literature review shows that being market oriented not only positively influences the level of marketing resources that firms possess but more importantly it enhances the required capabilities to deploy and assimilate such resources (Ngo and O'Cass, 2012). According to Kirca et al. (2005) a main body of the pertinent market orientation literature investigates firms' behaviour in the business environment, consistent with the marketing concept (Kohli and Jaworski, 1990) in which the concept of MO is constructed from both behavioural and cultural standpoints (Homburg and Pflesser, 2000). The behavioural viewpoint is regarded as a set of organisation activities that are relevant to the creation and dissemination of "responsiveness to market intelligence" (e.g. Kohli and Jaworski, 1990). On the other hand, the cultural viewpoint is regarded as organisations norms and values which promote behaviours that are in accordance with market orientation (Narver and Slater, 1990).

From behavioural perspective, market orientation was defined by Kohli and Jaworski (1990, p. 6) as "*the organisation-wide generation of market intelligence pertaining to current and future customer needs, dissemination of the intelligence across departments, and organisation-wide responsiveness to it*". Based on this definition three main components are defined for market orientation (Carbonell and Escudero, 2010): intelligence generation, dissemination, responsiveness. Intelligence generation presents the extent to which a firm accumulates primary and secondary information generated by competitors, suppliers, intermediaries as well as market forces such as social, cultural, and macroeconomic factors (Matsuno et al., 2000). Intelligence dissemination is regarded to the degree to which information is dispersed, shared and discussed among individuals and departments within a firm (Akgun et al., 2002). Responsiveness is a set of activities which are implemented in response to intelligence that is generated and disseminated (Carbonell and Escudero, 2010). Market orientation takes place when firm's competencies are constantly enhanced and developed to maintain competitive advantage within a target market (Morgan and Berthon, 2008). A market orientation is thus conceptualised to symbolize the extent to which a company sets the marketing concept as a vital organising principle of a company (Baker and

Sinkula, 2007, Day, 1994, Kohli and Jaworski, 1990) in order to synchronise a firm with its operational environment to facilitate responding strategically to any environmental changes (Kumar et al., 1998).

From a cultural perspective, Narver and Slater (1990, p. 21) defined market orientation as "*an essential element of business culture that most effectively and efficiently creates the necessary behaviors for the creation of superior value for buyers (customers) and, thus, continuous superior performance for the business*". Following Narver and Slater (1990), a study by Lukas and Ferrell (2000) also suggested three main elements of market orientation as customer orientation, competitor orientation, and inter-functional coordination. "*Customer orientation and competitor orientation represent a relative emphasis on collecting and processing information pertaining to customer preferences and competitor capabilities, respectively. Inter-functional coordination encompasses the coordinated application of organisational resources to synthesise and disseminate market intelligence*" (Lukas and Ferrell, 2000, p. 240). This behavioural classification of MO's components is consistent with Kohli and Jaworski (1990) perspective on the essence of market orientation.

A customer orientation obliges a firm to be aware of a buyer's value chain comprehensively (Day and Wensley, 1988) at a present time and more importantly in future as it may change depending on internal and market dynamics (Narver and Slater, 1990). While customer orientation is argued to reduce risks associated with a firm's business outcome, for instance reduce risk of product failure (Jaworski and Kohli, 1993), however a number of prior research suggest that relying too much on customer feedback can negatively influence on firms interests and outcomes such as the degree of product innovation (Bennett and Cooper, 1981, Christensen, 1997, Augusto and Coelho, 2009). Furthermore, competitor orientation requires that a firm identifies the short-term strengths and weaknesses as well as long-term capabilities and strategies of key current and potential competitors (Day and Wensley, 1988, Narver and Slater, 1990). In fact, competitor orientation involves the scanning of current and/or potential competitors, to recognise the total set of technologies which are capable of fulfilling articulated or hidden customer needs. The competitor analysis, according to Zahra et al. (1995), would thus help a firm to understand "*emerging substitutes, the speed with which substitute technologies will disseminate, and the timing of technological shifts*" (Augusto and Coelho, 2009, p. 98). Inter-functional coordination refers to the coordinated utilisation of a firm's resources in order to generate superior value for target customers. In this scenario, any issue in the targeted customer's value chain would offer an opportunity for a firm to create value for the customer (Narver and Slater, 1990). In a nutshell, the three behavioural elements of market orientation represents all activities related to the processes of market "acquisition" and "dissemination" and the "coordinated" creation of customer value (Narver and Slater, 1990).

According to Narver et al. (2004) customer needs and related solutions to these needs are classified into two groups: expressed and latent. Expressed needs and expressed solutions are defined "*as the needs and solutions of a customer of which the customer is aware and, therefore, can express*" (Narver et al., 2004, p.336). On the other hand, latent needs and latent solutions are defined as "*needs and solutions of which the customer is unaware*" (Narver et al., 2004, p.336).

Narver et al. (2004) challenged market oriented views of earlier studies and presented MO domain to include two essential dimensions, namely "*Responsive* and *Proactive*", since early studies (e.g. Jaworski and Kohli, 1993) mainly focused on the expressed needs of customers and did not emphasise on the latent needs and as a result, the measurement of market orientation has constructed only in responding to expressed type of needs.

Responsive market orientation (RMO) describes skills and routines to create, spread and employ market intelligence concerning existing customer's requirements in the market (Tsai et al., 2008, Narver et al., 2004, Atuahene-Gima et al., 2005) . Contrary to this, in proactive market orientation (PMO) a business puts some efforts to expose and satisfy the latent needs of customers (Narver et al., 2004). While a responsive market oriented firm emphasises on the fulfilment of articulated customer's need, a proactive market-oriented firm attempts to gain new information and knowledge in order to satisfy hidden customer's expectations (Atuahene-Gima et al., 2005). In fact, to gratify unarticulated customer needs, a proactive market oriented firm discovers new knowledge and markets which are drastically differed from existing experiences (Tsai et al., 2008). Considering the organisational learning point of view (Cohen and Levinthal, 1990, March, 1991, Levinthal and March, 1993), responsive MO deepens existing competence and proactive MO expands existing competence. "*The responsive market-oriented behaviours are characterized by proximity, refinement, efficiency, and implementation that reflect exploitation; proactive market oriented activities are characterized by discovery, variation, innovation, and risk-taking which reflect* *exploration*" (Tsai et al., 2008, p. 885). According to Atuahene-Gima et al. (2005) and Ngo and O'Cass (2012) responsive and proactive market orientated behaviours are therefore key capabilities/competencies in that they are information generation and use processes that involve complex interactions among employees and departments of a firm. Thus, they are originators of competitive advantage since they represent set of skills and processes which are not understandable simply and thus cannot be easily replicated by competitors in the market (Hunt and Lambe, 2000).

2.6.2. Antecedents of Market Orientation

The antecedents of market orientation is categorised into three groups: top management factors, interdepartmental factors, and organisational systems (Jaworski and Kohli, 1993, Kirca et al., 2005, Morris et al., 2007, Hashim and Bakar, 2011). A great focus of top management on MO positively impacts on an organisation's market orientation (Day, 1994, Narver and Slater, 1990) and in fact, in this scenario, top managers direct and lead norms and orientation of an organisation (Webster, 1988). The second set of antecedents, interdepartmental factors, consists of two main sub-elements, interdepartmental connectedness and conflict.

While interdepartmental connectedness develop and improve market orientation through the enhancement of share and use of information in organisation (Kennedy et al., 2003), interdepartmental conflict, in contrast, weakens market orientation by hampering "concerted" responses to potential market needs (Jaworski and Kohli, 1993). The last group of antecedents is organisational systems which includes two structural factor, namely "formalisation" and "centralisation", and two employee-related systems categories, "market-based reward systems" and "market-oriented training" system (Kirca et al., 2005). "*Formalisation, which refers to the definition of roles, procedures, and authority through rules, is inversely related to market orientation because it inhibits a firms' information utilisation*" (Kirca et al., 2005, p. 25) and consequently hamper developing an efficient response to changes occurred in the marketplace (Jaworski and Kohli, 1993). "*Centralisation, which refers to a limited delegation of decision-making authority in an organisation*" (Kirca et al., 2005, p. 25), would also have a negative impact on market orientation as it is restraining an efficient information diffusion and more importantly utilisation in a firm (Matsuno et al., 2002). With regard to employee-related systems, a market-based reward system employs market-oriented behaviour as pragmatic metrics and refers to a set of activities with the aim of motivating employees that in turn enhances market orientation (Kirca et al., 2005). On the other hand, a market-oriented training further educates employees about tangible and intangible needs of customer in order to harmonise a firm's strategies and activities with market orientation requirements (Ruekert, 1992).

2.6.3. Consequences of Market Orientation

The consequences of market orientation are categorised into four sub-groups as follows (Jaworski and Kohli, 1993, Kirca et al., 2005, Morris et al., 2007, Hashim and Bakar, 2011):

- *Organisational performance* includes cost-based performance (i.e. profit measures) and revenue based performance (i.e. sales and market share) measures. It can be further enhanced by employing advanced capabilities such as market-sensing and customer-linking which are predominantly derived from market orientation strategies (Day, 1994, Hult and Ketchen, 2001)

- *Customer consequences* include parameters such as quality of a firm's product and service, customer loyalty, and customer satisfaction (Jaworski and Kohli, 1993). Market orientation addresses quality related expectations of customers through facilitating a firm to create and maintain superior customer value (Brady and Cronin, 2001, Hashim and Bakar, 2011). It also improves customer satisfaction and loyalty by enhancing a prediction process of customer needs which consequently result in commercialising better product and service into a market (Slater and Narver, 1994b).

- *Innovation consequences* consist of factors such as innovativeness (Hult and Ketchen, 2001) and new product performance (Im and Workman, 2004). It can be enhanced by market orientation since "*it drives a continuous and proactive disposition toward meeting customer needs and it emphasises greater information use*" (Kirca et al., 2005, p. 25)

- *Employee consequences*: MO may also improve organisational commitment, employee team spirit, customer orientation, and job satisfaction (Kohli and Jaworski, 1990) "*by instilling a sense of pride and camaraderie among employees*" (Kirca et al., 2005, p. 26).

2.6.4. The role of Market Orientation in Product Innovation Process

In recent years, there has been a keen research attention on examining the relationship between market orientation and new product performance (Augusto and Coelho, 2009, Carbonell and Escudero, 2010, Wong and Tong, 2012). Previous studies introduced market orientation as a key driver of new product success (Narver et al., 2004, Atuahene-Gima et al., 2005, Langerak et al., 2004, Han et al., 1998, Sharifi et al., 2006, Zhang and Duan, 2010), innovation speed (Carbonell and Escudero, 2010), product innovativeness (Sandvik and Sandvik, 2003) and a degree of novelty (Bodlaj, 2011). Research have been undertaken in order to integrate market orientation and innovation such as the adoption of tools and techniques, role of the marketing department, marketing–R&D interface, (virtual) customer input, and cross-functional collaboration (Kok and Biemans, 2009). It is believed that market orientation is an essential antecedent of product innovation process behaviours, activities, and performance (e.g. Slater and Narver, 1994a, Baker and Sinkula, 2005, Atuahene-Gima, 1995, Laforet, 2008).

Based on a survey of U.S. manufacturing firms, Lukas and Ferrell (2000) found that product innovation varies depending on market orientation‘s components in which customer orientation increases the introduction of new to-the-world products and decreases the launching of me-too[3] products. Competitor orientation accelerates the introduction of me-too products but diminishes the launching of new-to-the-world products, and finally inter-functional coordination decreases the introduction of me-too products.

Similarly, Augusto and Coelho (2009) examined the relationship between market orientation and new-to-the-world product, however their findings were slightly different to compare Lukas and Ferrell (2000) conclusion, since no negative association was found between MO's components and product innovation. Their result suggests that customer and competitor orientations, together with inter-functional coordination, are significant drivers of a firm's new-to-the-world product innovation. Moreover, the components of MO are found to be differentially moderated by a firm's innovativeness, competitive strength, and environmental forces (Augusto and Coelho, 2009). Sandvik and Sandvik (2003) have further deepened the research on the relationship between MO and product innovation by investigating the impact

[3] Me-too products are considered new to the business organisation but familiar to the market; that is, imitations of competitors' products (Lukas and Ferrell, 2000, p. 240).

of market orientation on product innovativeness dimensions (use of new-to-the-firm and use of new-to-the-market products) and found that MO facilitates both dimensions of product innovativeness. By showing positive linkages between MO and product innovativeness dimensions, their findings further support previous studies in market orientation (e.g. Jaworski and Kohli, 1996) and product innovation (e.g. Lukas and Ferrell, 2000).

With regards to the market orientation dimensions (i.e. proactive and responsive), also few studies examined potential influences from proactive and responsive dimensions on product innovation performance. Initially Narver et al. (2004) argued that while employing the responsive market orientation strategy may be insufficient to create and continue new-product success, adopting a proactive market orientation strategy has a significant role to succeed in this process. Later, Atuahene-Gima et al. (2005) attempted to advance MO dimensions views and theories by empirically validating the constructs, their interaction and the moderating effect of organisational factors on the MO and new product performance (NPP) relationships. While they found out that both orientations are needed for successful new product program, statistical analysis asserted that RMO has a U-shaped relationship with new product performance and in contrast, proactive MO shows an inverted U-shaped association with NPP. Furthermore they argued that *"responsive MO is only positively related to new product program performance under specific conditions such as when strategic consensus among managers is high. On the other hand, the positive effect of proactive MO on new product program performance is further strengthened when learning orientation and marketing power are high*" (Atuahene-Gima et al., 2005, p.464). Considering the potential risks and costs associated with each aspect of market orientation (responsive and proactive), which can restrict product innovation, MO strategy may need different organisational conditions in order to guarantee positive impact on new product performance (Atuahene-Gima et al., 2005).

Tsai et al. (2008) extended the study by Atuahene-Gima et al. (2005) to further investigate and cover missing evidence of curvilinear relationships between R&P-MO and NPP while examining the impact of environmental turbulence on the relationships. On the basis of a sample 107 new product development programs in five high-tech industries they argued that responsive and proactive market orientations may increase the potential negative effects on the product development/innovation process and become detrimental to its performance should they surpass certain level. Their statistical findings asserted that in high technological turbulence condition, RMO may hamper new product success beyond a certain level. On the other hand, PMO and new product performance shows an inverted U-shaped association in low level of technological turbulence or competitive intensity. More recently a study of 325 Slovenian firms by Bodlaj (2011) reveals that only a proactive market orientation is positively related to the degree of novelty. He also suggests that a proactive market orientation may be more important for small companies as well as companies surrounded by high technological turbulent environment. Overall, the literature review suggests that the effects of market orientation dimensions on new product innovation are complex and greatly depend on other macro or micro elements such as environmental factors. Table 2.4 summarises the recent key studies on market orientation dimensions.

Table 2. 4: Key studies on Responsive and Proactive Market Orientations

Study	*Method and Context*	*Focus*	*Performance measure*	*Key results and contribution*
Narver et al.(2004)	Survey of 41 business units from 25 firms. (Cross-industry)	The relationship between responsive and proactive market orientations and new-product success	New-Product Success	To create and to sustain new-product success, a responsive market orientation is not sufficient and, thus, that a proactive market orientation plays a very important positive role in a business's new-product success.
Atuahene-Gima et al.*(2005)*	Survey of 175 U.S. manufacturing firms, (Cross-industry)	The Contingent Value of Responsive and Proactive Market Orientations for New Product Program Performance: moderating impacts of organisational implementation conditions and marketing function power	Product program performance, (i.e. Revenue, profitability, sales)	Whereas responsive MO has a U-shaped relationship with new product program performance, PMO has an inverted U-shaped relationship with NPP. The effects of RMO & PMO on NPP are moderated differentially by the organisational implementation conditions and marketing function power.
Tsai et al. *(2008)*	Survey of 107 new product development programs in five high tech industries	The moderating impact of environmental turbulence factors (i.e. technological turbulence, competitive intensity)	New product performance (i.e. revenue, sales volume, market share, sales growth, profitability)	An inverted U-shaped relationship exists between each of these two MO dimensions and new product performance. Under a high level of technological turbulence, RMO becomes

		on the curvilinear relationships between responsive and proactive market orientations and new product performance		detrimental to new product performance beyond a certain level; the relationship between PMO and new product performance is an inverted U-shaped under a low level of technological turbulence or competitive intensity.
Bodlaj (2011)	Survey of 325 Slovenian manufacturing firms (Cross-industry)	The relationship between a responsive and a proactive market orientations and the degree of novelty	Degree of novelty	Only a proactive market orientation is positively related to the degree of novelty. Furthermore a distinction between a responsive and a proactive market orientation is important for a better understanding of the effect of a market orientation on the degree of novelty.

Note: Partly adopted from Johnsen (2009)

2.7. Environmental Turbulence Factors

2.7.1. Impact of Environmental Turbulence Factors on Product Innovation

In the context of new product development, several studies claim that the environmental factors can moderate the success of product innovation and possible strategic orientations linked to the new product development process (e.g. Zhou, 2006, Lukas and Ferrell, 2000, Li and Calantone, 1998, Gatignon and Xuereb, 1997). For instance, Atuahene-Gima and Li (2004) argued that the difficulties and costs to gain new product success might be increased due to several environmental uncertainties which cannot be analysed effortlessly. According to Calantone et al. (2003) turbulent environments are detailed as showing high levels of periodically change which generates uncertainty and unpredictability (Bourgeois and Eisenhardt, 1988, Dickson and Weaver, 1997); dynamic and uncertain circumstances with significant instability in both demand and growth rates (Glazer and Weiss, 1993); fleeting competitive advantages that constantly are generated or corroded (Chakravarthy, 1997); and finally low barriers to entry as well as exit which continually alter the competitive structure of a industry (Chakravarthy, 1997).

Several research studies have been focused on the key elements of environmental conditions (Gotteland and Boule′, 2006). Dess and Beard (1984) suggested three dimensions for environmental factors: dynamism, complexity and capacity. The dynamism of the environment is regarded as "the variation degree over time of its constitutive elements" (Dess and Beard, 1984, Tan and Litschert, 1994). The complexity of the environment according to Tan and Litschert (1994) is "the heterogeneity degree of its constitutive elements" . And the last factor, capacity, is considered as "the degree by which the environment proposes a sustained growth over time" (McArthur and Nystrom, 1991, Dess and Beard, 1984). Contrary to this view a large body of relevant literature has focused on a potential uncertainty raised from environmental condition (Calantone et al., 2003). Environmental uncertainty refers to the rate of change and the degree of instability in the environment (Wang et al., 2011). As a result of this perspective, three dimensions are discussed as the main environmental factors: Technological turbulence, Competitive Intensity, and Market Turbulence. With regards to the moderating effect of these environmental factors (particularly technological turbulence and competitive intensity), previous studies have presented a mixed pattern of results and conclusions (Gatignon and Xuereb, 1997, Li and Calantone, 1998, Augusto and Coelho, 2009). "*Such a pattern can possibly be explained by industry differences in the flow of new product launches and also in terms of sensitivity to environmental conditions*" (Augusto and Coelho, 2009, p. 105). For instance, a meta-analytic study by Kirca et al. (2005) could not find strong evidences for the moderating impact of several environmental factors on the relationship between MO and product and/or firm performance.

2.7.1.1. Technological Turbulence

Technological turbulence has been widely studied in pertinent literature as an influential factor on the relationship between causal factors (i.e. market orientation and supplier involvement) and product innovation/development performance (e.g. Gotteland and Boule′, 2006, Tsai et al., 2008, Lee et al., 2009). Technological turbulence refers to the rate of technological change (Kohli and Jaworski, 1990). Lee et al. (2009) discussed this with regard to the companies which rely on technology to survive, and suggested that changes in technology can be a key factor that influences their ability to forecast the future.

With regard to the supplier integration into product development and innovation process, while a very limited number of studies (e.g. Ragatz et al., 2002) addressed the moderating role of technological turbulence, its direct and indirect impact on new product development process has not been ignored completely. Eisenhardt and Tabrizi (1995) claimed that low degree of supplier involvement may stem from the technological uncertainty. Furthermore, Wasti and Liker (1999, 1997) asserted that the accumulation of technology turbulence and suppliers technical capabilities will positively affect on supplier involvement in product development process. More recently, Lee et al. (2009) claimed that technology change leads to specific investments and supplier alliances which in turn enables firm to implement an effective approach to producing innovative products equipped with the technologies required by the market.

However , lack of consensus exist in the literature since "*prior work examining the degree to which technology uncertainty affects the outcomes of supplier involvement is fragmented and confusing*" (Ragatz et al., 2002, p. 393). For instance, a study of Japanese firms by Wasti and Liker (1997) proved that technological uncertainty can result in closer relationships with main suppliers and consequently improve the company's performance through early involvement in product development process. In contrast, the study of Primo and Amundson (2002) shows that high technological uncertainty condition may lead to hindrance in the product development process.

With regards to the complex relationship between MO and NPP, technological turbulence is the most frequently cited one among the environmental factors that are reported to moderate the association between MO and NPP. Han et al. (1998) asserted that the level of innovation in companies differ with market orientation which depends on the intensity of technological turbulence and also market uncertainty. They emphasised that in a condition of high technological turbulence, customer and competitor orientation and also inter-functional coordination will smooth the progress of technological innovations. Day and Wensley (1988) discussed that under high level of technological turbulence conditions customer interactions can offer a direction for product development/innovation efforts. Furthermore, in such environments, more opportunities can be explored for creating value to customers, and this can facilitate the introduction of new and innovative products (Narver and Slater, 1990).

However, a recent study by Tsai et al. (2008) criticised this view and suggested a mixed and more complex perspective on this issue. They supported that the curvilinear relationship between the two dimensions of market orientation (responsive and proactive) and new product performance is moderated by technological turbulence as one of the important external environmental characteristics. However, they argued that a firm that operates in more turbulent technological environment might be capable of employing alternative avenues to achieve a competitive advantage through technological innovations, thereby diminishing the importance of a responsive MO (Tsai et al., 2008). Atuahene-Gima et al. (2005) also discussed that firms which try to fulfil the customer needs may face familiarity trap that decreases attractiveness of alternative directions. Regarding the PMO behaviour, market-oriented firms endeavour to search and gain new information and knowledge in order to gratify hidden customer's expectations (Tsai et al., 2008). Such highly proactive market-oriented firms may gain radical innovations leading to exclusive benefits. Therefore high technological turbulence may bring favourable condition for proactive oriented company to employ new technology and knowledge to gain competitive advantage (Zhang and Duan, 2010).

2.7.1.2. Competitive Intensity

Similar to technological turbulence, competitive intensity also have been repeatedly focused in new product innovation and development studies (e.g. Gatignon and Xuereb, 1997, Li and Calantone, 1998, Zhou, 2006, Augusto and Coelho, 2009, Tsai et al., 2008, Zhang and Duan, 2010) which refers to the level of competition faced by an organisation (Jaworski and Kohli, 1993). Literature review however shows limited number of relevant researches (e.g. Augusto and Coelho, 2009, Tsai et al., 2008, Zhang and Duan, 2010) to address the potential interplay between market orientation, product development and innovation, and competitive intensity.

A study of 89 Portuguese companies by Augusto and Coelho (2009) claimed that the components of market orientation are differentially moderated by competitive intensity. They argued that positive impact of customer orientation on new-to-the-world product innovation is contingent upon a high level of competitive intensity. They also found that at higher level of competitive intensity any increase in coordination can be harmful for the development of new-to-the-world products.

Furthermore, Tsai et al. (2008) examined the moderating role of competitive intensity on the relationship between dimensions of market orientation (responsive and proactive) and new product performance. While the empirical study by Tsai et al. (2008) found the linear relationship between RMO and product performance, whether competition in market is high or low, however their findings indicate that when a competitive intensity is low the association between proactive MO and new product performance has an inverted U-shaped form suggesting that PMO behaviour enhances a product development performance up to a point. "*Under low competition conditions, customers have a few alternatives to satisfy their needs. Innovations resulting from the exploration of novelties may distract from current customer needs. Effort spent on exploring new knowledge to meet possible customer needs in the future may generate substantial costs because of uncertainty, making a firm with limited resources miss an opportunity to increase its competitive advantage by increasing experience and competence in current market domains. Under highly competitive conditions [...] by proactively seeking latent and emerging customer needs, firms may have a higher chance to differentiate themselves from competitors by creating new opportunities, thereby mitigating the negative effects of excessive proactive MO*" (Tsai et al., 2008, p. 892).

More recently Zhang and Duan (2010) disapproved the aforementioned findings by Tsai et al. (2008) and argued that competitive intensity has no moderating effect on the association between MO (both responsive and proactive) and new product performance (they also suggest the existence of linear relationship between MO dimensions and NPP).

2.7.1.3. Market Turbulence

Finally, According to Milliken (1987) market uncertainty is affiliated with precisely forecasting the future of the market preferences, the competition condition and the environmental forces evolution. Lee et al. (2009) argued that market turbulence can be considered as another significant aspect of environmental uncertainty "*...because, in an environment shaped by rapid changes in the product market, any firm would find it difficult to accurately forecast future changes*" (Lee et al., 2009, p. 191).

Market turbulence/uncertainty refers to the number of customers and the stability of their preferences (Subramanian and Gopalkrishna, 2001, Kohli and Jaworski, 1990) and has been identified as an influential variable which affects the relationship between company's strategic orientation and level of innovation (e.g. Han et al., 1998). Despite some studies have speculated on a possible moderation effect of market turbulence on the relationship between market orientation and performance (e.g. Harris, 2001, Atuahene-Gima, 1995, Greenley, 1995), there is however a lack of consensuses among researchers on this issue. For instance while some scholars (e.g. Pulendran et al., 2000, Greenley, 1995) found the role of market turbulence influential, other scholars (e.g. Slater and Narver, 1994a, Jaworski and Kohli, 1993) did not find any critical role for it.

The findings of previous researches are also varied based on the context of study (Harris, 2001). For example, in the US contexts, Jaworski and Kohli (1993) finds no support for the proposition that market turbulence moderate the relationship between market orientation and performance. In contrast, another study of US industries by Slater and Narver (1994a) asserted that market turbulence significantly moderates the link between MO and new product performance (i.e. return on assets). On the other hand in non-US contexts, Diamantopoulos and Hart (1993) developed a measure of market orientation based on proposed framework by Kohli and Jaworski (1990) and found out that MO–performance relationship is context-specific and moderated by market turbulence. A study of UK manufacturing by Harris (2001) also examined the moderating effect of market turbulence on MO-performance relationship and found out that the market turbulence influences varies according to which type of profitability measures are used.

The potential impact of market turbulence as one of the main dimensions of environmental turbulence factor on the relationship between market orientation dimensions (responsive and proactive) however has not yet been empirically examined.

2.8. Chapter Summary

The main focuses of this chapter were to introduce agile supply chain framework (originally suggested by Sharifi et al., 2006, Sharifi et al., 2009) as a research reference model and to review a large body of literature on product innovation. Based on the comprehensive literature review market orientation, supplier involvement, absorptive capacity, innovation life cycle, and environmental turbulence factors are identified as influential factors which may impact either directly or indirectly on the product innovation process and performance. Each of these influential factors was broadly reviewed in this chapter with the aim of identifying potential gaps and current limitation of the pertinent literature on product innovation subject. These limitation and gaps will be addressed by presenting research hypotheses in the next chapter (Chapter 3).

Chapter 3: Conceptual Framework and Hypothesis Development

3.1. Introduction

The chapter begins with explaining the development of the research conceptual framework against the theoretical background and the research reference model discussed in the literature review chapter. The conceptual framework comprises influential factors on (agile) product innovation performance namely as market orientation dimensions, supplier involvement, absorptive capacity, innovation life cycle, and environmental turbulence factors. Based on the model presented in Section 3.2.1, each of the areas is then further explored by presenting some evidences from the relevant literature to arrive at research hypotheses.

3.2. The Research Conceptual Framework: Agile Product Innovation

3.2.1. Conceptual Framework Development

The concept and process of product innovation (PI), as a critical competitive strategy for firms, has been influenced and evolved over the past two decades by factors such as the increasing uncertainty in business environment, shifting of the unit of competition from firm to supply chain, and theoretical and practical evolution of perceptions and perspectives on strategic management and organisational capabilities required for success (e.g. Tsai, 2009, Tsai et al., 2008, Stock et al., 2001, Abecassis-Moedas and Mahmoud-Jouini, 2008, Bodlaj, 2011, Narver et al., 2004). Such evolutions can be found in emerged concepts such as dynamic capabilities to include responsiveness and agility (Narasimhan and Kim, 2002). As Teece at al. (1997) projected, capabilities such as timely responsiveness, rapid and flexible product innovation, and effective coordination and redeployment of internal and external competences are going to win markets for firms in the new global marketplace. PI to succeed should therefore be pursued in a flexible process involving continuous reconfiguration of products in an agile (responsive or proactive) manner by reliance on external sources, particularly suppliers, as well as internal capabilities (Ismail and Sharifi, 2006) and strategies such as market orientation (Narver et al., 2004). For this purpose supply chain strategies shall be aligned with firm's competitive strategies (Narasimhan and Kim, 2002, Qi et al., 2011), particularly product innovation capabilities and strategies, and the required dynamic capabilities be developed on a base of existing internal competences (Teece et al., 1997). Four elements can be signified in this perspective: a) a need for developing and measuring capabilities alongside performance (Teece et al., 1997, Braunscheidel and Suresh, 2009) as indicators of firm's competitiveness; b) supplier involvement or integration and c) market orientation strategy as the antecedents to both performance (Lau et al., 2010, Primo and Amundson, 2002) and capabilities (Braunscheidel and Suresh, 2009), here agility in product innovation; and d) internal capability/capacity to work with internal and external sources, absorb knowledge and develop capabilities. This approach will open discussion to a less attended discourse in this area, which is about applying capability based measures to assess performance. Also it can be a novel way to address the inconsistencies in the literature particularly related to the impact of supplier involvement, market orientation, and environmental turbulence factors on PI performance (see Chapter 2).

Agility concept here assists to determine and set the capabilities for responding to uncertain and changing business environment of product innovation. Since its inception agility has been defined in many fashions. A DCT (dynamic capability theory) oriented approach by Braunscheidel and Suresh (2009) defines agility or supply chain agility as a capability (externally focused) which is built on internal competencies that enables the firm to respond to market changes and supply chain disruptions. While this definition reflects a main stream of literature on agility concept, Zhang and Sharifi (2007) and Ismail et al. (2006) take this view further from a similar perspective by suggesting that agility as an externally focused capability provides not only responsiveness to changes in the business environment but equip the firm to proactively exploit and capture the market and build sustainable competitiveness. Besides, according to Sharifi and Zhang (2001) and Ismail et al. (2006) agility is a capability which may present in organisations at different levels from addressing efficiencies of the organisation (robustness), to market responsiveness and further to becoming proactive in approaching and capturing markets. Ismail and Sharifi (2006) define supply chain agility as a platform to future proof the supply chain on which a firm, capable internally with the will and ability to exchange flow of knowledge with outside, works closely with suppliers and potential markets to innovate (product) responsively or proactively. Agility in this research is also considered at its broadest form as the capability for the firm to respond to as well as proactively approach markets. In line with the focus of the research the areas of capability related to product innovation, or product market position, is considered which according to both classic strategic management and DCT is a main source of competitiveness and flow of rents to firms (Teece et al., 1997). Products innovation will therefore be the concern in here both for the performance of a firm's products relative to its competitors, and also as the capability (here agile capability) to develop product market position. Therefore, inspired by the Agile Supply Chain framework introduced by Sharifi et al. (2006, 2009), in this study the overall competiveness of the firm, in terms of product innovation, is labelled as *Agile Product Innovation* (API) which comprises both, firm' financial/market performance and agility capabilities in product innovation. As mentioned in the literature review chapter, Sharifi et al. (2006) argued that an agile supply chain can be developed and implemented effectively through merging the Supply Chain Design (SCD) with design for Supply Chain (DFSC) concept (Sharifi et al., 2006). The balanced approach of merging SCD and DfSC, ensures that the vital circumstance to develop agility in demand networks are being looked into SCD emphasises on determining the network's strategy, design of its structure, operations and processes and aligning its focal component, while DFSC is considered as a part of new product development process which taking into account the success and performance of supply chain through designing a product (Sharifi et al., 2009). Sharifi et al. (2006) argued that the integration of two aforementioned viewpoints is affected by several important internal and external players such as market, business environment, company capability, and supply chain factors. Since product is considered as one of the main constituting elements of the supply chain in this framework, examining the potential effects of aforementioned external and internal factors on the performance associated with new innovative product is deemed to be necessary. In line with agile supply chain framework API in concept is therefore contemplated to be related to markets as well as supply chain, and is dependent on the capabilities available within the firm to support the strategy and innovation process.

These aspects are presented in the conceptual framework as shown in Figure 3.1. The performance and agility capability, which will be detailed later in Section 3.2.2, are theoretically impacted by supplier involvement and market orientation dimensions (proactive and responsive) as the subjects widely addressed in the relevant literature (e.g. Song and Benedetto, 2008, Petersen et al., 2005, Atuahene-Gima et al., 2005, Augusto and Coelho, 2009). Furthermore, Drawing on the earlier studies (e.g. Tsai, 2009, Stock et al., 2001, Kostopoulos et al., 2011) absorptive capacity as an internal competency and ability of the firm is suggested to directly impact the product performance and API capability, and also to influence the relationship between supplier involvement and product innovation performance and agility. Moreover, environmental characteristics containing technological turbulence, competitive intensity, and market uncertainty (Harris, 2001), are suggested to influence the relationship between market orientation dimensions and agile product innovation performance. In the same vein, in line with suggestion by Ragatz et al. (2002), the relationship between supplier involvement and agile product innovation performance is also suggested to be moderated by technological turbulence. Following the relevant literature (e.g. Kirca et al., 2005, Narver and Slater, 1990) these environmental factors are treated independently due to the non-existence of one or more of them in some market environments. Finally some key control variables are employed in the model to reduce or eliminate the likely bias stemming from the confounding effects.

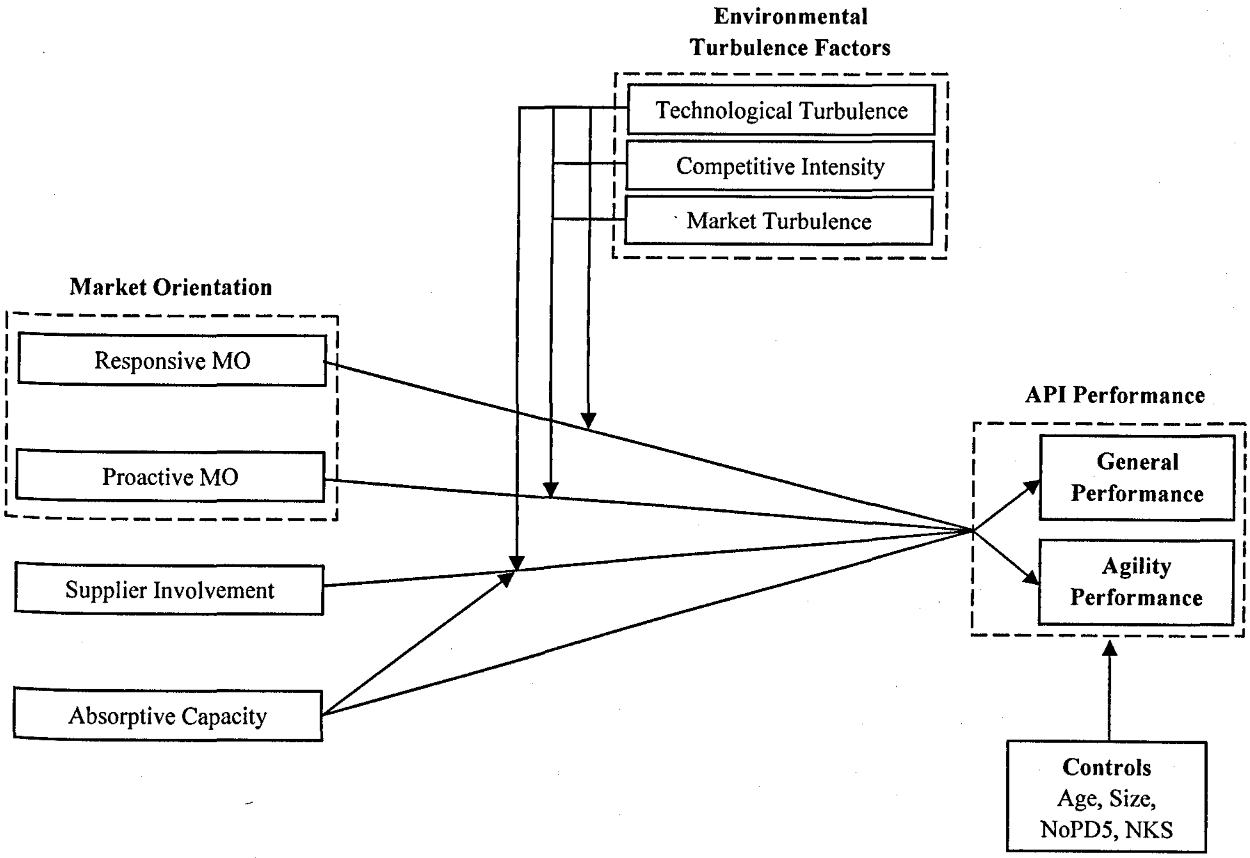

Figure 3. 1: The Study Conceptual Framework

Note: *NKS*: Number of key Suppliers; *NoPD5:* Number of product design in last five years.

3.2.2. Dimensions of Agile Product Innovation Performance

As mentioned in the literature review chapter, a number of previous researches have considered innovation performance (Alegre et al., 2006) as an indicator of performance at firm level. For instance, product innovation performance has been considered as both financial and non-financial outcomes of a company's product innovation efforts (Hollenstein, 1996). In this vein, two main groups of factors, namely process efficiency and product effectiveness (Verona, 1999), have been broadly discussed as indicators of a firm's performance. Process efficiency factor contains elements such as speed, productivity, and flexibility (Clark and Fujimoto, 1991, Verona, 1999) while product effectiveness represents elements such as profitability of the product, market share of the product, product revenue, and product quality (Verona, 1999). More recently Alegre et al. (2006) defined product innovation performance as an accumulation of two main dimensions of innovation efficacy (the degree of success of an innovation) and innovation efficiency (the effort carried out to achieve that degree of success). The majority of previous studies have however considered product innovation performance with only a single dimension.

In a world increasingly shaped by innovation-based competition it is too limiting to measure a firm's competitiveness based on its market and financial performance. While this limitation has been recognised by some researchers leading to suggestion of a multidimensional approach, as discussed before, further insight is required as to what should be considered instead and be applied to measure competitiveness and innovativeness of a firm in changing and volatile markets. Dynamic capability theory - DCT (Teece et al., 1997) argues that strategy should be based on more fundamental aspects of firm performance, rooted in competences and capabilities. From this perspective since products, and hence achievements from presenting them to market, are the manifestation of competences the focus should be on developing capabilities which lead into various products and innovative performance. More recent literature (for instance, Agile Supply Chain Framework suggested by Sharifi et al., 2006) , has branded such capabilities as agility, which enables firms to respond to change and also become proactive in approaching markets (Sharifi and Zhang, 2001, Braunscheidel and Suresh, 2009).

Alegre et al. (2006) suggested that innovation performance can be signified as an intermediate variable between business processes and general firm performance to get a clearer picture of actions and effects at the firm level. However, to distinguish performance (market and financial results from new products) and capabilities to respond to market changes (agility) through innovation the concept of *Agile Product Innovation* (API) is defined in this research as *the capability of introducing innovative products (new or innovatively modified) which is agile by being flexible and responsive to market requirements as well as to internal and external capabilities*. Based on this definition, product innovation performance is conceived with two dimensions: *General performance* and *Agility performance*. General performance mainly reflects the degree of success of a firm's financial and market position as well as customer satisfaction level. On the other hand, agility performance is defined to indicate the degree of success of a firm (rooted in capabilities) in being agile and innovative in dealing with new product introduction to the market. For measuring agility performance this study stays within the frames of research on product innovation (e.g. Prajogo and Ahmed, 2006, Koufteros et al., 2007) and include factors such as the number of innovations, the speed of innovation, time to market, and novelty of products (Prajogo and Ahmed, 2006).

Based on the model presented in figure 1 each of the areas is further explored by presenting some evidences from the relevant literature to arrive at research hypotheses.

3.3. Hypothesis Development

3.3.1. The Moderating Impact of Environmental Turbulence Factors on the Relationship between Market Orientation Dimensions and API Performance

As mentioned earlier in the literature review chapter, environmental uncertainty/ turbulence refers to the rate of change and the degree of instability in the environment (Wang et al., 2011). A number of environmental factors are reported to moderate the complex relationship between MO and NPP, among which technology turbulence is the most frequently cited one (e.g. Harris, 2001, Tsai et al., 2008, Ragatz et al., 2002).

Technological turbulence refers to the rate of technological change (Kohli and Jaworski, 1990). It is argued that a firm that operates in more turbulent technological environment might be capable of employing alternative avenues to achieve a competitive advantage through technological innovations, thereby diminishing the importance of a responsive MO

(Tsai et al., 2008). However, Day and Wensley (1988) discussed that under high level of technological turbulence conditions customer interactions can offer a direction for product development/innovation efforts. In other words, in a condition of high technological turbulence, employing customer orientation strategy will smooth the progress of technological innovations (Han et al., 1998). In such environments, more opportunities can be explored for creating value to customers by responsive market oriented firms, and this can facilitate the introduction of new and innovative products (Narver and Slater, 1990). Therefore, it would be expected that technological turbulence can moderate the relationship between responsive MO and agile product innovation performance, in which the higher the level of technological turbulence, the stronger the relationship between the both general and agility performance and RMO. Building on the aforementioned arguments, the following hypothesis is developed:

H_1: The relationship between responsive market orientation and a) General performance, b) Agility performance is tending to increase as the technological turbulence increases.

A proactive market oriented firm is likely to access a wide range of product and market opportunities that lie outside its experience through focusing on latent customer needs (Atuahene-Gima et al., 2005). Under a turbulent technological condition, these opportunities can lead a proactive market oriented firm to achieve a competitive advantage through technological innovations (Tsai et al., 2008). Achieving technological innovation can therefore leverage a firm's outcomes and in turn positively impacts on product innovation performance. This leads to Hypothesis 2:

H_2: The relationship between proactive market orientation and a) General performance, b) Agility performance is tending to increase as the technological turbulence increases.

Competitive intensity is introduced as another common environmental characteristic in the relevant literature, which refers to the level of competition faced by an organisation (Jaworski and Kohli, 1993). A number of studies have considered competitive intensity as a moderator in the relationship between market orientation and business performance (Wong and Ellis, 2007, Kohli and Jaworski, 1990, Slater and Narver, 1994a, Atuahene-Gima, 1995). However empirical studies on the affect of competitive intensity on new product success seem to be in conflict as reported by Atuahene-Gima (1995). For instance, while Cooper and Kleinschmidt

(1987) did not find strong association between the new product success and competitive intensity in market some other scholars (Zirger and Maidique, 1990, de Brentani, 1989) declared existence of negative relationship.

As mentioned in the literature review chapter, a limited number of research have addressed the potential interplay between two dimensions of market orientation (responsive and proactive), new product performance, and competitive intensity (e.g. Tsai et al., 2008). Atuahene-Gima et al. (2005) argued that RMO strategy assists firms to decrease the possibility of errors in problem solving, and also to reduce the complexity of using information in the product development process. They also discussed that focusing on current customers and their expressed needs would help companies to enhance the ability of combining knowledge in applying more cost-effective approaches to solve customers' problems. These advantages specially offer more value to a firm when the competition is fierce in the business environment. Therefore, from this line of reasoning it can be expected that a more intense competition is likely to provide more opportunities for highly responsive market oriented companies to gain advantage through satisfying expressed customer needs, thus:

H_3: The relationship between responsive market orientation and a) General performance, b) Agility performance is tending to increase as the competitive intensity increases.

On the other hand, proactive market oriented firms may gain valuable competitive advantage through product innovation process due to its nature resulting in radical products with unique benefits (Atuahene-Gima et al., 2005). However, high risks and costs are always linked with excessive proactive MO due to potential inefficiency associated with focus on unfamiliar information and knowledge (Levinthal and March, 1993, March, 1991). A highly proactive market oriented firm may shift from one innovation, market, or technology to another without utilising prior learning and experience (March, 1991) which in turn results in a large number of exploratory projects that can possibly diminish the firm's focus on developing product for current markets (Atuahene-Gima et al., 2005). Therefore, in high competition environments a lack of sufficient focus on developing product for current markets can be potentially harmful for new product development project in excessively proactive market oriented organisations. This can offer a good opportunity for rivals to responsively meet current market needs and capture the market. Hence, the following hypothesis is formulated:

H_4: The relationship between proactive market orientation and a) General performance, b) Agility performance is tending to decrease as the competitive intensity increases.

Market turbulence is the last environmental factor discussed to moderate the relationship between MO dimensions and API performance. As mentioned in the literature review chapter market turbulence/uncertainty refers to the number of customers and the stability of their preferences (Subramanian and Gopalkrishna, 2001, Kohli and Jaworski, 1990) and has been identified as an influential variable which affects the relationship between company's strategic orientation and level of innovation (e.g. Han et al., 1998). Despite some studies have speculated on a possible moderation effect of market turbulence on the relationship between market orientation and performance (e.g. Harris, 2001, Atuahene-Gima, 1995), there is however a lack of consensuses among researchers. For instance while some scholars (e.g. Pulendran et al., 2000) found the role of market turbulence influential, other scholars (e.g. Slater and Narver, 1994a, Jaworski and Kohli, 1993) did not find any critical role for it. This dimension has not yet been empirically examined with consideration of R&P dimensions.

In responsive market orientation behaviour, a firm endeavours to realise and meet the expressed needs of customers (Narver et al., 2004). When the customer sets and/or their preferences are highly volatile, a firm's offering may not fulfil customer expectations over a period of time (Kohli and Jaworski, 1990). Thus, there is a need for organisations to accumulate knowledge about the customers' preferences to effectively develop a product (Hunt and Morgan, 1995) and consequently satisfy articulated customer needs because the more the "voice" of potential customers is assimilated into organisation, the higher the performance of a business can be expected (Day, 1994). Therefore, in high market turbulence environment companies may have greater opportunities to exceed end consumer satisfaction by employing market intelligence on existing customer's requirements through product innovation process. In turn this may lead to more importance of a responsive market orientation. Based on the above arguments, one can expect:

H_5: The relationship between responsive market orientation and a) General performance, b) Agility performance is tending to increase as the market turbulence increases.

On the other hand, in proactive market orientation a business puts in efforts to expose and satisfy the latent needs of customers (Narver et al., 2004). Thus, highly market turbulence may lead to reduction in the importance of a proactive market orientation due to the large number of potential existing customer needs. Therefore, the next hypothesis is formulated as:

H_6: The relationship between proactive market orientation and a) General performance, b) Agility performance is tending to decrease as the market turbulence increases.

3.3.2. Supplier Involvement and API Performance

3.3.2.1. The impact of Supplier involvement on API performance

Previous studies (e.g. Carr and Kaynak, 2007, Cousins et al., 2011) claims that early and close relationship with supplier may be critical for a company in product innovation. While the review of literature shows that most studies, whether result in positive or negative conclusion regarding suppliers' impact, hypothesise a positive impact from suppliers on firms' performance, a lack of consistency in results and consensus on the subject among scholars becomes more prevalent.

A number of studies have found positive impact of supplier involvement on turnover (Faems et al., 2005), product innovativeness (e.g. Nieto and Santamaria, 2007), and other key performance criteria such as product costs and quality, and faster time to market (Ragatz et al., 1997, Clark and Fujimoto, 1991). In terms of causes of positive impacts from suppliers involvement studies refer to a number of factors. Lau et al. (2010) attribute it to information sharing with suppliers, while Song and Benedetto (2008) relate involving suppliers into the design stage with decrease in the possibilities of design errors, as well as benefits at testing and prototyping phases by sharing technical information in early stages. According to Cousins et al. (2011) involving supplier's engineers and technical staff in product development phase can lead to better decision making and problem solving at an earlier stage of development process, which this in turn as suggested by Nijssen et al. (1995) can possibly decrease cycle time associated with product development. There are however others who have approached cautiously to agree with such results (Sanchez and Pérez, 2003, Freel, 2003, Belderbos et al., 2004). Typical arguments from sceptic views include possibility of increase in development time (Zirger and Hartley, 1994), or considerable and development costs due to the need of greater coordination (Ittner and Larcker, 1997).

Based on the above discussion this study follows the general literature to consider a positive impact from supplier involvement on both general and agility performance. By improving a) product innovativeness (e.g. Nieto and Santamaria, 2007), b) enhancing product quality c) decreasing development cost, d) eliminating technical changes (Bonaccorsi and Lipparini, 1994, Monczka et al., 2000) and e) reducing cycle time of product development (Nijssen et al., 1995), supplier involvement may have positive impact on API performance (general and agility). Thus, building on the earlier studies, the following hypothesis is formulated:

H_7: The greater the supplier involvement in product innovation process the better a) the General performance, and b) the Agility performance will be.[4]

3.3.2.2. The impact of Innovation Life Cycle on the Relationship between Supplier Involvement and API Performance

Innovation life cycle is another factor proposed in this study which may impact on the relationship between supplier involvement and API performance. As mentioned in the literature review chapter, Abernathy and Utterback (1978) describe the pattern of industrial innovation in terms of three phases: the fluid stage, the transitional phase, and the specific phase. Based on the study of innovation life-cycle by Johnsen et al. (2006) this study considers the characteristics of different stages of ILC as follows:

In the fluid phase the intensity of innovation is high and firms in this phase mostly developing highly customised products for a target niche markets and a small group of customers (Powell and Moris, 2004). In the transitional phase product differentiation becomes important along with the emergence of stable dominant design (Johnsen et al., 2006). Finally in the mature phase, innovation aims at new processes in which volume and cost are key drivers. In this phase, process changes and disruptive new technologies are costly, ultimately causing the pace of change to slow (Powell and Moris, 2004).

To date only one study considered the position of supplier involvement in innovation life cycle which has potential limitations due to the small sample study. In a study of twelve UK-based healthcare organisations, Johnsen et al. (2006) discussed lack of positioning the

[4] A linear relationship between supplier involvement and API performance is hypothesised in this study considering the new adopted theoretical perspective (i.e. agility performance). However, since a few prior studies have found the curvilinear relationships between supplier involvement and performance (e.g. Das et al., 2006) the existence of such a relationship will be also examined later in the result chapter.

supplier involvement process on the innovation life cycle (ILC) in most supplier involvement models. They examined the potential variation in customer-supplier interaction through different stages of the innovation life cycle, since understanding of the position of supplier involvement in ILC may be essential to find out the level of supplier involvement required for a particular technology or product application.

Since there is a lack of proper empirical studies in the pertinent literature regarding the impact of innovation life cycle on the relationship between SI and API, following Johnsen et al. (2006), this study employs the theory of innovation life cycle (Utterback, 1994, Tidd et al., 2005, Abernathy and Utterback, 1978) to further investigate the impact of supplier involvement on API performance in different stages of innovation life cycle. While Johnsen et al. (2006) claimed that "*supplier and customer relationships may be less important factors in the innovation process in fluid and emerging contexts than in mature and specific contexts*" (Johnsen et al., 2006, p. 676), this research tends to envisage that there may be a positive influence from supplier involvement on API performance at all stages of innovation life cycle. The rationale behind this view is rooted in the concept of "open innovation" (Chesbrough, 2003, Chesbrough et al., 2006) which emphasises on networking and collaborative approaches throughout the innovation process. For instance, in terms of technological collaboration, Nieto and Santamaria (2007) asserted that continuity and diversity of different partners will impact positively on product innovation process. Collaboration with suppliers may offer valuable solutions to problems related to possible lack of resources and capabilities within a firm which are required to implement successful innovation process (Nieto and Santamaria, 2007, Belderbos et al., 2004); resulting the enhanced agile product innovation performance (general and agility) in all three stages of innovation lifecycle. This line of reasoning leads to the next set of research hypotheses:

H_8: The supplier involvement has a positive impact on a) General performance, and b) Agility performance in Emerging phase of innovation life cycle.

H_9: The supplier involvement has a positive impact on a) General performance, and b) Agility performance in Growth phase of innovation life cycle

H_{10}: The supplier involvement has a positive impact on a) General performance, and b) Agility performance in Mature phase of innovation life cycle

3.3.2.3. The moderating Impact of Technological Turbulence on the Relationship between Supplier Involvement and API Performance

As discussed in the literature review chapter, while lack of consensus exist in the literature and also very limited number of studies (e.g. Ragatz et al., 2002) addressed the moderating role of technological turbulence, however, its direct and indirect impact on new product development process has been addressed to some degrees. Technology change leads to specific investments and supplier alliances which in turn enables firm to implement an effective approach to producing innovative products equipped with the technologies required by the market (Lee et al., 2009). In other words, technological turbulence can result in closer relationships with main suppliers and consequently improve a firm's performance through early involvement in product development process (Wasti and Liker, 1997). Although, few earlier studies (e.g. Primo and Amundson, 2002) claimed that high technological turbulence/uncertainty condition may lead to hindrance in the product innovation and development process, this study would expect that when business is surrounded by rapid and unforeseen technological changes, greater opportunities for innovative companies may occur to improve product innovation process by taking advantages from employing supplier technical capabilities/knowledge in product innovation process (i.e. product design). Based on the above arguments, one can expect:

H_{11}: At a greater level of technological turbulence, the positive impact of supplier involvement on a) General performance, and b) Agility performance will increase

3.3.3. Absorptive Capacity and API Performance

3.3.3.1. The impact of Absorptive Capacity on API Performance

As discussed earlier in the literature review chapter, absorptive capacity is defined as the ability of firm to obtain, assimilate, and utilise external knowledge for its commercial ends (Cohen and Levinthal, 1990, Zahra and George, 2002). With regards to this definition, the main principle of absorptive capacity is the emphasis on external knowledge and information (e.g. Lichtenthaler and Lichtenthaler, 2009, Cohen and Levinthal, 1990), while generally assume that internal knowledge and information are adequately recognised and utilised (Tu et al., 2006). Tu *et al* (2006) and Rothaermel and Alexandre (2009) however suggest that any view of absorptive capacity of firms should also contain an ability of firms to develop knowledge internally. This in practice means a need for organisational mechanisms that lay on both internal and external knowledge, information and technology. Tu et al. (2006, p. 694) addressed this and suggested a more comprehensive definition for absorptive capacity (AC) as "*the organisational mechanisms that help to identify, communicate, and assimilate relevant external and internal knowledge. The elements of absorptive capacity are considered to be the firm's existing knowledge base, the effectiveness of systems that scan the environment, and the efficacy of the firm's communication processes*".

This study employed the definition of absorptive capacity introduced by Tu et al. (2006) in order to build up the related hypothesis. By considering both internal and external pertinent knowledge and technology, absorptive capacity allows a firm to predict more accurately the nature and commercial potential of technological advances that have potential impact on the firm's innovative performance (Cohen and Levinthal, 1990). Hence, it would be expected that greater absorptive capacity, which provides more effective organisational mechanisms to identify, communicate, and assimilate relevant external and internal knowledge, would lead to more effective product innovation process. AC may also be considered as a pivotal foundation of agility for companies. Creating new knowledge and integrating the knowledge with the existing capabilities through having flexibility within the firm's activities are of vital factors that can elevate "agility" and "speed to innovation" capabilities required for confronting with environmental changes (Gilbert and Cordey-Harves, 1996). "*Agile organisations are knowledge intensive organisations and are characterised because intellectual capital is the main factor of production and because they innovate in response to changing environments*" (Pérez-Bustamante, 1999, p.7). To achieve dynamic and agile capabilities, firms require the ability to assimilate and reconfigure internal and external competencies to deal with environmental uncertainties. This is in line with the concept and definition of absorptive capacity introduced by Tu et al. (2006). Hence, the following hypothesis is formulated:

H_{12}: the greater the absorptive capacity of the firm, the greater the a) General performance, b) Agility performance [5]

[5] A linear relationship between absorptive capacity and API performance is hypothesised in this study considering the new adopted theoretical perspective. However, since a few prior studies have found the curvilinear associations between absorptive capacity and product performance (Stock, et al., 2001) the existence of such a relationship will be tested later in the result chapter.

3.3.3.2. The moderating Impact of Absorptive Capacity on the Relationship between Supplier Involvement and API Performance

The review of relevant literature shows that no study, to date, has involved the role of absorptive capacity, as an internal capability/competence, to influence the relationship between supplier involvement and firm's performance and innovation capability. This factor becomes critical to this field of study, as theoretically discussed before, to support that capability to innovate (in an agile manner) should be a main concern which may be impacted by absorptive capacity directly and indirectly while suppliers are involved in product innovation project. It is also argued that a firms' absorptive capacity is not just a goal, but it moderates some organisation outcomes as well (Fosfuri and Tribó, 2008). In fact, absorptive capacity is increasingly regarded as a moderator- a key explanatory factor for contingent relationship in recent studies (e.g. Rothaermel and Alexandre, 2009, Tsai, 2009). Some evidence has been identified in the literature regarding the potential association between absorptive capacity and collaborative networks (Tsai, 2009) in which internal and external collaboration are considered as complementary factor for the concept of absorptive capacity (Cohen and Levinthal, 1990). Kim and Song (2007) discussed that absorptive capacity might be able to help organisations to generate new technology through collaborative activities with other firms. Firms with a greater absorptive capacity can employ knowledge and capability of suppliers into their product development process (Cohen and Levinthal, 1990).

In other words, inter-firm new product development partnerships with enhanced absorptive capacity as a dynamic capability will result in a superior product success and advanced product commercialisation (Ettlie and Pavlou, 2006). Consequently, these benefits and advantages can assure greater economic returns for such companies (Langerak et al., 2004). On the other hand with lower absorptive capacity there is a limited transfer of learning from suppliers to a firm (Szulanski, 1996), as there is only minimal skill and expertise with regard to the goods being sourced (Azadegan and Dooley, 2010). Furthermore, a firm with low absorptive capacity not only may find it very difficult to recognise the value of new ideas generated from close relationship with its suppliers, but may lack adequate ability to assimilate ideas into product innovation (Tsai, 2009). In this scenario, close relationship with suppliers may waste time and money and consequently hamper new product performance (Tsai, 2009).

Absorptive capacity can also be instrumental in smoothing the progress of innovation activities by acting as a conduit of transferring knowledge among different organisational units (Tsai, 2001). Inter-firm new product development partnership with the ability of learning better and faster (superior absorptive capacity) may therefore lead to superior functional competencies (Ettlie and Pavlou, 2006). Considering the definition of absorptive capacity adopted above it can be concluded that firms with a greater level of absorptive capacity can provide stronger organisational mechanisms in terms of recognising, communicating and assimilating relevant external and internal knowledge which would allow them to have well shaped communication with their main suppliers through knowledge exchange process. This communication process, in turn, may inspire new ideas for product designs and consequently may assist companies to integrate these new ideas into their product innovation process (Tsai, 2009). Therefore, it may facilitate a firm to gain valuable competitive advantages through strengthening its agility capabilities such as introducing new products in terms of being first-to market, faster new product development, and the level of newness of firm's new products.

It would be, therefore, expected that absorptive capacity can moderate the relationship between supplier involvement and API performance (general and agility), in which the higher absorptive capacity, the stronger the relationship between the API performance and supplier involvement. This leads to the next research hypothesis:

H_{13}: At a greater level of AC of the firm, the positive impact of supplier involvement on a) General performance, and b) Agility performance will increase.

3.4. Chapter summary

The first section of this chapter was focused on developing the research conceptual framework. The research conceptual model was originated by hiring the agility concept from the agile supply chain framework (Sharifi et al., 2006, Sharifi et al., 2009). Based on the review of relevant literature (Chapter 2), this framework was comprised by some influential factors (i.e. market orientation dimensions, supplier involvement, absorptive capacity, innovation life cycle, and environmental turbulence factors) which may impact on the dimensions of agile product innovation performance. Furthermore, Section 3.2.2 introduced the proposed dimensions for agile product innovation performance namely as general and agility.

Finally, Section 3.3 was dedicated to develop research hypotheses through explaining some evidences from the pertinent literature for each influential factor which proposed (e.g. supplier involvement) to impact on agile product innovation performance.

Chapter 4: Research Methodology

4.1. Introduction

The main goal of this chapter is to describe the research method used in this study. This chapter starts with some explanation on the epistemological perspective employed in this research. Then, the quantitative approach adopted in the study is explained followed by comprehensive description on the survey method containing information on the online survey application, sample, and key informants of the study.

Next, the measurements adopted for each research construct are well described including related references and items. The chapter then focuses on the process of questionnaire development and pre-testing followed by presenting some information on data collection procedure. Finally the chapter finishes with some explanations on response rate and respondent sample demographics such as firms' number of employees, age, industry group, and turnover.

4.2. Epistemological Stance

Social science is the study of human aspects and requires critical and detailed analysis of social phenomenon (Babbie, 2001). There are two perspectives of the study of social science. Antonio Gramsci argued in his writings of the Prison Notebooks (1929 – 1935) that social science is a matter of renovating and criticising thought and everyday life. He believed that "*If [one is] not able to understand real individuals, [one is] not able to understand what is universal and general*" (Harman, 1965) (as cited in Prison Notebooks). This is in contrast with the ideas of Mills who believes that people learn through experiences and that one can truly understand those around him through putting himself in the same situation (Philips, 1974). These perspectives breakdown into three main areas namely positivism, subjectivism and constructivism (Kumar, 2005). The positivist outlook believes that empirical observation and scientific methods can help derive factual accounts or help attain true knowledge (Blaikie, 2000). This outlook sustains the fact that social sciences can be considered a science as it looks into statistical calculations to justify reliability, validity and most importantly objectivity.

Another area of social science is subjectivism which is a belief that knowledge of society is subjective. Subjectivism is the school of thought that greatly depends on interpretation of information (Zanotti, 2007). In the case of Smith and Ricardo, who are positivist economists, subjectivism sees the value of an object rather than the person who views it. This theory was implemented in the 19th century to cover for the shortcomings of classical economists. The Austrian school of thought believed that the Labour Theory of Value does not follow through (www.Economicexpert.com) and sees the relevance of 'the inner workings of societal process of production' which determines what is to be produced, how much to produce and for whom these goods should be produced for. This theory is also based on Mills Bureaucratic Ethos which explains the Weberian concern of the bureaucratization of the society. Research in this sense would be more problem solving and administrative.

The last school of thought is constructivism which believes that knowledge and meaningful reality is constructed through interaction between people and between people and the material world (McLean, 1999). Constructivism deals with the creation of knowledge more than the reproduction of knowledge:

> *"We don't describe the world we see; we see the world we can describe."* (McLean, 1999)

This school of thought further emphasises that it is adequate to prove that social science can be used to describe academic research.

Based on these perspectives, epistemological positions are embedded in the study of social science. Easterby-Smith et al. (2008, p. 21) described the three major reasons of epistemology understanding importance as follows: "*Firstly, it could make research design clearly. Secondly, the researcher could understand what designs will work and what will not. Finally, it may also help the researcher to adapt research designs according to the constraint of different subject or knowledge structures*". Johnson and Duberley (2000) also suggest that epistemology can help researchers to perceive the implications of their own assumptions in their particular research areas. Epistemology is derived from the Greek words "episteme" which means knowledge and "logos" which means reason. Epistemology is concerned as "*the possible ways of gaining knowledge of social world, whatever it is understood to be. In short, claims about how what is assumed to exist can be known*" (Blaikie, 2000, p. 8). In other words, epistemology emphasis on what can be regarded as the valid knowledge (Walliman,

2006) and how it can be achieved (Snape and Spencer, 2003). The term of epistemology is therefore interpreted as the "study of knowledge" containing three main questions: "*how do we know*?"; "*what is the nature of knowledge?*"; "*what are the limits of knowledge?*". While several epistemological approaches are suggested in the literature to address these questions, including positivism', 'interpretive humanism', 'realism', 'empiricism', 'action', 'critical social science', and 'postmodernism' (Easterby-Smith et al., 2008, Sayer, 1992, Sayer, 2000), the positivism and interpretive humanism with two different perspectives are the most cited in social researches (Neuman, 2006, Neuman, 2010).

McLean (1999) believes that as the social world subsists objectively outside of the researcher's subjectivity, positivism epistemological assumption would be the knowledge which only reachable through experience. The pivotal focus of the positivist approach is the consideration of legitimate knowledge as the product of authentic experience (Caldwell, 1994), in which, social phenomena that cannot be captured directly, are observed through scientific procedures such as experiments, attitudinal scales and social surveys (McLean, 1999). The positivist school of thought is relied on the illustration of human behaviour in terms of causality through abridging phenomena and examining hypotheses (Gray, 2009). In addition, researchers may reiterate the experiences and also examine the theories behind the knowledge in order to assess the validity of the knowledge (Gray, 2009).

Interpretive humanists however deny the validity of empiricism as a source of knowledge with regards to the social world (McLean, 1999). In contrast to the positivism epistemological principle, the interpretivist approach suggests a meaningful explanation of social phenomena in natural settings (Neuman, 2010). McLean (1999) also discussed that in interpretive humanists approach the subjectivity of researcher is impacted by their own research. He argued that valid knowledge is derived from the construction of interpretive understandings of the meaning of social interaction for its participants.

This study employed the positivist approach which is broadly used in the social science research (Neuman, 2010). In this epistemological approach, a researcher is enabled to summarise an accumulation of contributory explanations and laws that can further explain a consistent pattern existing in the social world (Neuman, 2010, Easterby-Smith et al., 2008). While, a positivism perception envisages the irregularity of social reality over a period of time, the operationalisation of the concepts facilitates a researcher to quantify a research's facts (Easterby-Smith et al., 2008). To quantify the accumulated research's facts, generating the conceptualised propositions and/or hypotheses is required (Brannick and Coghlan, 2007). These hypotheses and propositions then are examined through conducting empirical observations. The quantifiable nature of empirical examinations is a valuable advantage of positivism approach which potentially reduces a concern regarding the validity and reliability of the measurements in a model study.

In this study, following the main principles of positivism approach, a set of hypotheses were first conceptualised (see Chapter 3), and then were tested by surveyed empirical data (see Chapter 5). It has to be noted that a great effort has been made to assess the dimensionality, validity, and reliability of measurement scales in the study model.

4.3. Research Methodology

Considering the nature of research aims, this study adopted quantitative survey approach to comprehensively address the research objectives and questions outlined in Section 1.3 and Section 1.4 respectively. Quantitative approach considers the researcher's viewpoints "... *in which the investigator primarily uses post-positivist claims for developing knowledge (i.e. cause and effect thinking, reduction to specific variables and hypotheses and questions, use of measurement and observation, and the test of theories) employs strategies of inquiry such as experiments and surveys, and collect data on predetermined instruments that yield statistical data*" (Creswell, 2003, p. 18). The attributes of quantitative research are summarised as '*seeking the facts/causes of social phenomena*', '*objective*', '*verification oriented*', '*reductionist*', '*hypothetico-deductive*', '*outcome oriented*', '*reliable*', and '*generalisable*' (Oakley, 1999, p. 156).

The aim of quantitative research is theory testing (Creswell, 2003) while it envisages social world as objective (Burrell and Morgan, 1979), wherein, investigating and addressing the existing causal relationships is the most appropriate possible approach to identify potential problems or phenomenon under study (Pugh and Hickson, 1976). Since the main goal of this research is to further investigating the associations between agile product innovation performance and three key influential factors (market orientation, absorptive capacity, and supplier involvement) under potential effect of some moderating elements (technological turbulence, competitive intensity, market turbulence, and innovation life-cycle), quantitative approach is deemed to be the most appropriate way to address research's objectives. Therefore, to test the developed hypotheses in Section 3.3, the field study in this research was administered through web-based questionnaire survey[6] method which is argued as one of the most appropriate method to collect data (Desai and Potter, 2006, Baruch and Holtom, 2008). The online survey method enables this research to build a considerably large firm level database through which the relationships between agile product innovation performance and potential influential factors can be tested. In this method respondents are invited by email or phone call to participate in the survey through visiting a provided website. The review of the relevant literature (e.g. Dillman, 2007, Griffis et al., 2003, Cobanoglu, 2001) shows that employing this method can offer valuable benefits and advantages to this study such as expediting response process, enhancing data quality, decreasing the administrative cost, and also increasing response rate in comparison with other survey methods such as mail and fax survey.

4.4. Sample and Key Informants

In line with key studies (e.g. Harris, 2001, Littler et al., 1995, Frenz and Ietto-Gillies, 2009, Love and Roper, 2004) in the product innovation subject the study population was selected to be manufacturing companies located in the UK as a region characterised by a mature economy for which a sample of 2000 organisations was drawn from the FAME database (accessed between June and July 2010: www.liv.ac.uk/library).

The FAME database contains descriptive data on over a quarter of a million major private and public UK firms and has been employed commonly in previous studies in the UK (e.g. Harris, 2001, Pitt et al., 1996). As mentioned above, a sample of 2000 units was chosen by systematic random selection procedure based on several criteria, such as:

- Independency: firms which have no holding company and no subsidiaries
- Turnover: over £500,000
- Date of registration: over five years
- Number of employees: over 25

[6] The access link to the web-base questionnaire was email to potential participants (see Section 4.7).

Following previous studies (e.g. Harris, 2001), these criteria were used to guarantee that only appropriately-sized firms with an established culture were considered.

However, the initial selected list contained several errors namely as: few chosen firms were no longer in business market; the essential details of some firms (i.e. name and telephone numbers) were not provided correctly; and some of the firms were not manufacturers. Therefore, a considerable amount of time was spent to purify the initial list. For instance details of the top 1000 firms (sorted by turn over) in the list was checked thorough their provided website before initial contact by phone or email. As a result, the total number of selected firms in the list was decreased to 1200.

Since an appropriate archival data on organisation or relationship level constructs of interest does not generally exist, the majority of studies on inter-organisational relationships are built and focused on the responses of key informants (Kumar et al., 1993). To reduce problems associated with response error and perceptual agreement, this study followed the lead of Kumar et al. (1993) in identifying key informants. Thus, a single informant was targeted within each manufacturing firm included in the sample and served as the sole respondent for each firm that participated in this study.

Since the focus of the study was on product innovation performance and its relationship with other influential factors such as market orientation, absorptive capacity, and supplier involvement, key informants were required to have a good insight into these factors. Therefore, due to the information requirements of this study, the person in charge of product development and/or innovation process with a good level of general knowledge regarding the firm's business environment (e.g. vice president, product manager, director of new product development) were deemed to be most appropriate informant to complete the questionnaire.

4.5. Measurement

In this section, the measures used for the research constructs are explained. This research undertook an in-depth review of the literature on product innovation, market orientation, absorptive capacity, supplier involvement, environmental turbulence factors, and innovation life cycle to identify potential measurements scales. Since measurement scales for the constructs employed in this study were widely exposed in the pertinent literature, a selection of existing measures was adapted to achieve the research objective. Employing existing measures significantly reduces concerns regarding validity and reliability of the constructs. It has to be noted that all the variables in this research were set to be measured with reflective scales, along the lines of their original conceptualisation (Diamantopoulos and Siguaw, 2006, Diamantopoulos and Winklhofer, 2001). Table 4.1 illustrates the details of the operationalisation of the research constructs (i.e. items, references, codes)[7].

Table 4. 1: Research Constructs

Constructs	Indicators	Codes
General Performance (Langerak et al., 2004)	Has met sales growth goals.	GP1
	Has met market share goals.	GP2
	Return on investment.	GP3
	Customer acceptance and satisfaction.	GP4
	Development costs.	GP5
Agility Performance (Langerak et al., 2004, Prajogo and Ahmed, 2006)	The level of newness (novelty) of our firm's new products.	Agil1
	The speed of our new product development.	Agil2
	The number of our new products that is first-to-market (early market entrants).	Agil3
	The number of new products our firm has introduced to the market.	Agil4
	Time-to-market.	Agil5
Absorptive Capacity (Tu et al., 2006)	The general knowledge and education level of our first-line workers is high.	AC1
	The knowledge of our managers is adequate when making business decisions.	AC2
	The communications between people at various levels is extensive.	AC3
	The communication of new ideas between departments is extensive.	AC4
	Our employees tend to trust and support the organisation and each other.	AC5
	We seek to learn from many sources such as routine search, benchmarking, customers and suppliers, R&D.	AC6
Supplier Involvement (Primo and Amundson, 2002, Song and Benedetto, 2008)	Our suppliers are active in the product development (PD) process & provide input into the PD project.	SI1
	Communications with suppliers on quality considerations and design issues and changes are close.	SI2
	Our company strives to establish long-term relationships with suppliers, and help them in their progress and development.	SI3

[7] The study's questionnaire can be found in the appendix.

	Our company has attempted involving its main suppliers in product innovation through co-investment programmes.	SI4
	Involving in Product design.	SI5
	Involving in prototyping & production.	SI6
	Involving in Product commercialization.	SI7
Responsive Market Orientation (Atuahene-Gima et al., 2005, Narver et al., 2004)	Our strategy for competitive advantage is based on our understanding of customers' needs.	RMO1
	We freely communicate information about our successful and unsuccessful customer experiences across all business functions.	RMO2
	We constantly monitor our level of commitment and orientation to serving customer needs.	RMO3
	We measure customer satisfaction systematically and frequently.	RMO4
	We are more customer-focused than our competitors.	RMO5
Proactive Market Orientation (Atuahene-Gima et al., 2005, Narver et al., 2004)	We continuously try to discover additional needs of our customers of which they are unaware.	PMO1
	We incorporate solutions to unarticulated customer needs in our new products.	PMO2
	We innovate even at the risk of making our own products obsolete.	PMO3
	We search for opportunities in areas where customers have a difficult time expressing their needs.	PMO4
	We work closely with lead users who try to recognize customer needs months or even years before the majority of the market may recognize them.	PMO5
Market Turbulence (Jaworski and Kohli, 1993)	In our kind of business, customers' product preferences change quite a bit over time.	MT1
	Our customers tend to look for new product all the time.	MT2
	We are witnessing demand for our products and services from customers who never bought them before.	MT3
	New customers tend to have product-related needs that are different from those of our existing customers.	MT4
	Our customer base and their demand do not change frequently.	MT5A
Competitive Intensity (Jaworski and Kohli, 1993)	Competition in our industry is fierce.	CI1
	There are many "promotion wars" in our industry.	CI2
	Anything that one competitor can offer, others can match readily.	CI3
	Price competition is a hallmark of our industry.	CI4
	New competitive moves occur very often in this industry.	CI5
Technological Turbulence (Jaworski and Kohli, 1993)	The technology in our industry is changing rapidly.	TT1
	Technological changes provide big opportunities in our industry.	TT2
	Due to rapid changes it is very difficult to forecast where the technology in our industry will be in the next 2 to 3 years.	TT3

	A large number of new product ideas have been made possible through technological breakthroughs in our industry.	TT4
	Technological developments in our industry are rather minor.	TT5A
Innovation Life-Cycle (Johnsen et al., 2006)	Emerging phase: Radical product innovation under high technological uncertainty; Diverse and often customized production plan.	ILC1
	Growth phase: Increasing process innovation; illustrated by emergence of a stable dominant design.	ILC2
	Mature phase: Process innovation and/or incremental product innovation; undifferentiated, standardized products.	ILC3

Note: References are in parentheses

4.5.1. General Performance

In this study general performance (GP) is referred to the extent to which a company achieved its goals for sales growth, market share, return on investment, customer satisfaction and development costs for its new product (Langerak et al., 2004). The scales of general performance were adopted from the study of Langerak et al. (2004) and Griffin and Page (1996). Langerak et al. (2004) refined 17 items in five subscales which reflect the dimensions of market level, financial output, customer acceptance, product level, and timing measures of new product success. Following Langerak et al. (2004), a seven-point Likert-type measurement scales was employed ranging from "very poor (= 1)" to "very good (= 7)" to assess the general performance in which respondents were asked to indicate: How well their organisation met the following goals for its new product:

- Sales growth goals.
- Market share goals.
- Return on investment.
- Customer acceptance and satisfaction.
- Development costs.

The Cronbach's Alpha for this scale was 0.87[8].

[8] The Cronbach's Alpha was calculated using SPSS and it should be greater that the cut-off point 0.5 suggested by Pallant (2007) to reduce concern regarding the reliability issue of employed items. For further information on reliability and validity of measurement items see Section 5.5.3.

4.5.2. Agility Performance

As theoretically explained in Section 3.2.1, agility, as an externally focused capability, is the result of development of internal capabilities and competencies. Considering the research focus on product innovation capability of the firm such capabilities can reflected in the performance of the firm in being innovative in its products and introducing new products to the market. This means to measure performance of the firm for newness/novelty of new products (to response to competitors or be proactively first to market), and how quick they are in turning innovation into product. To measure these features this study used one refined and proposed by Prajogo and Ahmed (2006). The proposed construct by Prajogo and Ahmed (2006) called "product innovation performance" is based on several criteria namely as the number of innovations, the speed of innovation, the level of innovativeness (novelty or newness of the technological aspect), and being the 'first' in the market. These criteria are in line with the agility concept which mainly focuses on being more responsive, flexible, and proactive- rather that reactive- (Ismail and Sharifi, 2006, Power et al., 2001). Hence, a five-item scale was employed to measure agility performance (AP) by using a seven-point Likert scoring format, where the respondents were asked to evaluate the agility performance of the firms against their major competitors in the industry: "How well your organisation performs relative to the major competitors in terms of":

- The level of newness (novelty) of our firm's new products.
- The speed of our new product development.
- The number of our new products that is first-to-market (early market entrants).
- The number of new products our firm has introduced to the market.
- Time-to-market.

The Cronbach's Alpha for this scale was 0.78.

4.5.3. Absorptive Capacity

Absorptive capacity (AC) refers as "*the organisational mechanisms that help to identify, communicate, and assimilate relevant external and internal knowledge. The elements of* *absorptive capacity are considered to be the firm's existing knowledge base, the effectiveness of systems that scan the environment, and the efficacy of the firm's communication processes*" (Tu et al., 2006, p. 694). Absorptive capacity was measured by the scales developed and refined by Tu et al. (2006). In their study absorptive capacity was considered as a multidimensional construct where its measurement scales are categorised into six main aspects: Worker knowledge, Manager Knowledge, Communications Network, Communications Climate, and Knowledge Scanning. A six-item scale of absorptive capacity in this research therefore was adopted from the aforementioned categories whereas a seven scoring format were used, ranging from 1 = fully disagree to 7 = fully agree. To evaluate the level of a firm's AC, respondents were asked to indicate: the extent to which they agree or disagree with the following statements:

- The general knowledge and education level of our first-line workers is high.
- The knowledge of our managers is adequate when making business decisions.
- The communications between people at various levels is extensive.
- The communication of new ideas between departments is extensive.
- Our employees tend to trust and support the organisation and each other.
- We seek to learn from many sources such as routine search, benchmarking, customers and suppliers, R&D.

The Cronbach's Alpha for this scale was 0.87.

4.5.4. Supplier Involvement

Supplier involvement was measured on a seven-item scale adapted from Primo and Amundson (2002) and Song and Benedetto (2008). While these scales assess the extent to which a firm involves its main suppliers in new product development, they also measure the level of communication between main suppliers and a product development team in companies (SI1-SI4, adopted form Primo and Primo and Amundson (2002)). Furthermore, they evaluate to what extent key suppliers are involved in the three predefined stages of product development: product design, prototyping and production, and product commercialisation (SI5- SI7, adopted from Song and Benedetto (2008)). Consistent with

Primo and Amundson (2002) and Song and Benedetto (2008), a 7-point Likert scoring format was used in these scales to measure items (Question SI1 to SI4: 1 = fully disagree; 7 = fully agree; Questions SI5 to SI7: 1 = no involvement to 7 = extensive involvement). Firstly respondents were asked to show the extent to which they agree or disagree with the following statements:

- Our suppliers are active in the product development (PD) process & provide input into the PD project.
- Communications with suppliers on quality considerations and design issues and changes are close.
- Our company strives to establish long-term relationships with suppliers, and help them in their progress and development.
- Our company has attempted involving its main suppliers in product innovation through co-investment programmes.

And secondly they were asked to indicate to what extent did they involve main suppliers in the following stages of development of this product?

- Involving in Product design.
- Involving in prototyping & production.
- Involving in Product commercialization.

The Cronbach's Alpha for this scale was 0.88.

4.5.5. Responsive Market Orientation

Responsive market orientation (RMO) describes skills and routines to create, spread and employ market intelligence concerning existing customer's requirements in the market (Tsai et al., 2008, Narver et al., 2004, Atuahene-Gima et al., 2005). A five-item measurement scale for responsive market orientation were taken from the Narver et al. (2004) and Atuahene-Gima et al. (2005) contributions. On a 7-point scale (ranging from 1 "fully disagree" to 7 "fully agree"), respondents were asked to indicate the extent "to which they agree or disagree with the following statements:

- Our strategy for competitive advantage is based on our understanding of customers' needs.
- We freely communicate information about our successful and unsuccessful customer experiences across all business functions.
- We constantly monitor our level of commitment and orientation to serving customer needs.
- We measure customer satisfaction systematically and frequently.
- We are more customer-focused than our competitors.

The Cronbach's Alpha for this scale was 0.89.

4.5.6. Proactive Market Orientation

Proactive market orientation (PMO) is referred to the extent to which a firm attempts to understand and satisfy customers' latent needs (Atuahene-Gima et al., 2005). In this study PMO was measured using five items. Similar to responsive market orientation measurement scale, this scale was also adopted from studies of Narver et al. (2004) and Atuahene-Gima et al. (2005). On a 7-point Likert scale (ranging from 1 "fully disagree" to 7 "fully agree"), respondents were asked to indicate the extent to which they agree or disagree with the following statements:

- We continuously try to discover additional needs of our customers of which they are unaware.
- We incorporate solutions to unarticulated customer needs in our new products.
- We innovate even at the risk of making our own products obsolete.
- We search for opportunities in areas where customers have a difficult time expressing their needs.

- We work closely with lead users who try to recognize customer needs months or even years before the majority of the market may recognize them.

The Cronbach's Alpha for this scale was 0.91.

4.5.7. Environmental Turbulence Factors

Technological Turbulence, Competitive Intensity, and Market Turbulence were measured by using five items for each which have been used previously in several studies, including Tsai et al. (2008), Augusto and Coelho (2009), and Lichtenthaler (2009). Technological turbulence (TT) refers to the rate of technological change (Kohli and Jaworski, 1990). The technological turbulence scale items are adopted from Jaworski and Kohli (1993) and measure the extent to which technology in an industry was in a state of flux (Jaworski and Kohli, 1993). Employing a 7-point Likert scale (ranging from 1 "fully disagree" to 7 "fully agree"), informants were requested to point out the extent "to which they agree or disagree with the following statements:

- The technology in our industry is changing rapidly.
- Technological changes provide big opportunities in our industry.
- Due to rapid changes it is very difficult to forecast where the technology in our industry will be in the next 2 to 3 years.
- A large number of new product ideas have been made possible through technological breakthroughs in our industry.
- Technological developments in our industry are rather minor.

The Cronbach's Alpha for this scale was 0.84.

Competitive intensity refers to the level of competition faced by a firm (Jaworski and Kohli, 1993, Augusto and Coelho, 2009). Competitive intensity scale items are those adopted from Jaworski and Kohli (1993) and assess the behaviour, resources, and ability of competitors to differentiate. On a basis of a 7-point scale (ranging from 1 "fully disagree" to 7 "fully agree"), respondents were asked to designate the extent to which they agree or disagree with the following statements:

- Competition in our industry is fierce.
- There are many "promotion wars" in our industry.
- Anything that one competitor can offer others can match readily.
- Price competition is a hallmark of our industry.
- New competitive moves occur very often in this industry.

The Cronbach's Alpha for this scale was 0.88.

Market turbulence/uncertainty (MT) refers to the number of customers and the stability of their preferences (Subramanian and Gopalkrishna, 2001, Kohli and Jaworski, 1990). The items for the market turbulence scale were taken from Jaworski and Kohli (1993) to assess the extent to which the composition and preferences of an organisation's customers tended to change over time. To evaluate MT, on a 7-point Likert scale anchors from 1 "fully disagree" to 7 "fully agree", participants were asked to indicate the extent "to which they agree or disagree with the following statements:

- In our kind of business, customers' product preferences change quite a bit over time.
- Our customers tend to look for new product all the time.
- We are witnessing demand for our products and services from customers who never bought them before.
- New customers tend to have product-related needs that are different from those of our existing customers.
- Our customer base and their demand do not change frequently.

The Cronbach's Alpha for this scale was 0.85.

4.5.8. Innovation Life-Cycle

Abernathy and Utterback (1978) described the pattern of industrial innovation in terms of three phases: 'fluid phase' (emerging phase), 'Transitional phase' (growth phase), and 'specific phase' (mature phase). In the fluid phase the intensity of innovation is high and firms in this phase mostly developing highly customised products for a target niche markets and a small group of customers (Powell and Moris, 2004). In the transitional phase product differentiation becomes important along with the emergence of stable dominant design (Johnsen et al., 2006). Finally in the mature phase, innovation aims at new processes in which volume and cost are key drivers. In this phase, process changes and disruptive new technologies are costly, ultimately causing the pace of change to slow (Powell and Moris, 2004). Based on the characteristics of the ILC stages respondents were requested to acknowledge the innovation stage for the last designed product of their firms. Therefore the where asked to answer the following question:

"If your last designed product goes through a cycle of innovation, and defined to include stages such as emergence-growth-mature (as defined in the following) where do you consider your product to be?"

a) Emerging phase: Radical product innovation under high technological uncertainty; Diverse and often customized production plan.

b) Growth phase: Increasing process innovation; illustrated by emergence of a stable dominant design.

c) Mature phase: Process innovation and/or incremental product innovation; undifferentiated, standardized products.

4.5.9. Control Variables

The hypotheses developed in this research were controlled for a number of variables. To set factors as control variables that might influence the agile product innovation performance, several industry variables were considered from relevant literature. Age and size are used as control variables in this research which have been frequently employed in the pertinent literature. In particular a firm's size has been considered as an important control variable since according to Bonner and Walker (2004) signifies the potential level of a company's resources and is measured by the number of employees. Furthermore, a number of key suppliers are deemed to have potential impact on general and agility performance. Hence a single item variable was employed to control the effect of this factor. Also, difference in the number of products designed in the last five years of companies may have effects on the relationship between influential factors (e.g. supplier involvement and market orientation) and API; therefore, it was controlled as well.

4.6. Questionnaire Development Procedure

The questionnaire was developed in order to collect data about the relationship between agile product innovation and potential influential factors and it consists of 57 questions (see the Appendix). As mentioned earlier, all the measurements were developed in accordance with the extant literature. Several techniques were employed in the development of the instrument and particularly in the question formation process (Groves et al., 2004). First some non-sensitive questions on company profile (background) information were embedded in the beginning of the questionnaire. These questions were designed based on the self-typing paragraph approach (James and Hatten, 1995) in which respondents were asked to write their answers in provided spaces. The non-sensitive questions were followed by sensitive questions which were listed to cover all dependent (i.e. general and agility performance) and independent variables (i.e. supplier involvement, absorptive capacity, market orientation, innovation lifecycle, and environmental turbulence). A seven-Likert scale approach was employed to develop these questions (with the exception of innovation life cycle which was constructed by using a single "multiple choice" question) since it is easy for informants to respond (Malhotra and Birks, 2007). Furthermore, as suggested by Hair et al. (2010) multi-items scaled were used for sensitive questions to reduce concerns regarding the item response bias in which, the minimum of five items were used for each construct.

The questionnaire was run through a comprehensive assessment procedure to guarantee its efficiency and validity prior to being formally utilised in this study. First, it was reviewed by two professional colleagues who are well-experienced in quantitative research in order to evaluate the type, appearance and sequence of employed questions. Following the first step, the questionnaire survey was piloted through a face-to-face administration with five senior managers who spent at least 40 minutes to complete the questionnaire and commented on questions formation and context. To assess to what extent the questionnaire was interpreted, some cognitive questions were asked by interviewer such as "what do you think this question is addressing?".

Finally, the last version of the questionnaire was pre-tested by selected academics and research peers, and 15 PhD students. The main goal of pre-testing the questionnaire was to further evaluate its face validity (Creswell, 2003, Fink, 1995). The participants in the pilot-test of the questionnaire provided valuable feedbacks. While most comments and feedbacks were regarded to the covering letter, some criticised clarity of some of the questions. Therefore, based on the provided comments by the informants, the structure of the covering letter was modified and the problematic questions were rephrased. Furthermore, a technical trouble in the process of completing web-based questionnaire survey was also reported by four of the informants who encountered a problem to open the access link. This issue was solved prior to the official administration of the questionnaire survey.

4.7. Sampling and Data Collection Procedure

As explained above, the research questionnaire was designed in accordance with the extant literature and through a number of iterations. Following a pre-test of the questionnaire through consultation with a number of selected academics and research peers as well as a pilot study (15 cases), a sample of 1200 units was drawn from the FAME database of registered UK firms.

The survey was conducted over the internet by using web-based survey in June and July 2010. The on-line questionnaire survey was administrated using "Survey Monkey" software (www.surveymonkey.com). According to Ballard and Prine (2002) and Bandilla et al. (2003) employing the on-line survey questionnaire enhances the level of privacy and confidentiality a respondent had while participating in the study. Furthermore, the web-based questionnaire survey exploits computer technology to automate routing and tracking procedure in complex questionnaires and edit checks (Bandilla et al., 2003, Ballard and Prine, 2002). The "survey Monkey" software was particularly selected since it is very flexible and reliable which had enabled the user a range of personalisation including size, font, colour, etc. More importantly using this software allowed the researcher to identify informants along with the time they had spent to complete the online questionnaire.

To conduct the survey, first, senior managers were contacted by telephone and email to solicit participation and to recommend appropriate respondents to complete the research questionnaire. These initial contacts were also made to increase the research response rate as suggested in the relevant literature (Harvey, 1987, Church, 1993). Through this step, several senior managers however asked to be excused from responding to the questionnaire mainly due to their busy schedule at the time initial contacts were made.

As mentioned earlier, given that the survey was mainly concerned with product innovation process and firm's overall position, the questionnaire was addressed to the person in charge of product development and innovation process (e.g. vice president, product manager, director of new product development, and managing director) at each selected company. The initial contacts filtered the total number of potential companies down to 743 which agreed to collaborate in this study. In the next step, the invitation email was sent to mangers who verbally promised to participate in the survey. Following the procedure suggested by Dillman (2000), access to the survey was restricted by the invitation email to eliminate unwanted and irrelevant responses, for which all of the informants received a personalized email containing covering letter and the access link to the online survey (In some cases, due to the respondent's preference a hard copy of the questionnaire was posted). The covering letter contained some details regarding the goals, objectives, and scope of the study, and guaranteed the confidentially of information obtained from participants. To further encourage potential informants, those who were interested in receiving an executive summary were also asked to provide personal details regardless of whether or not they participated in the research. It has to be noted that an exclusive code was assigned for each informant (Dillman, 2000) in order to simplify the follow-up procedure.

As a result from the first wave 188 usable responses were received. To increase response rate follow up step was then taken. Reminder emails were sent after two weeks to those who did not respond and consequently an additional 45 usable responses were received.

4.8. Description of the Survey Responses

4.8.1. Response Rate

As described earlier, while the link to the online questionnaire was sent to 743 potential informants (persons in charge of product development and innovation process), in total 233 usable responses were received representing a response rate of 31.3 percent. It has to be noted that an initial number of responses was 257, however, 24 cases were discarded since they either had more than 15 percent missing values or diagnosed as outliers (see Section 5.2.1).

Given that the data were collected during the recent recession and financial crisis and more importantly considering the sensitive nature of some items used in the questionnaire and the portfolio of informants, the response rate of 31.3 % is reasonably high compared to similar studies in the context of product development and innovation (Tsai et al., 2008, Cousins et al., 2011, Petersen et al., 2005, Koufteros et al., 2007).

4.8.2. Respondent Sample Demographics

The preliminary analysis of the responses signified that participating firms span diversely across manufacturing sector industries which would enable the research for generalising the findings (Gatignon and Xuereb, 1997). Representations included from Electrical and Electronics, Automotive, Engineering and machinery equipment, Food, Aerospace, Plastic, Chemical, and Medical/pharmaceutical. In total, the sample represented eight industry groups with the largest number from the electrical and electronics companies (Table 4.2).

Table 4. 2: Industry Group

Industry Sector	Percentage
Electrical and Electronics	21.5 %
Automotive	15.9 %
Engineering and machinery equipment	13.7 %
Food	11.2 %
Aerospace	10.7 %
Plastic	9.9 %
Chemical	9.0 %
Medical/pharmaceutical	8.1 %

The firm's number of employees is categorised into five main groups: fewer than 100 employees; between 101 and 500 employees; between 501 and 1000 employees; between 1001 and 5000 employees; and finally more than 5000 employees. As can be seen in Table 4.3, while the majority of the participating companies (i.e. 58.5 %) in this research were small and medium sized which had fewer than 500 employees, 41.5 % were large-sized with a total number of employees more than 500.

Table 4. 3: Company's size

Number of Employees	Percentage
Less than 100	34.4 %
101-500	24.1 %
501-1000	16.7 %
1001-5000	13.6 %
More than 5000	11.2 %

In terms of firm's age, three groups were defined based on the collected data namely as: under 10; between 11 to 50; and 51 and over. Only 10.1 % of responding firms had been operating in the market less than 10 years. In contrast, the majority of participating firms (i.e. 61.2) had been operating in the market for 11 to 50 years. Finally, results indicate that the remainder responding firms, who had been active in market for more than 50 years, account for 28.7 % of the study sample size (Table 4.4).

Table 4. 4: Company's age

Number of Employees	Percentage
< 10 years old	10.1 %
11-50	61.2 %
> 51 years old	28.7 %

With regards to the participating firm's turnover, a total of 66.9% of the responding firms had a turnover of more than five million Pounds in 2010. Table 4.5 provides the distribution of the turnovers of the participating firms in this study.

Table 4. 5: Company's Turnover

Number of Employees	Percentage
Under £1 million	15.9 %
£1,000,001 - £5 million	17.2 %
£5,000,001 - £20 million	34.7 %
20,000,000 - £50 million	15.6 %
Over £50 million	16.6 %

4.9. Chapter summary

This chapter began with presenting some information on the epistemological perspective employed in this research. Then, the quantitative approach as the adopted research methodology in this study was explained in which online survey method was introduced as the main research instrument to collect data. In the next section, the sample of study, UK manufacturing companies, and key informants (i.e. person in charge of product development and innovation process) were described and the rationale behind selecting potential participants were explored in details.

The construct measurements were presented in the subsequent section which contains key information on dependent variables, independent variables, and control variables. The items and recourses employed for research's construct were also well presented. It has to be noted that all the items used in this research were adapted from the relevant literature to eliminate concerns regarding the reliability and validity of the constructs.

In the next section, the process of questionnaire development and pre-testing was described comprehensively. It was described that the questionnaire was gone through a comprehensive assessment procedure to guarantee its efficiency and validity prior to being formally utilised in this study. Then, the subsequent section described the data collection procedure. In this process, the link to the online questionnaire was sent to 743 potential informants and as a result 233 usable responses had been received. Finally this chapter finished with some explanations on response rate and respondent sample demographics such as firms' number of employees, age, industry group, and turnover.

Chapter 5: Data Analysis

5.1. Introduction

The purpose of this chapter is to present the result of statistical analysis. The data in this study were analysed by undertaking two main steps: a) Confirmatory Factor Analysis (CFA) and b) Hierarchical Regression and Group Analysis. The chapter begins by explaining preliminary concerns regarding the survey research such as outliers, normality, non-response bias and common method bias.

In the subsequent section the output of CFA using AMOS 18 is presented (first stage). CFA was used to assess the dimensionality, reliability, and validity of the scales. The measurement details including measurement loadings and cross loadings among research's items are also presented. These essential details and information were not only used to purify the research measurements, but also to improve the model fit indices. The information on how the measures were purified using path estimates, standardised residuals and modification indices are also well discussed. Based on the purified measurement, the fit indices of a new CFA model are comprehensively assessed and explained. Furthermore, Convergent Validity, Discriminant Validity, and Explanatory Factor Analysis are also employed to assess the validity of the research's measurement.

In the second step, the results of hypotheses testing are discussed in details using hierarchical regression and group analysis. Hierarchical regression adds controls, explanatory variables and interaction terms incrementally to gauge their relative contributions; hence it enables researcher to evaluate the overall model in terms of its ability to predict the dependent measures (Hair et al., 2010).

5.2. Data screening

Prior to the data analysis procedure, the research dataset must be evaluated in terms of outliers and normality as the critical preliminary tasks for employing multivariate data analysis (Hair et al., 2010). Furthermore, an appropriate approach should be also chosen to deal with missing values in the dataset to reduce concern regarding reliability and validity of the analysis in the study.

5.2.1. Outliers and Normality

Outliers are mostly raised from procedural errors (Hair et al., 2010) and they are defined as "*cases with values well above or well below the majority of other case*" (Pallant, 2007, p. 62) in the dataset. While outliers cannot be emphasised solely as cases that cause problems or in contrast as cases which bring benefits for the research (Churchill, 1999), they can be either kept or excluded from the dataset based on their characteristics and the objective of the employed analysis by the research (Hair et al., 2010). In this study, following Hair et al. (2010), the outliers were identified based on the calculation of a standard deviation of each case in the research dataset. Any case with the standard deviation value bellow the cut-off point of 0.5 was considered as an outlier. As a result, 15 cases were diagnosed as outliers and thus excluded from dataset.

Normality, as one of the essential assumption in multivariate analysis (Raykov and Marcoulides, 2008), is regarded to the distribution form of the collected data. In this study following the procedure suggested by Pallant (2007) the Kolmogorov-Smirnov[9] statistic was used to assess the normality of the distribution of scores in the study sample. In this procedure a non-significant result (**Sig.** value of more than 0.05) indicates normality. Statistical analysis showed the **Sig.** values for research variables were 0.000, suggesting violation of the assumption of normality.

However, according to Hair et al. (2010) and Pallant (2007), this is quite common in large samples (here 233 cases). Instead in large samples, the normality assumption is ideally tested by using univariate normality approach (Hair et al., 2010). Following this method, the normality test was done for each variable in the research model through employing the "normal probability- probability" plot. As a result of this test, the univariate normality assumption for each variable in the model was supported since none of the variables deviated

[9] Kolmogorov–Smirnov test is a nonparametric test for the equality of continuous, one-dimensional probability distributions that can be used to compare a sample with a reference probability distribution. The Kolmogorov–Smirnov statistic quantifies a distance between the empirical distribution function of the sample and the cumulative distribution function of the reference distribution (Pallant, 2007).

considerably from the normal distribution. Examples of the "normal probability- probability" plots are presented in Figure 5.1, 5.2, and 5.3 for three items associated with the general performance construct.

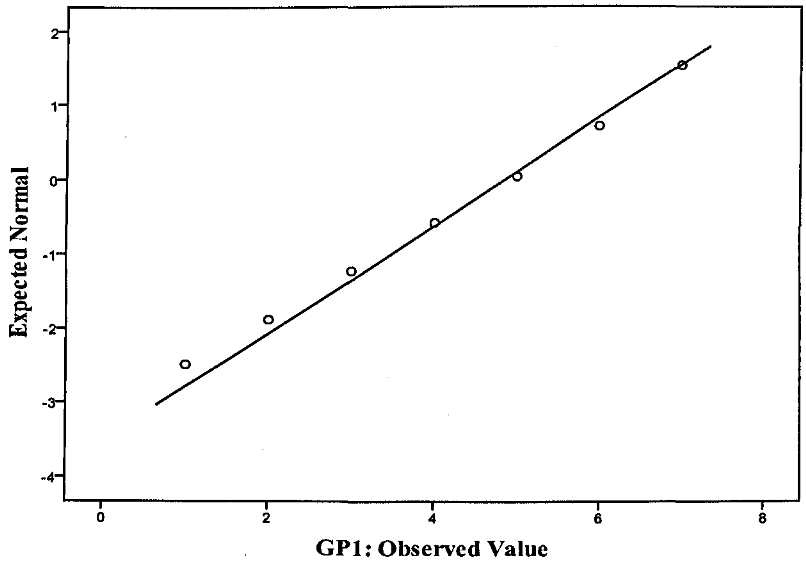

Figure 5. 1: GP1, Univariate normality

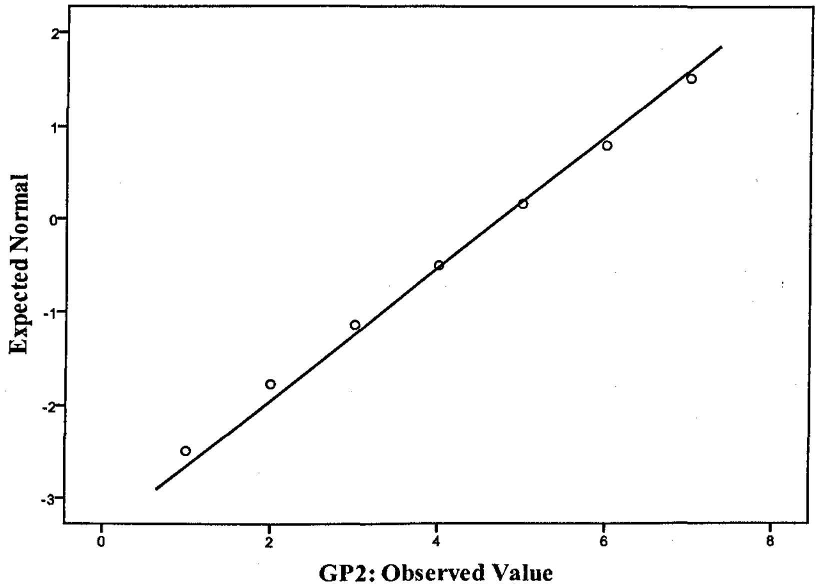

Figure 5. 2: GP2, Univariate normality

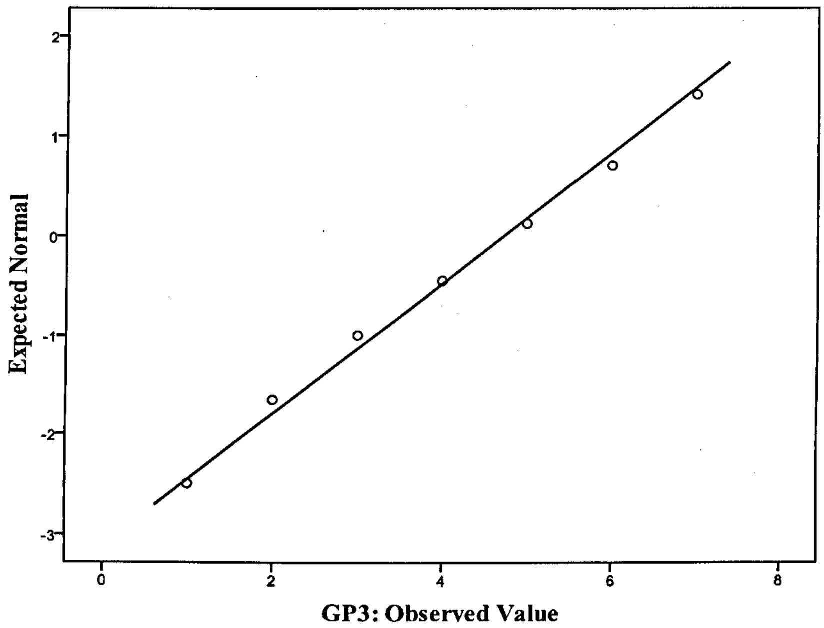

Figure 5. 3: GP3, Univariate normality

5.2.2. Missing Data

When an empirical research is undertaken it is very rare to achieve complete data from every case (Pallant, 2007). According to Schafer and Olsen (1998) the (a) sensitive nature of questions; (b) understandability of questions for informants; (c); and lack of appropriate knowledge of informants to answer questions, are the key explanations for missing values. One of the main concerns in conducting empirical research is how to remedy the missing values since approaching a wrong strategy can cause serious problems (Unnebrink and Windeler, 2001).

This study approached two techniques to deal with missing values. First, regarding the analysis in Section 5.5 (i.e. performing CFA via AMOS 18), the maximum likelihood estimation (MLE) was employed. As suggested by Myung (2003) "*MLE has many optimal properties in estimation:*

- *Sufficiency: complete information about the parameter of interest contained in its MLE estimator);*
- *Consistency: true parameter value that generated the data recovered asymptotically, i.e. for data of sufficiently large samples;*

➢ *Efficiency: lowest-possible variance of parameter estimates achieved asymptotically;*

➢ *and parameterization invariance: same MLE solution obtained independent of the parametrization used*" (Myung, 2003, p. 90).

Second, regarding the analysis in Section 5.7 (i.e. performing Hierarchical regression via SPSS 19), "Pair-wise exclusion" method was employed. This method, "*excludes the case (person) only if they are missing the data required for the specific analysis. They will still be included in any of the analysis for which they have the necessary information*" (Pallant, 2007, p. 57).

5.3. Non-Response Bias

Non-response bias is argued to be a significant source of error in a survey research (Dillman, 2007), which takes place when those who participated in the survey significantly differ from those who did not, mainly in terms of key characteristics of interest to the study. This study followed a simple method suggested by Gerbing and Anderson (1988), to check for the existence of non-response bias in the research. Thus, the study sample was investigated to check whether non-respondents firms differed significantly from the responding firms in terms of key firm characteristics (e.g. size, age, and turnover). As a result of comparison no significant difference was found; indicating that non-response bias is not problematic in this study. Also, to estimate the likelihood of a late response bias this study followed the procedure suggested by Armstrong and Overton (1977). Following this method, participants were divided into two groups: early responses and late responses. Early responses were those responding on the basis of first contact. In contrast, late responses were those firms responding after the reminder email were sent to them (second wave). By conducting t-tests, no significant difference was found at the 0.05 level between early and late respondents related to both key constructs of general and agility performance.

5.4. Common Method Bias: Procedural and Statistical Remedies

Since data were collected for the dependent and independent variables from a single-informant in this research, a common method bias may occur. The existence of common method bias causes a significant problem for the validity of findings in behavioural research

(Podsakoff et al., 2003). This bias is resulted from common method variance (CMV) which refers to the amount of spurious covariance shared among variables (Podsakoff et al., 2003).

To deal with this issue two methods are mostly discussed in the pertinent literature namely as procedural and statistical remedies (Hair et al., 2010). In this research, several techniques were considered to remedy matters regarding the single informants and common method variance before (procedural remedies) and also after (statistical remedies) conducting the survey. Therefore, as adopted in previous studies (e.g. Atuahene-Gima et al., 2005) and following the practical procedure suggested by Podsakoff et al. (2003) three steps were taken in the research design process to reduce the potential effect of common method bias. First, as mentioned in the research methodology chapter (Chapter 4), the questionnaire was designed in accordance with the extant literature and through a number of iterations. Second, general topic sections were used in the questionnaire instead of grouping items in their relevant variables. Finally, anonymity of informants was promised in order to improve the accuracy level of responses.

With regards to statistical remedies, after conducting the survey, Harman's one-factor test was used to further examine the possibility of common method variance (CMV) bias. Common method variance (CMV) is a major concern if a single factor accounts for most of the total variance. A principal components factor analysis of all measures yielded 7 factors with eigenvalues above 1.0, with total explained variance of 69.88 %. Because the first factor accounted for only 21.51 % of the variance, CMV is not deemed to be a concern.

To further test the possibility of common method variance Confirmatory Factor Analysis (CFA) technique was also employed (this technique is based on the comparison of fit indices between the models with different levels of complexity). As a result of the test, if the fit index of a simpler model is similar to the complex model, common method bias could be a problem (Korsgaard and Roberson, 1995). To perform the CFA test two models were developed in this research. In the first model all items were loaded into one confirmatory factor with $\chi 2$ (df=594) = 2986.32. Comparing these results against $\chi 2$ (df = 491) = 788.97 for the measurement model (second model: each item were loaded into its predefined constructs) yields a $\Delta\chi 2$ of 2197.35 with df = 103, p<0.001 (see Section 5.5.2 for measurement model fit indices). Hence, common method bias is not problematic in this research.

5.5. Confirmatory Factor Analysis

Confirmatory factor analysis (CFA) is a helpful approach of testing how well the measured variables represent a smaller number of constructs (Hair et al., 2010). CFA is generally used to provide a confirmatory test of a study's measurement theory[10] (Hair et al., 2010) which determines whether a theoretical model is entirely validated by empirical findings. In fact, it is employed by a researcher to test the validity and reliability of constructs in the study (Shaw and Shiu, 2002). The CFA model facilitates researchers not only to verify the model's constructs, also to determine the variable's measures and potential interrelations. Thus, in this study, the CFA model was run to:

- Purify the measurements of the constructs (diagnose potential problems with measures).
- Assess constructs validity (Calculate Convergent, Discriminant and Nomological validity).
- Ensure there are no cross-loadings and uncorrelated errors.
- Test constructs reliability.

5.5.1. Diagnosing Potential Problems with a Measurement Theory (Constructs' Measurements Purification)

CFA helps researchers to investigate or confirm whether a theoretical measurement model is valid (Hair et al., 2010). Researchers endeavour to use different empirical measures to obtain acceptable fit indices of model and in other words to examine all aspects of construct validity. Through this procedure, CFA supplies some diagnostic information that may offer a route to improve and modify a study's measurement theory. Hair and his colleagues (2010) suggested four main areas that can be focused to discover potential problems associated with measures as follows: path estimates, standardised residuals, modification indices, and specification search.

[10] A measurement theory specifies how measured variables logically and systematically represent constructs involved in a theoretical model (Hair, et al., 2010).

In this research, to evaluate the study measurement model, first all of the indicators were entered into the CFA model[11]. As a result, the fit indices of the first model are: CFI=0.889, IFI=0.891, NFI=0.769 and TLI=0.874. As it is clear from these figures, all of the indices are lower than desirable 0.9 claimed by Byrne (2001). One of the explanations for the weak indices could be the existence of low loadings for number of factors in the model (details of loading factors are presented in Section 5.5.1.1). In addition, the second explanation of poor fit indices would be the number of constructs and their indicators in the model. The number of variables (9) and their relevant indicators (48) is noticeably high for the number of collected cases (233). Therefore, it is essential to perform some practical techniques to modify the measurements included in the model. To improve these indices, the study applied the diagnostic approach (i.e. path estimates, standardised residuals, modification indices, and specification search) suggested by Hair et al., (2010).

5.5.1.1. Path Estimates

According to Hair et al. (2010), one of the easiest techniques to recognise a potential problem with a measurement theory is to compare estimated loadings. In this method the loading lower than 0.5 should be removed from the model. In other words, loading should be at least 0.5 and ideally 0.7 or higher. Therefore, in this study, items loading less than 0.7 on their respective constructs were excluded to get better fit indices in the CFA model. Table 5.1 presents model's indicators, and their codes and loadings.

Table 5. 1: Original Model: Constructs, Items, and Related Loading Values

Constructs	Indicators	Codes	Loadings
General Performance	Has met sales growth goals.	GP1	*0.900*
	Has met market share goals.	GP2	*0.785*
	Return on investment.	GP3	*0.795*
	Customer acceptance and satisfaction.*	GP4	*0.612*
	Development costs.*	GP5	*0.621*
Agility Performance	The level of newness (novelty) of our firm's new products.	Agil1	*0.747*
	The speed of our new product development.	Agil2	*0.736*
	The number of our new products that is first-to-market	Agil3	*0.727*

[11] The model fit was assessed by evaluating Bentler-Bonet normed fit index (NFI), comparative fit index (CFI), incremental fit index (IFI), Tucker Lewis index (TLI), normed chi-square, and report root mean square error of approximation (RMSEA).

	(early market entrants).		
	The number of new products our firm has introduced to the market.*	Agil4	*0.603*
	Time-to-market.*	Agil5	*0.451*
Absorptive Capacity	The general knowledge and education level of our first-line workers is high.*	AC1	*0.582*
	The knowledge of our managers is adequate when making business decisions.	AC2	*0.758*
	The communications between people at various levels is extensive.	AC3	*0.795*
	The communication of new ideas between departments is extensive.	AC4	*0.820*
	Our employees tend to trust and support the organisation and each other.	AC5	*0.795*
	We seek to learn from many sources such as routine. search, benchmarking, customers and suppliers, R&D.*	AC6	*0.690*
Supplier Involvement	Our suppliers are active in the product development (PD) process & provide input into the PD project.	SI1	*0.815*
	Communications with suppliers on quality considerations and design issues and changes are close.	SI2	*0.774*
	Our company strives to establish long-term relationships with suppliers, and help them in their progress and development.	SI3	*0.745*
	Our company has attempted involving its main suppliers in product innovation through co-investment programmes.*	SI4	*0.619*
	Involving in Product design.	SI5	*0.774*
	Involving in prototyping & production.	SI6	*0.771*
	Involving in product commercialisation.*	SI7	*0.601*
Responsive Market Orientation	Our strategy for competitive advantage is based on our understanding of customers' needs.	RMO1	*0.771*
	We freely communicate information about our successful and unsuccessful customer experiences across all business functions.*	RMO2	*0.568*
	We constantly monitor our level of commitment and orientation to serving customer needs.	RMO3	*0.911*

	We measure customer satisfaction systematically and frequently.	RMO4	*0.807*
	We are more customer-focused than our competitors.	RMO5	*0.789*
Proactive Market Orientation	We continuously try to discover additional needs of our customers of which they are unaware.	PMO1	*0.868*
	We incorporate solutions to unarticulated customer needs in our new products.	PMO2	*0.902*
	We innovate even at the risk of making our own products obsolete.*	PMO3	*0.608*
	We search for opportunities in areas where customers have a difficult time expressing their needs.	PMO4	*0.821*
	We work closely with lead users who try to recognise customer needs months or even years before the majority of the market may recognize them.	PMO5	*0.781*
Market Turbulence	In our kind of business, customers' product preferences change quite a bit over time.	MT1	*0.777*
	Our customers tend to look for new product all the time.	MT2	*0.865*
	We are witnessing demand for our products and services from customers who never bought them before.*	MT3	*0.614*
	New customers tend to have product-related needs that are different from those of our existing customers. *	MT4	*0.512*
	Our customer base and their demand do not change frequently.	MT5A	*0.755*
Competitive Intensity	Competition in our industry is fierce.	CI1	*0.817*
	There are many "promotion wars" in our industry.	CI2	*0.840*
	Anything that one competitor can offer, others can match readily.	CI3	*0.780*
	Price competition is a hallmark of our industry.*	CI4	*0.607*
	New competitive moves occur very often in this industry.	CI5	*0.811*
Technological Turbulence	The technology in our industry is changing rapidly.	TT1	*0.852*
	Technological changes provide big opportunities in our industry.	TT2	*0.714*
	Due to rapid changes it is very difficult to forecast where the technology in our industry will be in the next 2 to 3 years.*	TT3	*0.584*
	A large number of new product ideas have been made	TT4	*0.727*

	possible through technological breakthroughs in our industry.		
	Technological developments in our industry are rather minor.	TT5A	*0.703*

* = items with loading less than 0.7

As can be seen in Table 5.1, the loadings estimates of the following items were less than the ideal cut-off point (0.7): GP4 (0.612), GP5 (0.621), Agil4 (0.603), Agil5 (0.451), AC1 (0.582), AC6 (0.690), SI4 (0.619), SI7 (0.601), RMO2 (0.568), PMO3 (0.608), MT3 (0.614), MT4 (0.512), CI4 (0.607), TT3 (0.584). Hence, the aforementioned indicators were eliminated from the CFA model to improve fit indices. After removing the items with disqualified loadings, CFA was re-run to get an output for the new model. As it was predicted, the purification method improved the fit indices significantly. The new fit indices are as follows (the fit indices before purification are presented in parentheses): CFI=0.934 (0.889), IFI=0.936 (0.891), NFI=0.904 (0.769), and TLI=0.923 (0.874). Table 5.2 presents model's indicators, and their codes and loadings after performing the purification process.

Table 5. 2: Modified Model: Constructs, Items, and Related Loading Values

Constructs	Indicators	Codes	Loadings
General Performance	Has met sales growth goals.	GP1	*0.901*
	Has met market share goals.	GP2	*0.798*
	Return on investment.	GP3	*0.790*
Agility Performance	The level of newness (novelty) of our firm's new products.	Agil1	*0.781*
	The speed of our new product development.	Agil2	*0.721*
	The number of our new products that is first-to-market (early market entrants).	Agil3	*0.760*
Absorptive Capacity	The knowledge of our managers is adequate when making business decisions.	AC2	*0.729*
	The communications between people at various levels is extensive.	AC3	*0.810*
	The communication of new ideas between departments is extensive.	AC4	*0.833*
	Our employees tend to trust and support the organisation and each other.	AC5	*0.802*
Supplier	Our suppliers are active in the product development (PD)	SI1	*0.827*

Involvement	process & provide input into the PD project.		
	Communications with suppliers on quality considerations and design issues and changes are close.	SI2	*0.808*
	Our company strives to establish long-term relationships with suppliers, and help them in their progress and development.	SI3	*0.774*
	Involving in product design.	SI5	*0.739*
	Involving in prototyping & production.	SI6	*0.725*
Responsive Market Orientation	Our strategy for competitive advantage is based on our understanding of customers' needs.	RMO1	*0.770*
	We constantly monitor our level of commitment and orientation to serving customer needs.	RMO3	*0.902*
	We measure customer satisfaction systematically and frequently.	RMO4	*0.813*
	We are more customer-focused than our competitors.	RMO5	*0.803*
Proactive Market Orientation	We continuously try to discover additional needs of our customers of which they are unaware.	PMO1	*0.872*
	We incorporate solutions to unarticulated customer needs in our new products.	PMO2	*0.902*
	We search for opportunities in areas where customers have a difficult time expressing their needs.	PMO4	*0.815*
	We work closely with lead users who try to recognise customer needs months or even years before the majority of the market may recognize them.	PMO5	*0.780*
Market Turbulence	In our kind of business, customers' product preferences change quite a bit over time.	MT1	*0.786*
	Our customers tend to look for new product all the time.	MT2	*0.848*
	Our customer base and their demand do not change frequently.	MT5A	*0.780*
Competitive Intensity	Competition in our industry is fierce.	CI1	*0.820*
	There are many "promotion wars" in our industry.	CI2	*0.844*
	Anything that one competitor can offer, others can match readily.	CI3	*0.756*
	New competitive moves occur very often in this industry.	CI5	*0.824*
Technological Turbulence	The technology in our industry is changing rapidly.	TT1	*0.823*
	Technological changes provide big opportunities in our	TT2	*0.719*

industry.		
A large number of new product ideas have been made possible through technological breakthroughs in our industry.	TT4	*0.752*
Technological developments in our industry are rather minor.	TT5A	*0.729*

5.5.1.2. Standardised Residuals and Modification Indices

Standardised Residuals and Modification Indices techniques can also be employed to further evaluate the measurement model. Residuals are listed in the output of SEM programs. According to Hair et al., (2010) while standard residuals less than 2.5 do not cause any problem, the value higher than 4.0 leads to unacceptable degrees of error. Modification indices also can facilitate researchers in amending the study measurement model. Generally, modification indices of approximately 4 or higher indicate that the fit could be improved considerably by freeing the corresponding path (Hair et al., 2010). In this study, since the good model fit indices resulted from first purification step, standardised residuals and modification indices approaches were not required to be employed.

5.5.2. Model Fit Evaluation

As explained in previous section, the fit indices of the final CFA model are as follows: CFI=0.934, IFI=0.936, NFI=0.904, and TLI=0.923. In total, for 233 collected cases, nine observed variables (2 dependent and 7 independent variables) and 34 indicators were included in the final model. In general, CFI and TLI of models containing more than 30 observed variables (with a sample size smaller than 250) should be above 0.92 (Hair et al., 2010). Hence, as there are 34 observed variables in the model, no problem was found with regards to CFI and TLI values.

Generally, all of the fit indices are good since they are above cut-off point 0.9; however, the model fit evaluation cannot be done by only assessing the CFI and other aforementioned fit indices. In addition to goodness-of-fit indices, at least, one badness-of-fit index such as "root mean square error approximation" (RMSEA) together with the chi-square ($\chi2$) and the associated degree of freedom should be considered to evaluate the research measurement model. It is suggested that analysing a) the $\chi 2$ value and the degrees of freedom, b) the CFI (representative of goodness-of-fit indices) and c) the RMSEA, supplies adequate information to assess the measurement model (Hair et al., 2010).

The output of CFA model indicates the value of 788.986 for $\chi 2$ (P-value= 0.00) with Degrees of Freedom, *df* = 491. The chi-square value is expected to be significant for the model with 30 or higher observed variables and a sample size smaller than 250 (Hair et al., 2010) which is the case in this research with 35 observed variables and a sample of 233 respondents. Moreover, the ratio of $\chi 2$ to *df* is also commonly used to further evaluate the mode (Hair et al., 2010). Considering the research CFA model, the ratio of $\chi 2$ to *df* is acceptable ($\frac{x^2}{df}$ = 1.607) since it was less than a cut-off 3.0 suggested by Hu and Bentler (1999).

Furthermore, with regards to badness-of-indices, RMSEA is considered in this research. As suggested by Hair et al. (2010), for models with more than 30 observed variables, RMSEA should be lower than 0.08. The output of CFA model indicates a very good RMSEA which is lower than a cut-off point with the value of 0.051. As a conclusion, following Hair et al. (2010), the combination of goodness-of fit and badness-of-fit indices, in addition to chi-square value and the degrees of freedom indicates a good model fit for the research measurement model. Table 5.3 presents the correlation matrix of variables in the study.

Table 5. 3: Correlation Matrix of Variables

	1	2	3	4	5	6	7	8	9
(1) General Performance	1.00								
(2) Agility Performance	.377	1.00							
(3) Absorptive capacity	.445	.580	1.00						
(4) Supplier Involvement	-.248	.379	.254	1.00					
(5) Proactive MO	.286	.435	.487	.117	1.00				
(6) Responsive MO	.347	.283	.368	.083	.267	1.00			
(7) Technology Turbulence	.025	.154	.221	.178	.188	-.009	1.00		
(8) Competitive Intensity	-.079	-.041	.010	.126	-.113	.068	.111	1.00	
(9) Market turbulence	-.084	.172	.091	.202	.130	.026	.341	.270	1.00

N=233, CFI=0.934, IFI=0.936, NFI=0.904, and TLI=0.923

5.5.3. Assessing New Measurement Model

One of the main advantages of CFA is its ability to evaluate the construct validity of a proposed measurement theory. "*Construct validity is the extent to which a set of measured items actually reflects the theoretical latent construct those items are designed to measure*" (Hair et al., 2010, p. 776). In order to assess the validity of a model several approaches can be employed which mainly deal with the accuracy of measurement. In this study, Convergent validity and Discriminant validity (suggested by Hair et al., 2010) were employed to assess the constructs validity.

5.5.3.1. Convergent Validity

The construct's items should coverage or share a high proportion of variance in common, known as convergent validity (Hair et al., 2010). Convergent validity is commonly assessed by using three main techniques namely as: Factor Loading, Average Variance Extracted (AVE), and finally Composite Reliability (CR). First, the standardized loading estimates for all items in the model should exceed cut-off point 0.5 and/or ideally 0.7. Second, the Average variance extracted (AVE) should be equal or more than 0.5, to present sufficient convergences. The AVE among a set of constructs is defined as "*a summary indicator of convergence and is equal to squared standardised factor loading divided by the number of items*" (Hair et al., 2010, p. 777).

$$AVE = \frac{\sum_{i=1}^{n} \lambda_i^2}{n}$$

(The λ symbolises the standardised factor loadings and i presents the number of items)

Finally, the composite reliability (CR) was considered as the last indicator of convergent validity for this study. It is known as the measure of the reliability and internal consistency of the measured variables representing the latent constructs (Hair et al., 2010). The composite reliability (construct reliability) indicator should be 0.7 or higher to suggest a good reliability of the study model (Bagozzi et al., 1991). Following the formula suggested by Bagozzi et al. (1991) CRs can be calculated as follows:

$$CR = \frac{(\sum_{i=1}^{n} \lambda_i)^2}{(\sum_{i=1}^{n} \lambda_i)^2 + \sum_{i=1}^{n} \delta_i}$$

(wherein The λ indicates the standardised factor loadings, δ depicts the error variance terms for a construct (which is computed by $1-\lambda^2$), and i presents the number of items)

Table 5.4 presents the AVE, CR, factor loading, Cronbach's Alpha, mean, and standard deviation, for the constructs (including related items) in the research model.

Table 5. 4: Constructs' Validity

Constructs	Codes	AVE	Mean	SD	λ	CR
General Performance	GP1		4.86	1.386	*0.901*	
Cronbach's	GP2	0.691	4.74	1.411	*0.798*	0.870
Alpha= 0.866	GP3		4.73	1.523	*0.790*	
Agility Performance	Agil1		5.17	1.209	*0.781*	
Cronbach's	Agil2	0.569	4.62	1.301	*0.721*	0.798
Alpha= 0.776	Agil3		4.40	1.410	*0.760*	
Absorptive Capacity	AC2		5.13	1.233	*0.729*	
Cronbach's	AC3	0.631	4.91	1.258	*0.810*	0.872
Alpha= 0.872	AC4		4.72	1.314	*0.833*	
	AC5		5.07	1.342	*0.802*	
Supplier Involvement	SI1		4.09	1.516	*0.827*	
Cronbach's	SI2	0.602	4.55	1.383	*0.808*	
Alpha= 0.881	SI3		5.07	1.388	*0.774*	0.883
	SI5		3.76	1.703	*0.739*	
	SI6		4.10	1.720	*0.725*	
Responsive MO	RMO1		5.40	1.398	*0.770*	
Cronbach's	RMO3	0.678	5.03	1.405	*0.902*	0.894
Alpha= 0.892	RMO4		4.89	1.461	*0.813*	
	RMO5		5.08	1.376	*0.803*	
Proactive MO	PMO1		5.11	1.402	*0.872*	
Cronbach's	PMO2	0.712	5.02	1.408	*0.902*	0.908
Alpha= 0.906	PMO4		4.86	1.429	*0.815*	
	PMO5		4.86	1.448	*0.780*	
Market Turbulence	MT1		4.37	1.685	*0.786*	
Cronbach's	MT2	0.648	4.24	1.703	*0.848*	0.847
Alpha= 0.846	MT5A		4.01	1.690	*0.780*	
Competitive Intensity	CI1		5.21	1.792	*0.820*	
Cronbach's	CI2	0.659	3.92	1.937	*0.844*	0.885
Alpha= 0.884	CI3		4.13	1.753	*0.756*	
	CI5		4.16	1.709	*0.824*	
Technological Turbulence	TT1		4.39	1.655	*0.823*	
Cronbach's	TT2	0.573	5.11	1.538	*0.719*	0.842
Alpha= 0.842	TT4		4.33	1.600	*0.752*	
	TT5A		4.50	1.745	*0.729*	

Based on the information presented in Table 5.4, the convergent validity of the constructs in the model is further explained in the following:

General performance: As it is shown in Table 5.4, the item's loadings of general performance exceeded the cut-off point 0.7. AVE is also above 0.5 as it is required by contingent validity. Therefore, following the AVE formula ($AVE = \frac{\sum_{i=1}^{n}\lambda_i^2}{n}$), AVE is computed as follows:

AVE = (0.812 + 0.637 + 0.624)/3= 0.690902 so → **AVE=0.691**

Furthermore, CR with the value of 0.97 reached the satisfactory level (as a rule of thumb CR should be above 0.7). From the CR formula ($CR = \frac{(\sum_{i=1}^{n}\lambda_i)^2}{(\sum_{i=1}^{n}\lambda_i)^2+\sum_{i=1}^{n}\delta_i}$) composite reliability for general performance was calculated as follows:

$CR = (0.901+ 0.798 + 0.790)^2 / [(0.901+ 0.798 + 0.790)^2 + (0.188+0.363+0.376)] =$ 0.869806 So → **CR=0.870**

As a result, all of the three criteria for convergent validity are satisfied by general performance construct.

Agility Performance: First, standard loadings for agility performance construct are all above 0.7 (minimum should be equal 0.5 or higher). Furthermore, AVE (0.569) is higher than 0.5; suggesting adequate convergence. At last, CR is greater than the minimum (0.7) with the value of 0.798. Therefore, convergent validity is not problematic for the agility performance construct.

Absorptive capacity: All item's loadings for absorptive capacity are also higher than 0.7. Moreover, AVE is 0.631 for this factor which is above 0.5. Also CR is higher than 0.7 with the value of 0.872. Hence no problem exists for absorptive capacity regarding the convergent validity.

Supplier involvement: Similar to the aforementioned constructs, convergent validity does not make any problem for supplier involvement since (a) all loadings are above 0.7. (b) AVE is higher than 0.5 (AVE=0.602), and (c) CR is greater than 0.7 with the value of 0.883.

Responsive market orientation: For this construct all the standard loadings are above 0.7, AVE is higher than 0.5 (AVE=0.678) and CR is 0.894; hence, the criteria for the convergent validity are well satisfied.

Proactive market orientation: All loadings related to this construct are higher than 0.7. AVE is equal to 0.712 and CR is 0.908 which indicate convergent validity for PMO.

Market turbulence: All loadings of market turbulence are above 0.70 and achieved the minimum requirement level. AVE suggests sufficient convergence by the value of 0.648. Finally, CR with the value of 0.847 is surpassed the minimum point (0.7). Therefore, no problem exists regarding the convergent validity for this construct.

Competitive intensity: The items loading related to competitive intensity are above 0.7. In addition, the AVE is equal to 0.659. Moreover, CR for this construct is 0.885. Overall, the abovementioned criteria are adequate for convergent validity.

Technology Turbulence: the standard loadings of technological turbulence construct are all above 0.7. AVE (0.573) is also higher than 0.5 and it suggests satisfactory level of convergence. Finally, CR is higher than the minimum (0.7) with the value of 0.842. Accordingly, results for these three criteria address the requirements of convergent validity for this construct.

The conclusion is that the CR for each constructs was higher than cut-off point 0.7 (Bagozzi et al., 1991) ranging from 0.798 to 0.908. In addition, the minimum level (0.5) for AVE (Bagozzi et al., 1991, Hair et al., 2010) was exceeded by all constructs in the model (ranging from 0.569 to 0.712). Also, all item loadings were above 0.7 and significant at the 0.01 significance level which indicate convergent validity (Bagozzi et al., 1991, Hair et al., 2010).

5.5.3.2. Discriminant Validity

Discriminant Validity is the "*the extent to which a construct is truly distant from other variables*" (Hair et al., 2010, p. 778). High discriminant validity can confirm that a particular construct in the model is distinctive from other constructs and it uniquely presents a phenomenon that others are not able to do.

To evaluate discriminant validity two approaches are commonly employed:

1. The correlation between any pair of constructs can be predetermined as the value of one. If the fit of the two-construct model is not significantly better than that of the one-construct model, then discriminant validity is insufficient (Hair et al., 2010).

2. The second method is based on a comparison between the average variance extracted (AVE) and the square of the correlation estimate of any two constructs in the model in which AVE should be always higher than the squared inter-construct correlation estimates (SIC) (Fornell and Larcker, 1981).

However, in practice, the first method does not always indicate the strong signs of discriminant validity because even high correlations may still generate significant differences in fit (Hair et al., 2010). Hence, in this research, discriminant validity was assessed by using the second procedure suggested by Fornell and Larcker (1981).

Table 5.5 illustrates the Inter-construct Correlations (Φ matrix) as well as the AVEs for all constructs in the model. In all cases the AVE is higher than the SIC; hence, discriminant validity is not problematic in this study.

Table 5. 5: Squared Inter-Construct Correlation Estimates and Related AVEs

	1	2	3	4	5	6	7	8	9
(1) General Performance	**0.691**								
(2) Agility Performance	0.142	**0.569**							
(3) Absorptive capacity	0.198	0.337	**0.631**						
(4) Supplier Involvement	0.062	0.143	0.065	**0.602**					
(5) Proactive MO	0.082	0.189	0.237	0.014	**0.712**				
(6) Responsive MO	0.121	0.080	0.136	0.007	0.071	**0.678**			
(7) Technology Turbulence	0.001	0.024	0.049	0.032	0.035	0.000	**0.573**		
(8) Competitive Intensity	0.006	0.002	0.000	0.016	0.013	0.005	0.012	**0.659**	
(9) Market turbulence	0.007	0.030	0.008	0.041	0.017	0.001	0.117	0.073	**0.648**

N=233, CFI=0.934, IFI=0.936, NFI=0.904, and TLI=0.923

Notes: The figures underlined and included on the diagonal are average variances extracted (AVE)

5.6. Explanatory Factor Analysis

Explanatory Factor Analysis (EFA) seeks to uncover the underlying structure of a relatively large set of variables (Hair et al., 2010). Explanatory factor analysis was employed in this research to achieve two main goals:

1. To determine whether all item in the model are loaded on their predefined constructs.

2. To underline any potential cross-loadings in the new developed model.

Table 5.6 presents the Pattern Matrix of exploratory factor analysis for the new model. As illustrated in the table, all of the loadings are greater than the cut-off point 0.5 (Hair et al., 2010) and loaded on their expected constructs. Moreover, while there is no cross-loading exist in the measurement model, the EFA model clarified nine unique constructs with eigenvalues more than one. This finding supports the conceptualising of nine constructs in the research model presented in Chapter 3. These nine identified constructs in the model explain 75.51 % of total variance.

Table 5. 6: Exploratory Factor Analysis

		Component								
Factor	**Code**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	AC3	.957								
Absorptive Capacity	AC5	.784								
	AC2	.748								
	AC4	.669								
	SI5		.919							
Supplier Involvement	SI6		.901							
	SI1		.690							
	SI2		.620							
	SI3		.603							
	TT4			.823						
Technological turbulence	TT5A			.807						
	TT1			.803						
	TT2			.785						
	CI1				.895					
Competitive Intensity	CI2				.871					
	CI5				.832					
	CI3				.823					
	RMO3					-.887				
Responsive MO	RMO4					-.859				
	RMO5					-.854				
	RMO1					-.794				
	PMO5						-.867			
Proactive MO	PMO4						-.861			
	PMO1						-.857			
	PMO2						-.848			
Market Turbulence	MT2							-.902		

	MT5A	-.853		
	MT1	-.826		
	Agil3		.784	
Agility Performance	Agil1		.692	
	Agil2		.615	
	GP2			.859
General Performance	GP3			.836
	GP1			.833

Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization. Rotation converged in 12 iterations.

5.7. Hypothesis Testing

5.7.1. Results for Testing Hypotheses H1 to H6

The research hypotheses related to the moderating effect of technological turbulence factors on the relationship between market orientation dimensions (i.e. RMO and PMO) and agile product innovation performance were examined by employing hierarchical regression. Hierarchical regression is the most appropriate approach to test moderating effects which is widely applied in previous studies (e.g. Tsai, 2009, Tsai et al., 2008, Atuahene-Gima et al., 2005, Narver et al., 2004). In this method, "*the independent variables are entered into the equation in the order specified by the researcher based on theoretical grounds. Variables or set of variables are entered in steps (or blocks), with each independent variable being assessed in terms of what it adds to the prediction of the dependent variable, after the previous variables have been controlled for*" (Pallant, 2007, p. 147).

In this study, as there are two dependent variables (DV) in the research model (DV: General Performance (GP), Agility Performance (AP)), the hierarchical regression was employed for each DV separately. Model[12] 1 contains control variables including age, number of product design in the last 5 years, and number of employees. The natural logarithm value was assigned to each control instead of the original value to deal with the problem of skewness. Then, market orientation variables (responsive and proactive) were entered in model 2, followed by the interaction terms in the model 3. These interactions are the cross-products[13] between the two dimensions of MO and environmental characteristics (technological turbulence, competitive intensity, and market turbulence). While the cross-product term in analysis might be collinear with their constituent parts, to increase interpretability of

[12] Each model contains a group of variables entered to the regression equation by the researcher (Pallant, 2007).
[13] The cross product is a binary operation on two vectors and it results in a vector in perpendicular to both of the vectors being multiplied (Pallant, 2007).

interactions and to diminish the bias resulting from multi-collinearity, this research adopts the simple procedure suggested by Aiken and West (1991). In line with this procedure all independent variables were mean centred except for control variables and then interaction terms (cross product) were formed. As it is shown in Table 5.7, 5.8, and 5.9 the VIF (variance inflation factors) for all coefficient estimates in a final model were lower than cut-off point of 10 (claimed by Mason and Perreault, 1991) suggesting that results were not impacted by multi-collinearity.

Consistent with relevant studies (e.g. Harris, 2001) regression equations were estimated-based on the data in model 3- to investigate the moderating effect of environmental factors (technological turbulence, market turbulence, and competitive intensity) on the relationship between market orientation dimensions and API performance. In this procedure, the multiplicative interaction terms are included in the regression equation (Golden, 1992, Schoonhoven, 1981). That is:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_1X_3 + b_5X_2X_3 + \ldots + b_nX_n + e \qquad (1)$$

where X_1 and X_2 represent responsive and proactive market orientation respectively (predictor variables), X_3 is the moderator variable (environmental factors), and finally X_1X_3 and X_2X_3 are the multiplicative interaction terms and $b_{(0,1\ldots,n)}$ symbolise un-standardised coefficients. To interpret the significant interaction term the partial derivation of equation 1 (see Schoonhoven, 1981) can be used which helps to clarify any changes in the nature of the interplay between the predictor and the dependent variables over the range of the moderator variable:

$$dY \backslash dX_1 = b_1 + b_4X_3 \qquad (2)$$

$$dY \backslash dX_2 = b_2 + b_5X_3 \qquad (3)$$

(b_1, b_2, b_4, b_5 = unstandardized coefficients)

5.7.1.1. Moderating Effect of Technological Turbulence

Table 5.7 shows the moderating effect of technological turbulence (TT) on the link between responsive and proactive market orientation and agile product innovation performance (general and agility).

With regards to *general performance* (DV_1), while the addition of the main factors (model 2) to the model 1 containing control variables increases the R^2 by 0.13, the addition of the interaction term (model 3) to the main effects model (model 2) further increases the R-square by 0.04, both with significant F-values at $P<0.05$. Considering control variables only "Age" is significantly related to general performance in all models. In model 2 (main effects model), both dimensions of MO are significantly related to general performance (RMO: 0.27, $p<0.001$; PMO: 0.19, $p<0.01$), however technological turbulence is not significantly linked to GP.

In model 3, the coefficient estimate for the interaction term RMOxTT is not significant (0.11, $p>0.05$). This finding rejects the existence of a positive interaction effect on GP, deriving from the combination of RMO and TT; hence no support is found for H_{1a}. Instead, the results in model 3 show that the coefficient estimate for the interaction term between the PMO and technological turbulence is negative and significant (-0.22, $p<0.01$). The negative sign associated with β coefficient fails to support $H_{2a.}$ However Since β is found to be significant (-0.22, $p<0.01$), following the procedure suggested by Schoonhoven (1981), the partial derivative was calculated by employing un-standardized regression coefficients:

$$dGP\backslash dPMO = 0.198 + (-\ 0.150)\ TT = 0 \tag{4}$$

$$TT = 0.198/\ 0.150 = 1.32 \tag{5}$$

The figure for TT in Equation 5 indicates the inflection point in the moderator influence. When values of TT (whether above or below the inflection point of 1.32) are replaced in Equation 4, answers above 1.32 are negative and answers which are below 1.32 are positive. With regards to the possible range of values for centred TT variable (-3.61 to 2.39), the above statement reveals that for high levels of technological turbulence, proactive market orientation is negatively associated with general performance whilst for low levels of technological turbulence, PMO is positively related to general performance.

With regards to *Agility Performance* (DV_2), the addition of the main factors (model 5) to control variables (model 4) results in $\Delta R^2 = 0.21$. Also the addition of the interaction term (model 6) to the main effects model slightly increases the R^2 by 0.02. The F-values for the two incremental R-squared values attained a 5-percent level statistical significance. As for the control variables, in all models "Number of product design in last five years" is significantly related to AP. Moreover, whereas both MO dimensions have a statistically significant association with agility performance (RMO: 0.19, $p<0.01$; PMO: 0.31, $p<0.001$), technological turbulence did not show a significant relationship with agility performance in model 5 (0.07, $p>0.05$).

Finally, after considering the moderating effect of TT, the figures in model 6 indicate that the coefficient estimate for cross-product term (PMOxTT) did not achieve the statistical significance; hence this result rejects the H_{2b} (-0.09, $p>0.05$). However, the interaction term between the RMO and TT is significant at 5-percent significance level (0.17, $p<0.05$) and the nature of the moderation is:

$$dAP \backslash dRMO = 0.185 + (0.118)\, TT = 0 \tag{6}$$

$$TT = -0.185 / 0.118 = -1.57 \tag{7}$$

The figure for TT in Equation 7 indicates the inflection point in the moderator influence. When values of technological turbulence (whether above or below the inflection point of -1.57) are replaced in Equation 4, answers above -1.57 are positive and answers below -1.57 are negative. With regards to the possible range of values for TT, the above statement clears that for high levels of technological turbulence, responsive market orientation is positively associated with agility performance whilst for only low TT responsive market orientation is negatively related to agility performance. Therefore, H_{1b} is supported by the result.

Table 5. 7: Moderator: Technological Turbulence

	General Performance			Agility Performance			
Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	VIF
Age	0.28(4.15)***	0.25(3.88)***	0.2 (3.27)**	-0.04(-0.57)	-0.02(-0.34)	-0.04(-0.66)	1.25
EMPL	-0.04(-0.54)	-0.01(-0.06)	-0.01(-0.08)	-0.06(-0.80)	-0.05(-0.70)	-0.04(-0.55)	1.31
NoPD5	0.11(1.64)	0.04(0.56)	0.04(0.59)	0.28(4.05)***	0.20(3.32)**	0.22(3.51)**	1.20
TT		0.001(0.01)	-0.02(-0.27)		0.07(1.08)	0.07(1.17)	1.08
RMO		0.27(4.23)***	0.23(3.62)***		0.19(2.77)**	0.17(2.40)*	1.43
PMO		0.19(3.01)**	0.20(3.09)**		0.31(4.36)***	0.30(4.30)***	1.49
RMOxTT			0.11(1.56)			0.17(2.24)*	1.67
PMOxTT			-0.22(-3.23)**			-0.09(-1.21)	1.65
R^2	0.09	0.22	0.26	0.07	0.28	0.30	
Adj-R^2	0.07	0.20	0.23	0.06	0.26	0.28	
F-Value	7.27***	10.20***	9.25***	5.57**	13.55***	10.94***	

****, p<0.001; **, p<0.01, *, p<0.05; T-values are in parentheses.*

5.7.1.2. Moderating Effect of Competitive Intensity

Table 5.8 reports the moderating effects of competitive intensity (CI) on the link between responsive and proactive market orientation and agile product innovation performance. With regards to *general performance* (DV_1), while the addition of the main factors to the model 1 containing control variables increases the R^2 by 0.13, the addition of the interaction term (model 3) to the main effects model (model 2) increases the R-square by 0.03. The F-values for the two incremental R-squared values at 5-percent level was significant. Only "Age" as a control variable is significantly related to general performance in all models. In model 2 (main effects model), both dimensions of MO are significantly related to GP (RMO: 0.28, $p<0.001$; PMO: 0.18, $p<0.01$), while competitive intensity is not significant.

Furthermore, after considering the moderating effect of CI, the results in model 3 show that the coefficient estimates for cross-product term (RMOxCI) did not attain the statistical significance, hence this result rejects the H_{3a} (0.08, $p>0.05$). Instead, the coefficient estimate for the interaction term between the PMO and competitive intensity is negative and significant (-0.16, $p<0.05$). CI inflection point is calculated as:

$$dGP \backslash dPMO = 0.212 + (-\ 0.114)\ CI = 0 \qquad (8)$$

$$CI = 0.212/\ 0.114 = 1.86 \qquad (9)$$

With regards to the possible range of values for the centred CI variable (-3.65 to 2.35), it can be concluded that for high levels of competitive intensity, proactive market orientation is negatively associated with general performance whilst for low levels of competitive intensity, proactive market orientation is positively related to general performance; therefore, H_{4a} is supported.

With regards to *Agility Performance* (DV_2), the addition of the main factors (model 5) to control variables increases the R^2 by 0.20. Also the addition of the interaction term (model 6) to the main effects model increases the R-square by 0.03, and the F-values for the two incremental R-squared are significant at a 5-percent level. With regards to control variables, only "Number of product design in last five years" is significantly related in all models. Moreover, whereas both MO dimensions have a statistically significant association with agility performance (RMO: 0.19, $p<0.01$; PMO: 0.32, $p<0.001$), competitive intensity did not show a significant relationship with agility performance in model 5.

Finally, after considering the moderating effect of CI, the data in model 6 claims that the coefficient estimate for cross-product term (PMOxCI) did not attain the statistical significance; hence this result rejects the H_{4b} (-0.06, $p>0.05$). On the other hand, the cross-product term (RMOxCI) is positive and significant (0.20, $p<0.01$), and consequently the nature of the moderation is:

$$dAP\backslash dRMO = 0.199 + (0.170)\, CI = 0 \tag{10}$$

$$CI = -0.199/\, 0.170 = -1.17 \tag{11}$$

Regarding the possible range of values for CI, the above equations assert that for high levels of competitive intensity, responsive market orientation is positively linked with agility performance whilst for low levels of CI responsive market orientation is negatively related to agility performance (inflection point: -1.17). Hence, this result supports H_{3b}.

Table 5. 8: Moderator: Competitive Intensity

	General Performance			Agility Performance			
Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	VIF
Age	0.28(4.15)***	0.24(3.79)***	0.22(3.48)**	-0.04(-0.55)	-0.02(-0.33)	-0.02(-0.23)	1.22
EMPL	-0.04(-0.54)	-0.01(-0.09)	-0.03(-0.41)	-0.06(-0.77)	-0.05(-0.70)	-0.05(-0.74)	1.31
NoPD5	0.11(1.64)	0.05(0.78)	0.04 (0.62)	0.28(3.91)***	0.21(3.26)**	0.22(3.41)**	1.18
CI		-0.07(-1.12)	-0.06(-0.90)		-0.03(-0.42)	-0.01(-0.17)	1.13
RMO		0.28(4.33)***	0.27(4.33)***		0.19(2.69)**	0.18(2.51)*	1.42
PMO		0.18(2.88)**	0.21(3.24)**		0.32(4.47)***	0.29(4.09)***	1.45
RMOxCI			0.08(1.29)			0.20(2.90)**	1.30
PMOxCI			-0.16(-2.42)*			-0.06(-0.94)	1.31
R^2	0.09	0.22	0.25	0.07	0.27	0.30	
Adj-R^2	0.07	0.20	0.22	0.06	0.25	0.28	
F-Value	7.27***	10.47***	8.78***	5.18**	12.39***	10.67***	

***, $p<0.001$; **, $p<0.01$, *, $p<0.05$; T-values are in parentheses.

5.7.1.3. Moderating effects of Market Turbulence

Table 5.9 presents the moderating effect of market turbulence (MT) on the link between responsive and proactive market orientation and agile product innovation performance.

With regards to *general performance* (DV_1), the addition of the main factors (model 2) to the model 1 amplifies the R^2 by 0.14. Also, the addition of the interaction term to the main effects model increases the R-square by 0.03. The F-values for the two incremental R-squared values are significant at 0.05. Considering control variables only "Age" is significantly linked to general performance in all models. In model 2 (main effects model), it can be noted that both dimensions of MO and also market turbulence are significantly related to GP (RMO: 0.27, $p<0.001$; PMO: 0.21, $p<0.01$; MT: -0.10, $p<0.1$).

Furthermore, after considering the moderating effect of MT, the results in model 3 show that the coefficient estimate for cross-product term (RMOxMT) did not attain the statistical significance; hence this result rejects the H_{5a} (0.07, $p>0.05$). Instead, the figures in model 3 explain that the coefficient estimate for the interaction term between the PMO and market turbulence is negative and significant (-0.19, $p<0.01$). Therefore, the nature of the moderation can be interpreted as follows:

$$dGP \backslash dPMO = 0.222 + (-\,0.106)\,MT = 0 \tag{12}$$

$$MT = 0.222/\,0.106 = 2.09 \tag{13}$$

Considering the possible range of values for MT (-3.18 to 2.82), the above equations shows that for high levels of market turbulence, proactive market orientation is negatively associated with general performance whilst for low levels of market turbulence, proactive market orientation is positively related to general performance. Hence, this result lends support to the hypothesis H_{6a} (inflection point: 2.09).

With regards to *Agility Performance* (DV_2), the addition of the main factors to control variables magnifies the R^2 by 0.21. Also the addition of the interaction term to the main effects model increases the R-square by 0.03 both with significant F-values at $P<0.05$. With regards to control variables, "Number of product design in last five years" is significantly related to agility performance in all models.

Moreover, whereas both MO dimensions have a statistically significant association with agility performance (RMO: 0.19, $p<0.01$; PMO: 0.32, $p<0.001$), market turbulence did not show a significant relationship with agility performance in model 5.

At last, after considering the moderating effect of MT, the data in model 6 claims that the coefficient estimate for cross-product term (PMOxMT) did not attain the statistical significance; therefore, H_{6b} is rejected (-0.09, p>0.05). On the other hand, the cross-product term (RMOxMT) is significant (0.22, p<0.01); hence, the nature of the moderation is:

$$dAP \backslash dRMO = 0.138 + (0.156)\, MT = 0 \quad (14)$$

$$MT = -0.138 / 0.156 = -0.88 \quad (15)$$

Regarding the potential range of values for MT, it can be concluded that for high levels of market turbulence, responsive market orientation is positively associated with agility performance whilst for low levels of MT, responsive market orientation is negatively related to agility performance. Thus, H_{5b} is supported.

Table 5. 9: Moderator: Market Turbulence

	General Performance			Agility Performance			
Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	VIF
Age	$0.28(4.14)^{***}$	$0.24(3.70)^{***}$	$0.22(3.46)^{**}$	-0.04(-0.55)	-0.01(-0.17)	-0.02(-0.36)	1.25
EMPL	-0.04(-0.54)	-0.01(-0.18)	-0.03(-0.44)	-0.06(-0.78)	-0.05(-0.66)	-0.04(-0.53)	1.30
NoPD5	0.11(1.64)	0.06(0.86)	0.04(0.60)	$0.28(3.95)^{***}$	$0.20(3.03)^{**}$	$0.19(2.96)^{**}$	1.16
MT		$-0.10(-1.68)^{©}$	$-0.13(-2.15)^{*}$		0.06(0.93)	0.06(1.00)	1.09
RMO		$0.27(4.20)^{***}$	$0.21(3.14)^{**}$		$0.19(2.65)^{**}$	$0.12(1.70)^{©}$	1.53
PMO		$0.21(3.27)^{**}$	$0.22(3.49)^{**}$		$0.32(4.50)^{***}$	$0.32(4.55)^{***}$	1.42
RMOxMT			0.07(1.15)			$0.22(2.83)^{**}$	1.66
PMOxMT			$-0.19(-2.87)^{**}$			-0.09(-1.19)	1.52
R^2	0.09	0.23	0.26	0.07	0.28	0.31	
Adj-R^2	0.08	0.21	0.23	0.06	0.25	0.28	
F-Value	7.24^{***}	10.76^{***}	9.35^{***}	5.29^{**}	12.79^{***}	10.93^{***}	

****, p<0.001; **, p<0.01, *, p<0.05, ©, p<0.10; T-values are in parentheses.*

5.7.2. Results for Testing Hypotheses H7 to H13

Similar to the market orientation related hypothesis, the research hypotheses regarding the supplier involvement, absorptive capacity, and technological turbulence were also examined by employing hierarchical regression. Since there are two dependent variables (DV) in the research model (DV: General Performance, Agility Performance), the hierarchical regression was employed for each DV separately (Table 5.10: General Performance, Table 5.11: Agility Performance). Model 1 contains several control variables including age, number of product design in last 5 years, number of employees, and number of key suppliers. The natural logarithm value was assigned to each control instead of the original value to deal with the problem of skewness. Then, technological turbulence, absorptive capacity and supplier involvement were entered in model 2. The squared terms of absorptive capacity and supplier involvement were inserted in model 3 to check the existence of curvilinear relationships between supplier involvement, absorptive capacity and the research dependent variables (i.e. general and agility). Finally the interaction terms between supplier involvement (SI) and absorptive capacity as well as interaction term between SI and technological turbulence were placed in model 4. Furthermore the interaction terms between squared supplier involvement and absorptive capacity was also entered to test the effect of absorptive capacity on the potential curvilinear relationship between supplier involvement and agile product innovation (API) dimensions. Similarly, the cross-product variable between squared supplier involvement and technological turbulence was also created and entered in model 4 to examine the effect of TT on the potential curvilinear relationship between supplier involvement and API dimensions.

Following the approach employed in Section 5.7.1, all independent variables were centred except control variables and then interaction terms (cross products) were formed to reduce concerns regarding the multi-collinearity issue (Aiken and West, 1991). As it is depicted in Table 5.10 and 5.11, the VIF (variance inflation factors) for all coefficient estimates in model 3 were lower than cut-off point of 10 and it means that results were not impacted by multi-collinearity.

Table 5.10 shows the relationship between absorptive capacity (AC), technological turbulence (TT), supplier involvement (SI) and general performance (GP). While the addition of the main factors (model 2) to the model 1 containing control variables increases R^2 by 24 percentage points, the addition of supplier involvement and absorptive capacity quadratic terms (model 3) to the main effects model (model 2) increases R^2 by only 2 percentage points. Moreover, the addition of interaction terms (model 4) to the squared terms model further increases R^2 by 5 percentage points. The F-values for the three incremental R^2 values attained a 5-percent level statistical significance. Firstly, control variables do not result in significant association with general performance in all models. As the figures show in the main effects model (model 2), there is a significant relationship between supplier involvement and general performance ($p<0.001$). However, this result fails to support H_{7a} considering the negative sign appeared with standardised coefficient ($\beta = -0.37$). Hence, these analyses indicate that stronger supplier involvement is related to decrease in general performance of a firm.

The result in model 2 also indicates that absorptive capacity (AC) significantly interplays with general performance. The positive standardised coefficient claims the positive and direct relationship between AC and general performance ($\beta = 0.44$, $p<0.001$). Therefore, this result lends support to the next research hypothesis declaring that stronger absorptive capacity of the firm's supply chain will lead to greater general performance (H_{12a}). However, a negative and significant coefficient estimate is observed in the squared term of AC in model 3, indicating that there is a curvilinear relationship (inverted U-shaped based on a negative sign of coefficient) between absorptive capacity and general performance ($\beta = 0.15$, $p<0.05$). In this relationship, a higher level of absorptive capacity is linked with a higher level of general performance, but only up to a certain level. By exceeding this turning point, higher levels of absorptive capacity are linked with lower levels of general performance. In contrast the negative coefficient estimate for the squared term of SI is not significant ($\beta = -0.08$, $p>0.05$), thus no curvilinear relationship exist between supplier involvement and general performance.

Furthermore, in model 4, the coefficient estimate for the interaction between the SI squared and absorptive capacity did not attain the statistical significance level ($\beta = 0.07$, $p>0.05$). Similarly, the coefficient estimates for the cross-products between SI and technological turbulence as well as SI squared and TT did not attain the statistical significance level ($\beta =$ 0.05 and -0.03 respectively; $p>0.05$), hence this result rejects the H_{11a}. Moreover, the β coefficient for interaction term between supplier involvement and absorptive capacity is negative and significant ($\beta = -0.24$, $p<0.001$), hence no support is found for the hypothesis 13a. However, as a significant association was found between SIxAC and general performance (GP) more in depth analysis was undertaken to shed more light on the nature of this relationship. Following the procedure suggested by Schoonhoven (1981), the partial derivative was calculated by employing un-standardized regression coefficients:

$$dGP \backslash dSI = -0.274 + (-0.191)\,AC = 0 \qquad (16)$$

$$AC = -0.274/0.191 = -1.43 \qquad (17)$$

The figure for AC in Equation 17 indicates the inflection point of -1.43 in the moderator influence. To gain an intuitive understanding of the nature of this interaction effect, the common procedure introduced by Aiken and West (1991) was used which examines the significance of the regression coefficient for the independent variable at one standard deviation above and below the mean (labelled as a high level, and low level respectively) of a moderator construct (absorptive capacity in our study). Employing this technique revealed a significant and negative relationship between supplier involvement and general performance at a high level of absorptive capacity ($\beta = -0.28$, $p<0.01$), while a negative but not significant relationship between general performance (GP) and SI was found for low level of absorptive capacity ($\beta = -0.04$, $p>0.05$).

Table 5. 10: DV: General Performance, Moderator: Absorptive Capacity, Technological turbulence

Variable	Model 1	Model 2	Model 3	Model 4	VIF
Age	0.04 (0.46)	0.03 (0.43)	0.02 (0.35)	0.03 (0.38)	1.24
EMPL	0.02 (0.29)	0.03 (0.35)	0.01 (0.07)	-0.01 (-0.11)	1.49
NoPD5	0.12 (1.64)	0.03 (0.43)	0.05 (0.68)	0.05 (0.82)	1.24
NKS	0.00 (0.01)	0.03 (0.44)	0.03 (0.46)	0.03 (0.41)	1.46
AC		0.44 (6.82)***	0.43 (6.58)***	0.42 (6.44)***	1.26
SI		-0.37 (-5.86)***	-0.37 (-5.86)***	-0.27 (-4.09)***	1.31
TT		0.01 (0.10)	0.02 (0.25)	0.03 (0.38)	1.30
AC^2			-0.15 (-2.45)*	-0.14 (-2.30)*	1.10
SI^2			-0.08 (-1.18)	-0.04 (-0.61)	1.32
SI x AC				-0.24 (-3.69)***	1.22
SI^2 x AC				0.06 (0.99)	1.06
SI x TT				0.05 (0.85)	1.04
SI^2 x TT				-0.03 (-0.37)	1.60
R^2	0.02	0.26	0.28	0.33	
Adjusted R^2	0.00	0.23	0.25	0.29	
F-Value	1.06	9.95***	8.63***	7.53***	

***, *p<0.001*; **, *p<0.01*; *, *p<0.05*; *T-values are in parentheses*

Table 5.11 reports the results of the hierarchical regression analysis considering the agility performance as a dependent variable. The addition of the main factors (model 2) to control variables (model 1) amplifies R^2 by 32 percentage points. Also, the addition of supplier involvement and absorptive capacity quadratic terms (model 3) to the main effects model (model 2) increases R^2 by only 1 percentage points. Moreover, the addition of the interaction terms (model 4) to the model 3 increases R^2 by 4 percentage points. With regards to control variables, while "Number of product design in the last five years" is significantly related in all models, "number of key suppliers" has negative and significant relationship with agility performance in model 2 and 3. Moreover, whereas supplier involvement had a statistically significant association with agility performance ($\beta = 0.27$, $p<0.001$), absorptive capacity also showed a significant and positive relationship with agility performance in model 2 ($\beta = 0.43$, $p<0.001$). Hence, as predicted in H_{7b} and H_{12b}, these results suggest that stronger supplier involvement and greater absorptive capacity are both related to increased agility performance of a firm.

Furthermore, in model 3, the coefficient estimates for the squared terms of SI and AC are not significant (β: -0.07 and -0.07 respectively; $p>0.05$), thus no curvature is produced by supplier involvement and/or absorptive capacity effects on agility performance. Finally in model 4, while the coefficient estimate for the interaction between the SI squared and absorptive capacity did not attain the statistical significance level ($\beta = -0.01$, $p>0.05$), the coefficient estimate for cross-product term (SIxAC) is positive and significant which supports H_{13b} ($\beta = 0.15$, $p<0.01$). In other words, greater absorptive capacity of a firm strengthens the direct relationship between supplier involvement and agility performance. Thus the nature of the moderation is as follows:

$$dAP \backslash dSI = 0.174 + (0.105)\,AC = 0 \tag{17}$$

$$AC = -\,0.174/\,0.105 = -1.66 \tag{18}$$

The figure for AC in Equation 18 presents the inflection point of -1.66 in the moderator influence. Furthermore, in order to interpret and gain better understanding of interaction effect, the suggested procedures by Aiken and West (1991) was used. At a high level of absorptive capacity, a significant and positive relationship was found between supplier involvement and agility performance ($\beta = 0.19$, $p<0.05$). In contrast, a positive but not significant relationship between supplier involvement and agility performance was found at the low level of absorptive capacity ($\beta = 0.03$, $p>0.05$).

Moreover, figures in model 4 also show that while the coefficient estimate for the interaction between the SI squared and technological turbulence did not achieve the statistical significance level ($\beta = 0.04$, $p>0.05$), the coefficient estimate for cross-product term (SIxTT) is positive and significant ($\beta = 0.13$, $p<0.05$). This indicates that greater level of technological turbulence strengthens the association between supplier involvement and agility performance; thus H_{11b} is supported and the nature of the moderation is:

$$dAP\backslash dSI = 0.174 + (-\ 0.125)\ TT = 0 \tag{19}$$

$$TT = -\ 0.174/\ 0.125 = -1.39 \tag{20}$$

The figure for TT in Equation 20 is the inflection point of -1.39 in the moderator influence. Following the procedure suggested by Aiken and West (1991), at a high level of technological turbulence, a significant and positive association was found between supplier involvement and agility performance ($\beta = 0.21$, $p<0.05$). On the other hand, a positive and not significant relationship between SI and agility performance was resulted at the low levels of technological turbulence ($\beta = 0.07$, $p>0.05$).

Table 5. 11: DV: Agility Performance, Moderator: Absorptive Capacity, Technological Turbulence

Variable	Model 1	Model 2	Model 3	Model 4	VIF
Age	-0.03 (-0.34)	-0.01(-0.08)	-0.01 (-0.17)	-0.02 (-0.26)	1.24
EMPL	-0.03 (-0.40)	-0.02 (-0.30)	-0.03 (-0.45)	-0.02 (-0.32)	1.49
NoPD5	0.30 (4.19)***	0.20 (3.33)**	0.21 (3.42)**	0.20 (3.37)**	1.24
NKS	-0.10 (-1.31)	-0.14 (-2.12)*	-0.14 (-2.16)*	-0.12 (-1.90)	1.46
AC		0.43 (7.46)***	0.43 (7.32)***	0.41 (6.87)***	1.26
SI		0.27 (4.70)***	0.27 (4.73)***	0.20 (3.36)**	1.31
TT		0.11 (1.98)*	0.12 (2.12)	0.09 (1.48)	1.30
AC^2			-0.07 (-1.28)	-0.08 (-1.49)	1.10
SI^2			-0.07 (-1.19)	-0.10 (-1.59)	1.32
SI x AC				0.15 (2.62)**	1.22
SI^2 x AC				-0.01 (-0.04)	1.06
SI x TT				0.13 (2.33)*	1.04
SI^2 x TT				0.04 (0.64)	1.60
R^2	0.08	0.40	0.41	0.45	
Adjusted R^2	0.06	0.39	0.39	0.41	
F-Value	4.46**	19.90***	15.81***	12.45***	

****, p<0.001; **, p<0.01; *, p<0.05; T-values are in parentheses*

5.7.2.1. Result for Hypotheses related to Innovation Life-Cycle

As it was hypothesised in chapter 3, in addition to testing the general relationship between supplier involvement and API performance, this research is also interested in investigating whether the association between SI and API performance would be the same in different phases of innovation life cycle (ILC). Based on the conceptualised three stages for ILC (i.e.

emerging phase, growth phase, and mature phase), the dataset was categorised into three parts (group analysis), followed by performing the regression analysis to test the relationship between supplier involvement and two dimensions of API performance (general and agility). Table 5.12 illustrates the result of group analysis in which regression analysis was done for each part (phase) separately.

Table 5. 12: Supplier Involvement and Innovation Life-cycle

	Emerging Phase		Growth Phase		Mature Phase	
Variable	General Performance	Agility Performance	General Performance	Agility Performance	General Performance	Agility Performance
SI	- 0.11	0.44 ***	- 0.23 *	0.35***	- 0.52***	0.18
	(- 0.93)	(4.05)	(- 2.30)	(3.69)	(- 4.65)	(1.38)
R^2	0.01	0.20	0.05	0.12	0.27	0.03
Adj. R^2	0.00	0.18	0.04	0.11	0.25	0.02
F-Value	0.87	16.36***	5.28*	13.58***	21.63***	1.90

***, *p<0.001;* **, *p<0.01;* *, *p<0.05; T-values are in parentheses*

With regards to the emerging phase, the coefficient estimate for the relationship between SI and general performance did not attain the statistical significance; therefore, H_{8a} is rejected (-0.11, p>0.05). On the other hand supplier involvement has a statistically significant association with agility performance (0.44, p<0.001), Hence, H_{8b} is supported, suggesting that stronger supplier involvement is related to increased agility performance of a firm in the emerging phase of innovation life-cycle.

With regards to the growth phase, there is a significant relationship between supplier involvement and general performance (p<0.05). However, this result fails to support H_{9a} considering the negative sign appeared with standardised coefficient (β = -0.23). Hence, these analyses indicate that stronger supplier involvement is related to decrease in general performance of a firm in the growth phase of ILC. Furthermore, SI found to be positively and significantly associated with agility performance (0.35, p<0.001); thus, H_{9b} is supported indicating that stronger supplier involvement is related to increased agility performance of a firm in the growth phase of innovation life-cycle.

Finally with regards to the mature phase, a significant relationship is found between supplier involvement and general performance (p<0.001). However, this result fails to support H_{10a} regarding the negative sign associated with standardised coefficient (β = -0.52); indicating that stronger SI is related to decrease in general performance of a firm in the mature phase of

ILC. In addition, the coefficient estimate for the relationship between SI and agility performance did not achieve the statistical significance firm in the mature phase of innovation life cycle; therefore, H_{10b} is rejected (0.18, p>0.05).

5.7.3. Post Hoc Analysis: Relationship between two Dimensions of API

Since two dimensions of agile product innovation performance may have a significant interaction with each other, the post hoc analysis was done to shed light on the relationship between general and agility performance. Therefore, the potential impact of agility dimension on general performance was examined using hierarchical regression (Table 5.13). Following the simple procedure suggested by Pallant (2007), control variables including age, number of product design in last 5 years, number of employees, and number of key suppliers were entered in model 1. Similar to analysis in previous sections, the natural logarithm value was assigned to each control instead of the original value to deal with the problem of skewness. Then, agility performance as an independent variable was entered in model 2 to evaluate its impact on general performance.

The figures in Table 5.13 depicts that the addition of the agility dimension (model 2) to the model 1 containing control variables increases the R^2 by 0.13 in which the incremental F-value is significant at P<0.05. The control variables do not result in significant association with general performance in both model 1 and model 2. Furthermore, the β coefficient associated with agility dimension in model 2 is found to be positive and significant. This finding indicates that a stronger agility capability is related to increased general performance of a firm. In other words, greater levels of agility capability leads to superior financial and market related performance of a firm.

Table 5. 13: General and Agility performance

Variable	Model 1	Model 2	VIF
Age	0.04 (0.46)	0.05 (0.64)	1.23
EMPL	0.02 (0.29)	0.04 (0.46)	1.45
NoPD5	0.12 (1.64)	0.01 (0.11)	1.26
NKS	0.00 (0.01)	0.04 (0.52)	1.41
Agility performance		0.38 (5.65)***	1.09
R^2	0.02	0.15	
Adjusted R^2	0.00	0.13	
F-Value	1.06	7.38***	

****, p<0.001; **, p<0.01; *, p<0.05*

5.8. Chapter summary

This chapter was devoted to present the result of data analysis. The chapter began with explaining preliminary concerns regarding the survey research such as outliers, normality, non-response bias and common method bias. Then, the result of Confirmatory Factor Analysis (CFA) using AMOS 18 was presented to assess the dimensionality, reliability, and validity of the scales employed in the research model. Furthermore, Convergent Validity, Discriminant Validity, and Explanatory Factor Analysis were also explained to further assess the validity of the research's measurement.

The remainder of chapter was dedicated to present, the results of hypothesis testing using hierarchical regression and group analysis. Table 5.13 summarises the major findings of the research.

Table 5. 14: Summary of Results of Hypotheses Testing

Hypothesis 1a	*The relationship between responsive market orientation and General performance is tending to increase as the technological turbulence increases.*	Rejected
Hypothesis 1b	*The relationship between responsive market orientation and Agility performance is tending to increase as the technological turbulence increases.*	Supported
Hypothesis 2a	*The relationship between proactive market orientation and General performance is tending to increase as the technological turbulence increases.*	Rejected
Hypothesis 2b	*The relationship between proactive market orientation and Agility performance is tending to increase as the technological turbulence increases.*	Rejected
Hypothesis 3a	*The relationship between responsive market orientation and General performance is tending to increase as the competitive intensity increases.*	Rejected
Hypothesis 3b	*The relationship between responsive market orientation and Agility performance is tending to increase as the competitive intensity increases.*	Supported
Hypothesis 4a	*The relationship between proactive market orientation and*	Supported

	General performance is tending to decrease as the competitive intensity increases.	
Hypothesis 4b	*The relationship between proactive market orientation and Agility performance is tending to decrease as the competitive intensity increases.*	Rejected
Hypothesis 5a	*The relationship between responsive market orientation and General performance is tending to increase as the market turbulence increases.*	Rejected
Hypothesis 5b	*The relationship between responsive market orientation and Agility performance is tending to increase as the market turbulence increases.*	Supported
Hypothesis 6a	*The relationship between proactive market orientation and General performance is tending to decrease as the market turbulence increases.*	Supported
Hypothesis 6b	*The relationship between proactive market orientation and Agility performance is tending to decrease as the market turbulence increases.*	Rejected
Hypothesis 7a	*The greater the supplier involvement in product innovation process the better the General performance will be*	Rejected
Hypothesis 7b	*The greater the supplier involvement in product innovation process the better the Agility performance will be*	Supported
Hypothesis 8a	*The supplier involvement has a positive impact on General performance in Emerging phase of innovation life cycle.*	Rejected
Hypothesis 8b	*The supplier involvement has a positive impact on Agility performance in Emerging phase of innovation life cycle.*	Supported
Hypothesis 9a	*The supplier involvement has a positive impact on General performance in Growth phase of innovation life cycle*	Rejected
Hypothesis 9b	*The supplier involvement has a positive impact on Agility performance in Growth phase of innovation life cycle*	Supported
Hypothesis 10a	*The supplier involvement has a positive impact on General performance in Mature phase of innovation life cycle*	Rejected
Hypothesis 10b	*The supplier involvement has a positive impact on Agility performance in Mature phase of innovation life cycle.*	Rejected

Hypothesis 11a	*At a greater level of technological turbulence, the positive impact of supplier involvement on General performance will increase.*	Rejected
Hypothesis 11b	*At a greater level of technological turbulence, the positive impact of supplier involvement on Agility performance will increase.*	Supported
Hypothesis 12a	*The greater the absorptive capacity of the firm, the greater the General performance.*	Supported
Hypothesis 12b	*The greater the absorptive capacity of the firm, the greater the Agility performance*	Supported
Hypothesis 13a	*At a greater level of AC of the firm, the positive impact of supplier involvement on General performance will increase.*	Rejected
Hypothesis 13b	*At a greater level of AC of the firm, the positive impact of supplier involvement on Agility performance will increase.*	Supported

Chapter 6: Discussion of results

6.1. Introduction

The purpose of this chapter is to further discuss the findings of empirical analysis presented in the previous chapter (Chapter 5). The second section is devoted to explore the results related to the associations between market orientation dimensions and agile product innovation performance under environmental turbulence circumstances (i.e. technological turbulence, competitive intensity, and market turbulence).

The third section interprets the results on the links between supplier involvement and agile product innovation performance. In addition, the relationship between supplier involvement and API performance is further explored considering the different stages of innovation life cycle (emerging, growth, and mature). This section also presents a discussion for the moderating effect of technological turbulence on the contingent association between supplier involvement and API performance dimensions.

The fourth section is dedicated to discuss findings regarding the association between a firm's absorptive capacity and API performance. This is followed by discussions on the moderating impact of absorptive capacity on the relationship supplier involvement and agile product innovation performance.

6.2. Market Orientation Dimensions and Agile Product Innovation

6.2.1. Direct Impact of Market Orientation Dimensions on Agile Product Innovation Performance

One of the main purposes of this research was to investigate the contingent relationship between market orientation (MO) dimensions (responsive and proactive) and agile product innovation performance under environmental turbulence circumstances. To shed more light on the interaction between MO dimensions and product performance, product innovation performance was grouped into two General and Agility performance measures. With regards to the direct impact of MO dimensions on product innovation performance, while some recent studies (i.e. Atuahene-Gima et al., 2005, Tsai et al., 2008) claimed a curvilinear relationship between responsive and proactive market orientations and new product performance, this study found only linear and positive relationship between the two dimensions of market orientation and the agile product innovation performance which is supported by the findings of some other studies in the market orientation context (Narver et al., 2004, Zhang and Duan, 2010, Bodlaj, 2011)

However in the current volatile business atmosphere, the importance of organisational strategies, here market orientation, varies according to the environmental context (Harris, 2001, Rose and Shoham, 2002, Cadogan et al., 2003, Jaworski and Kohli, 1993). The results of this research demonstrate that environmental turbulence factors also play vital roles in the relationships between two dimensions of market orientation and agile product innovation performance. This is in line with the findings of the empirical study by Tsai et al. (2008), suggesting that the relationship between the two dimensions of market orientation and new product performance may depend on external environmental characteristics. The contingent association between MO dimensions and API performance under the impact of different environmental turbulence factors (i.e. technological turbulence, competitive intensity, and market turbulence) are further discussed in the following sections:

6.2.2. Impacts of Environmental Turbulences factors on the Relationship between Market Orientation Dimensions and API Performance

6.2.2.1. Responsive Market Orientation and API Performance

The statistical analysis reveals a consistent behaviour and identical effect of all three environmental factors (i.e. technological turbulence, competitive intensity, and market turbulence) on the link between responsive market orientation and agile product innovation performance. The research finding shows no empirical support for the three hypotheses related to the moderating effect of environmental turbulences on the relationship between RMO and general performance. On the contrary, the results explain that all of the environmental factors have positive impact on the relationship between RMO and agility performance.

Firstly, a positive and linear relationship is found between responsive MO and agility performance under high level of technological turbulence conditions (H_{1b}). This suggests that companies surviving in relatively turbulent technological environment are capable of improving their product agility performance through realising and meeting the expressed needs of customers. With regards to the technological turbulence definition- rate of technological change (Kohli and Jaworski, 1990)- any increase in technological turbulence is linked with the introduction of relatively new or modified technology. The introduction of new technology may offer superior opportunities for companies to increase the number of innovations, the speed of innovation, and also the level of innovativeness (novelty or newness of the technological aspect). Furthermore, as suggested by Narver et al. (2004) expressed needs of customer may have either expressed or latent solutions. A responsive market oriented firm may be able to address expressed needs by generating new latent solutions in high turbulent technological environment and as a result gain an inimitable competitive advantage. Therefore, under high levels of technological turbulence responsive market oriented company can satisfy articulated customer needs by introducing its new innovative product and consequently achieve an advantage on its product agility performance. For example, as cited by Tsai et al. (2008), FLYTECH Company is a POS (point of sale) hardware platform producer and operates in a highly turbulent technological environment. With the aim of responding to market competition, this firm has constantly developed different POS models supporting CPU speeds and functions for a variety of applications to meet its expressed customer needs and has achieved valuable competitive advantages (e.g. early market entrants, high levels of newness associated with the company's product) in international POS market.

Consistent with recent relevant studies (i.e. Tsai et al., 2008) the research findings also show the existence of a linear and positive relationship between responsive MO and agility performance under high levels of competitive intensity (H_{3b}). One interpretation of this finding is that when a firm's business environment is associated with high levels of competition, potential customers have different choices to satisfy their current needs. Therefore, for companies operating in this atmosphere the ability to be agile and responsive in satisfying expressed customer needs in a right time seems to be vital (Tsai et al., 2008). By increasing the level of competitive intensity, lack of flexibility and speed of a firm to satisfy articulated customer's expectation would allow competitors to take its position in the market. Thus, a firm should endeavour to build up and/or improve some skills and routines in recognising and meeting current customer needs very quickly. In other words, high competitive environment leads companies to become more responsive market oriented by producing innovative products as well as increasing the speed of new product development and consequently its agility performance. For example, automotive industry, in developing countries, during the early 2000s entered in the intense competition era. SAIPA, an Iranian automotive manufacturer, has realised the intense competition and gradually focused on expressed needs of domestic market. It was mainly done by investing on the applicable mechanisms to understand the articulated needs of customers (e.g. customer based survey). Consequently SAIPA was honoured the ranking of Iran's No. 2 branded automotive company as a result of introducing number of new cars' model featuring with new and innovative components which satisfies articulated needs of its local customers.

Finally, a positive and linear relationship is explored between responsive MO and agility performance under high level of market turbulence conditions (H_{5b}). Focusing on current customer needs when a firm deals with a fixed number of customers with stable preferences (low market turbulence) is likely to have only little effect on performance (Kohli and Jaworski, 1990). In contrast, the knowledge about the customers' preferences absorbed from being (responsive) market oriented could lead to more effective market targeting, product development, and positioning (Hunt and Morgan, 1995, Narver et al., 2004), particularly when customer sets and their preferences are less stable. Therefore, owning the proper skills to identify expressed customer needs may lead to increased ability of a firm to be more agile and responsive to cater different customer expectations under high market turbulence which in turn can improve a firm's agility performance. This attitude can be found in many world class manufacturing and service organisations which have predominantly become customer focused and market oriented, and as the result gathered extensive momentum through developing capabilities to respond appropriately to market and customer demands and changes. Example of Apple as one of the most respected customer focused businesses in the new century is well documented. Apple has totally focused its innovation on customer and market and become a highly agile world leader.

6.2.2.2. Proactive Market Orientation and API Performance

Similar to the relationship between responsive MO and API performance, the research findings show the consistent behaviour and identical effect of all three environmental dimensions (i.e. technological turbulence, competitive intensity, and market turbulence) on the link between proactive market orientation and agile product innovation performance. The statistical analyses suggest no support for the three hypotheses related to the moderating effect of environmental turbulences on the relationship between PMO and agility performance. On the contrary, the results assert that all three environmental factors have negative impact on the relationship between PMO and general performance.

To argue the case it can be first observed that, a negative and linear relationship is found between proactive MO and general performance under high level of technological turbulence conditions (H_{2a}). In this type of environment different routes can be taken to satisfy latent and unarticulated customer needs regarding the wide diversity of new introduced technology in any industry. While a proactive market oriented firm endeavours and invests to understand latent customer needs and to develop new product by employing new technology in relatively long period of time, introduction of more advanced/ new technology may obsolete the new introduced product even in the new product development phase. This in turn can negatively impact on new product's financial performance. This suggests that companies operating in relatively turbulent technological environment may confront a potential risk which weakens new product success while they are attempting to understand and satisfy customers' latent needs. For example, computer technologies during the late 1990s experienced a highly turbulent technological condition. Acer, a Taiwanese computer company ranking as the world's Number 4 branded PC manufacturer, has invested a great amount of money on assimilating new technological knowledge for producing new computers to satisfy latent customer needs. However, Acer finally failed to achieve this mission and the company turned back to focus on quickly responding its articulated customer needs.

The statistical analysis also reveals the existence of a linear and negative relationship between proactive MO and general performance under high level of competitive intensity (H_{4a}). When competitive intensity is high, the need for exploring new technological knowledge amplifies because customers can take alternative routes to satisfy their needs (Tsai et al., 2008). Although proactively pursuing latent customer needs may facilitate a firm to differentiate itself from market competitors (Tsai et al., 2008, Atuahene-Gima et al., 2005), however it may cause a risk of losing potential customers in the market. A proactive market orientated firm may need to sacrifice a considerable amount of time and investment to assimilate external and/or internal new technological knowledge in order to satisfy unarticulated customer needs. Under high competitive condition, while a firm proactively seeking latent customer need, other companies may target a firm's potential customers by responsively satisfying current customer needs. Therefore, while in high turbulent environment producing continuously innovative product via exploring novelties is very important for companies (Koberg et al., 2003), conversely being extremely proactive in this type of environment can negatively impact on general performance of companies. For instance, as cited by Tsai et al. (2008), TAIFLEX Scientific Company (a flexible copper-cladded laminator, FCCL, materials provider and the winner of 13th National Award of Small Medium Enterprises in Taiwan) has focused to seeking latent markets. As a result of many years of R&D experiences, this company has developed highly precision inspection know-how, moving toward high reliability of FCCL products. As a result of employing a proactive strategy, TAIFLEX Company was successful to differentiate itself in the market. However, by focusing too much in unarticulated customer needs (lack of consideration on expressed customer needs in parallel), TAIFLEX gradually has lost its market share as its key competitors have undertaken its position in the market by satisfying TAIFLEX's customers' articulated needs.

Finally, the research findings assert the existence of a linear and negative interplay between proactive MO and general performance under high level of market turbulence (H_{6a}). When a customer sets and/or their preferences of a proactive firm are unstable (high market turbulence), a wide range of unarticulated customer needs should be targeted to be served. In this condition, a firm's offerings may become incompatible with customer's needs over a period of time (Kohli and Jaworski, 1990). Misalignment of customer's latent expectation and a firm's set of offerings over a period of time can negatively affect new product success. This negative effect is characterised by poor financial and marketing ratio and relatively low level of customer satisfaction representing general performance of a firm. This insight presents some specific scenario which according to the general literature presents situation of concern for industry. The insight deserves real world indication of occurrence which this research within its scope has not found some clear examples, and shall leave it for further research as suggested in the final chapter too.

In short, considering both dimensions of market orientation the research findings further support the suggestions of prior studies (Tsai et al., 2008, Atuahene-Gima et al., 2005) regarding the existence of moderating effects of technological turbulence and completive intensity on the relationship between MO dimensions and new product performance. Furthermore, the research also introduced the market turbulence factor as an influential factor (moderator) on the contingent link between market orientation dimensions and product innovation performance.

6.3. Supplier Involvement and Agile Product Innovation Performance

6.3.1. Direct impact of Supplier Involvement on Agile Product Innovation Performance

The next key objective of this research was to investigate the contingency relationships between supplier involvement and agile product innovation performance (general and agility) by considering the potential impacts of technological turbulence and innovation life-cycle.

While, following the majority of studies in the pertinent literature (e.g. Nieto and Santamaria, 2007, Bonaccorsi and Lipparini, 1994, Monczka et al., 2000, Nijssen et al., 1995, Cousins et al., 2011, Song and Benedetto, 2008) a positive and direct relationship between supplier involvement and general performance was hypothesised, statistical analysis in this study fails to support this hypothesis (H_{7a}). Also to be consistent with prior studies (e.g. Das et al., 2006) the existence of curvilinear relationship between supplier involvement and both dimensions of agile product innovation was checked which however was not supported by the research statistical analysis.

Surprisingly, the counterintuitive result shows that stronger supplier involvement is related to a decreased general performance of a firm. This result is however in line with some previous research in the literature which showed no positive relationship or even claimed negative interaction between supplier involvement and key outcomes of new product performance such as product development cost (Freel, 2003, Sanchez and Pérez, 2003, Belderbos et al., 2004, Eisenhardt and Tabrizi, 1995), partly due to the need for greater coordination (Ittner and Larcker, 1997). When a firm is not able to develop cost effective products, even if it is distinctive in terms of novelty and quality, it cannot command premium pricing suitable for its potential market. This may lead to an irretrievable loss in a firm's predicted sales and consequently its market share. Therefore, increasing costs associated with innovative product development not only could negatively affect a firm's financial goals (i.e. sales growth, return on investment) in short-term, but can also violate the customer satisfaction level as a result. This line of reasoning leads to support for the research finding, however unexpected, that a negative relationship exists between supplier involvement and general performance. For example, as cited by Von Corswant and Tunälv (2002), a Swedish company who produces parts and components for automotive manufacturer experienced unsuccessful collaborations with some of its main suppliers. The qualitative study by Corswant and Tunälv (2002) indicates lack of adequate levels of coordination between partners as the main reason behind the unsuccessful collaboration with suppliers. As a result of poor communication and coordination between Swedish companies and its key suppliers, the process of knowledge transfer in particular became problematic which ultimately increased the cost associated with new products.

On the other hand, the research finding shows positive and direct effect of supplier involvement on agility performance (H_{7b}) which is supported by a number of previous studies (e.g. Song and Benedetto, 2008, Nijssen et al., 1995, Rauniar et al., 2008, Petersen et al., 2005, Whitley, 2002). Close relationships with suppliers can enable companies to employ supplier's capabilities from various points of view with the aim of improving and re-boosting their product development strategies (Eisenhardt and Tabrizi, 1995, Bonaccorsi and Lipparini, 1994, 2005). By sharing information at early stages of the innovation process with suppliers, a firm can identify, solve, and enhance potential technical difficulties and as a result reduce a cycle time associated with product development (Nijssen et al., 1995). Likewise, supplier involvement can speed up a new product development process by eliminating and/or reducing potential product design glitches and errors (Rauniar et al., 2008). Furthermore, by collaborating with suppliers, companies can achieve valuable knowledge about new technologies and process improvements (Whitley, 2002) and also achievement of innovation outcomes can be accelerated considerably (Liker et al., 1999). This can lead to improving product innovativeness and novelty of innovation (Nieto and Santamaria, 2007) and can also allow a considerable increase in the number of firm's new innovative product. Moreover, Petersen et al. (2005) conclude that contribution of suppliers can result in a superior decision making which in turn, facilitates the development of a better design outcome and consequently superior innovation. Therefore, it can be concluded that companies can expect greater agility performance by involving their suppliers into their product innovation process. For example, in a case of Swedish company mentioned above as a case of unsuccessful collaborating with suppliers, although the collaboration with its main suppliers unexpectedly increased total cost for new products, but on the other hand it facilitated a company not only to enhance the novelty and newness of its new products, also to increase the number of new products that was first-to-market. These advantages were achieved by the Swedish company as a result of assimilating knowledge about new technologies and process improvements generated by key suppliers.

Here the contrasting results for the two dimensions of API performance lend support to the research approach in considering product innovation performance as a multidimensional construct. This in fact means that the value of relations with suppliers should not be sought only in the financial and market aspects, which happens in this study to show a negative impact. Suppliers may bring other values to the firm's (product) innovation process which in turn would contribute to the success of its innovation ventures. For instance, as mentioned earlier, pertinent knowledge offered by suppliers would enhance a firm's capability of exploring new and novel ideas to produce more innovative product. The enhanced innovation capability in long-term can enable firms to improve innovation process which in turn may shrink costs associated with product development process, resulting in improvement of a firm's general performance. This intuitive interpretation however needs to be further investigated in future research (see Section 7.4).

6.3.2. Supplier Involvement in Innovation Life-Cycle

To shed more light on the nature of the contingent association between supplier involvement and agile product innovation performance, following Johnsen et al. (2006), this research employed the theory of innovation life cycle (Utterback, 1994, Tidd et al., 2005, Abernathy and Utterback, 1978). The employment of ILC theory facilitated this study to further investigate the impact of supplier involvement on API performance in different stages of innovation life cycle. As mentioned in Section 3.3.2.2, the research hypothesised the positive impact of supplier involvement on API performance (general and agility) in all three stages of innovation life-cycle (i.e. emerging, growth, mature). However the statistical analysis revealed the mixed results instead (H_8, H_9, H_{10}):

While supplier involvement did not have a significant relationship with general performance in the emerging phase, it showed a negative impact on general performance in the growth and mature phases. On the other hand, SI presented a positive association with agility performance in the emerging and growth phases, while its impact on agility performance was not significant in the mature stage.

The data showing the β coefficient values associated with SI in different stages (see Table 5.12) is evident that the strongest positive impact that can be expected from supplier involvement on product innovation performance is in the emerging stage. This is so as firstly the β coefficient for SI-agility performance in this stage is the largest value among all stages, and secondly the β coefficient for SI-general performance is the minimum (across the three stages) and not significant. In contrast, in the mature phase involving suppliers in product innovation process may be considered as an inappropriate strategy since β coefficient for SI-agility performance is not significant and more importantly β coefficient for SI-general performance has the highest value compared with other phases. This will be explained further in the following paragraphs.

As mentioned in Chapter 3, Johnsen et al. (2006), suggested that "*supplier and customer relationships may be less important factors in the innovation process in fluid and emerging contexts than in mature and specific contexts*" (Johnsen et al., 2006, p. 676). However, the findings of this study cautiously disagree with such suggestions and in contrary claims that involving suppliers in the product innovation process may be more important in emerging phase vis-à-vis growth phase and especially mature phase.

With regards to the emerging phase, first, involving suppliers into product innovation process would enable firms to utilise and assimilate a range of valuable solutions- offered by key suppliers- for technical glitches and errors that may occur in early steps of design and innovation process (Sobrero and Roberts, 2001). The assimilation of these solutions, therefore may lead to accelerating the innovation process, thus resulting in considerable increase in the speed of new product innovation and development.

Furthermore, employing new technologies brought in by suppliers can facilitate firms in enhancing the newness and novelty of firm's new products which cannot be easily imitated by competitors. The employment of technological capabilities of suppliers would thus allow firms to make fundamental changes in new products that represent revolutionary changes in product or process technology. These fundamental changes are labelled as radical innovations

(Song and Benedetto, 2008) which are the main characteristics of emerging phase of innovation life-cycle (Johnsen et al., 2006).

With regards to the growth phase, statistical analysis revealed a mixed result in which while stronger supplier involvement is associated with a decreased financial and market related performance of a firm, it may improve the innovation and agility related performance. This result is in line with the findings regarding the general relationship between supplier involvement and agile product innovation performance (general and agility) explained in Section 6.3.1. More in-depth investigation on the contrasting results for the two dimensions of API performance in growth phase remains as further research in which the longitudinal study on the long-term effect of suppliers on product innovation performance will be in the centre of attention (see Section 7.4).

Finally, with regards to the mature phase, supplier involvement may, however, impede the successful product innovation process. The rationale behind this is that, in the mature stage, firms mainly focus on standardised products and incremental product innovation. Since one of the main principle of producing standardised products is to focus on the cost reduction strategies, involving suppliers may not be helpful to implement such strategies for instance due to the need for greater coordination among internal and external partners (Ittner and Larcker, 1997). Increasing cost associated with the firm's products in turn may therefore negatively impact on financial performance aspects such as return on investment and consequently on customer acceptance and satisfaction levels.

Furthermore, focusing on the development of standardised products may also reduce the importance of supplier's technological capabilities, since, there is no great need for enhancing the newness and novelty of firm's new product (radical innovations) in the mature phase quite opposite to the emerging phase.

6.3.3. Moderating Effect of Technological turbulence on the Relationship between Supplier Involvement and API performance

To further investigate the contingent relationship between supplier involvement and agile product innovation performance the moderating impact of technological turbulence on this relationship was also tested in this study. The statistical findings show that technological turbulence only has the moderating effect on the relationship between supplier involvement and agility performance (H_{11b}) in which the greater levels of technological turbulence strengthen the positive association between supplier involvement and agility performance.

The rationale behind this is that technological turbulence in the market environment offers alternative ways to satisfy customer needs by employing new technology and knowledge in producing new and innovative products. However, due to the current competitive environment firms in general are not able to identify and assimilate the pertinent technologies at a right time as the internal firm's capabilities are limited to scan and cover all technological changes in both internal and external business environment. Therefore, there is a need to collaborate with external players such as suppliers to employ new technologies developed by those suppliers. Also close collaboration with suppliers who are well familiar with new technologies in the business environment can help firms to envisage the technological changes in the future which perhaps open a window of opportunity to develop new and innovative products. Thus, under high levels of technological turbulence, involving suppliers would enable firms to identify and more importantly assimilate the new technologies developed by suppliers into the new product innovation process; thus resulting in the improvement of product agility performance criteria such as the a) enhancement of newness and novelty associated with new products; b) increase in a number of new developed products; c) reduction of a development time (for instance by improving design process), and d) early market entrants.

This finding is in line with some previous studies in this context. For instance, Wasti and Liker (1999, 1997) suggested that the accumulation of technology turbulence and suppliers technical capabilities will positively affect supplier involvement in product development process. In other words, technological turbulence can result in closer relationships with main suppliers and consequently improve a firm's performance through early involvement in product development process (Wasti and Liker, 1997). Furthermore, Lee et al. (2009), also emphasised on the important role of technological turbulence in SI-new product performance relationship and argue that technology change leads to specific investments and supplier alliances which in turn enables firm to implement an effective approach to producing innovative products equipped with the technologies required by the market.

6.4. Absorptive capacity and Agile Product Innovation Performance

6.4.1. Direct impact of Absorptive capacity on Agile Product Innovation Performance

The next purpose of this research was to investigate the relationship between absorptive capacity and agile product innovation performance. The research finding shows positive and direct effect of absorptive capacity on both dimensions of API performance (general and agility; H_{12a} and H_{12b} respectively). Furthermore, post hoc analysis also shows an invert-U shaped relationship between absorptive capacity and general performance which may offer better explanation for effects of a firm's absorptive capacity on product innovation output. This finding is in line with the study of Stock et al. (2001) who suggested existence of curvilinear relationship between new product performance and absorptive capacity. As mentioned in the literature review chapter, absorptive capacity is defined as the organisational mechanisms that help to identify, communicate and assimilate relevant external and internal knowledge (Tu et al., 2006). According to Tu et al. (2006) absorptive capacity contains three main elements namely the firm's existing knowledge base, the effectiveness of systems that scan the environment, and the efficacy of the firm's communication processes. The accumulation of these three elements would allow a firm to improve the process of absorbing knowledge for commercial ends. This improvement enables a firm to generate more advanced innovative product (Nonaka and Takeuchi, 1995) which in turn results in increasing level of customer satisfaction and better financial performance. However, the existence of curvilinear relationship suggests that a firm may not be able to gain further advantage on its general performance associated with product innovation by excessively investing on absorptive capacity. This can be due to the fact that there are diminishing returns to investments in learning as there are likely diminishing returns to investment in almost any other efforts in improving processes (Stock et al., 2001).

On the other hand the empirical findings suggest a positive and linear relationship between absorptive capacity and agility performance. By improving the process of absorbing knowledge for commercial ends (Tu et al., 2006) companies can satisfy the needs of potential emerging markets in the condition of business environment uncertainty (Lichtenthaler, 2009). Also, agility and speed to innovate in response to the environment can arise from achieving a full integration and dissemination of knowledge within the organisation while maintaining its flexibility (Gilbert and Cordey-Harves, 1996). This in turn shows the role of absorptive capacity's mechanisms as a dynamic capability for achieving agility. Therefore, advancing further the absorptive capacity as a set of vital mechanisms to better assimilate and reconfigure internal and external competencies will result in an increase in agility performance, and hence with product innovation.

6.4.2. Moderating Effect of Absorptive Capacity on the Relationship between Supplier Involvement and API Performance

Apart from direct effect of absorptive capacity, its moderating impact on the relationship between supplier involvement and agile product innovation performance (general and agility) was also hypothesised in the research conceptual framework. While the positive impact of supplier involvement on general performance was predicted to be increasingly manifested as the absorptive capacity increases, statistical analysis in this study fails to support this hypothesis (H_{13a})[14]. However, data analysis shows that while there is a negative interplay between supplier involvement and general performance, absorptive capacity negatively impacts on this relationship. This result further supports the empirical findings by Tsai (2009) suggesting that the relationship between collaborative network (i.e. supplier involvement) and new product performance is moderated by absorptive capacity of a firm. By using the procedure introduced by Aiken and West (1991) it was found that at a high level of absorptive capacity, supplier involvement has negative effect on general performance. This finding despite being unexpected again may be explained by referring to some factors as key drivers dictating this relationship. First, increasing the absorptive capacity in terms of developing well-built knowledge-learning and sharing system between a company and its main suppliers needs initial investment in information system and technology which means increase in the cost associated with the new product innovation. Also implementation of information technology infrastructure is a costly and time consuming activity, which requires a systematic and well planned and managed training programme for employees to utilise the information sharing process. Some implication from these requirements include slow and error laden transition stages, delays in product development process, and increase in the cost

[14] As can be seen in Table 5.10 and 5.11 the (SI^2xAC) cross product term was also entered into the regression analysis in order to examine the impact of absorptive capacity on a potential nonlinear relationship between supplier involvement and both dimensions of agile product innovation performance. As a result the interaction terms did not achieve a statistical significant; rejecting the existence of non-leaner relationship between SI and API performance (general and agility).

of product and services leading to customer dissatisfaction as well as poor financial performance ratios (e.g. diminishing returns to investment in short time).

The results also support the research final hypothesis (H_{13b}) suggesting that the relationship between supplier involvement and agility performance is increasingly manifested as the firm's absorptive capacity increases. Higher levels of absorptive capacity facilitate a firm to perform better than its competitors in innovation activities via achieving privileged range of advantages from a particular cluster of external knowledge (Tsai, 2001). This enhancement would allow companies to have a stronger exchange and employment of novel ideas, relevant knowledge and experience regarding the key issues such as product design, technical issues, and even management practices. Consequently this enhanced communication and collaboration with main suppliers facilitate a firm to increase the speed, flexibility and innovativeness measures associated with new developed product resulting in improved levels of agility performance.

6.5. The Impact of Agility Capability on General Performance

Apart from testing the formulated hypothesis, this study also attempted to examine the potential relationship between two dimensions of agile product innovation performance (general and agility). The result of post hoc analysis (Table 5.13) shows the existence of positive association between agility and firm's general performance which is consistent with the suggestion of scholars in the pertinent literature (Va´zquez-Bustelo et al., 2007, Reinartz et al., 2004, Jin-Xing et al., 2011) who identified agile capabilities as important determinants of business performance (Yusuf et al., 2004). Agility can contribute to organisational performance in various ways (Sambamurthy et al., 2003, Jin-Xing et al., 2011) including: quickly responding to any changes in customer demand, which enables agile organisations to improve customer satisfaction and grasp valuable opportunities in the market by leveraging knowledge regarding the customer needs and requirements (Kidd, 1994); developing a network of partnership which facilitates agile organisations to understand and utilise knowledge and competencies of external partner i.e. suppliers (Venkatraman and Henderson, 1998); and rapidly redesigning and streamlining an organisation's business process, which allows agile organisations to reduce costs and also achieve greater levels of speed, flexibility and accuracy (Teece et al., 1997).

This finding sheds more light on the complex relationship found in this research between influential factors (e.g. supplier involvement) and API performance dimensions. The positive association between general performance and agility capability can offer further insight into, for instance, the case of the relationship between supplier collaboration and API performance. In this scenario, while the different effects of SI on general performance and agility performance (negative and positive respectively) can be viewed as strong evidence to support a two dimensional model of firm's innovation performance, the positive impact of agility capability on general performance claims the supplier involvement in product innovation process would enhance general performance of a firm associated with new product (financial and market related criteria) by advancing firm's agile capability.

This finding also resonates with the propositions in strategic management literature which, while recommend turning of the focus from financial related performance to capabilities, envisage a likely positive association between financial and market related performance and capabilities (see Teece et al., 1997). In general, the results from the research shows that any approach to study the strategy and process of innovation in firms and the effects of collaboration with suppliers and other external sources of knowledge should regard the strategies adopted by the firm regarding their business environment particularly the market in terms of agile capabilities. In other words the literature of the subject should include agility in its broad meaning as an essential aspect for ascertaining innovation strategy of the firms.

6.6. Chapter Summary

The main purpose of this chapter was to discuss the results stemming from the research statistical analysis. The chapter began with the interpretation on the contingent relationships between market orientation dimensions (responsive and proactive) and agile product innovation performance by considering the impact of environmental turbulence factors (i.e. technological turbulence, competitive intensity, and market turbulence). Then, the chapter focused on the association between supplier involvement and API performance dimensions by exploring the impacts of innovation life-cycle theory and technological turbulence factor.

Finally the chapter explored the relationship between absorptive capacity and API performance, followed by the discussion on the potential influence of absorptive capacity on the contingent link between supplier involvement and agile product innovation performance.

Chapter 7: Conclusions, Limitations, and Future Research

7.1. Introduction

The main goal of this concluding chapter is to highlight the key findings, contributions and limitations of this research. It begins with addressing the research questions introduced in Chapter one. Then, it illustrates the key contributions of this study. Finally, the limitations of this research and the possible directions for future research are explained in details.

7.2. Confronting the Research Questions with the Research Findings

The main purpose of this study was revolved around developing a multidimensional perspective on Product Innovation (PI) and understanding of how such differentiated dimensions of PI performance may influence our knowledge of the issues related to product innovation. An extensive literature review of the subject area and existing knowledge of the issues revealed the major influential factors to impact product innovation performance. These include absorptive capacity- (Stock et al., 2001, Kostopoulos et al., 2011), market orientation (Atuahene-Gima et al., 2005, Tsai et al., 2008), and supplier involvement and integration (Cousins et al., 2011, Song and Benedetto, 2008). The research direction taken to deal with contingency effects of the main factors of supplier involvement, market orientation, and absorptive capacity, as discussed in the introduction chapter, together with the explanation of current inconsistent views (see Section 3.2.1) led the research to employ better explaining theories for the purpose of conducting the research and contribute to the body of knowledge. For that purpose agility theory (Sharifi et al., 2009), as a leading strategy for competing in volatile business environment, was considered to develop a comprehensive perspective and particularly to set the multidimensional measure for product innovation performance.

The approach followed in the research was based on the latest developments in the subject knowledge and a well thought through and elaborated account of the gaps in the existing theories and understandings. The core idea was, as explained before too, that explaining circumstances to determine and influence PIP requires new visions and theories. The theoretical rationale behind adopting this approach primarily was that product innovation to succeed should be chased in a flexible process involving continuous reconfiguration of products in an agile (responsive or proactive) manner by reliance on external sources, particularly suppliers, as well as internal capabilities (Ismail and Sharifi, 2006) and strategies such as market orientation (Narver et al., 2004). Also as expressed in the literature to achieve such goals supply chain strategies should also be synchronised with firm's competitive strategies (Narasimhan and Kim, 2002, Qi et al., 2011), in particular, product innovation capabilities and strategies, and the required dynamic capabilities be developed on a base of existing internal competences (Teece et al., 1997). Hence, four elements can be emphasised in this perspective: a) a need for developing and measuring capabilities alongside performance (Teece et al., 1997, Braunscheidel and Suresh, 2009) as indicators of firm's competitiveness; b) supplier involvement or integration and c) market orientation strategy as the antecedents to both performance (Lau et al., 2010, Primo and Amundson, 2002) and capabilities (Braunscheidel and Suresh, 2009), here agility in product innovation; and d) internal capability/capacity to work with internal and external sources, absorb knowledge and develop capabilities.

Therefore, inspired by the "Agile Supply Chain framework" introduced by Sharifi et al. (2006, 2009), in this study the overall competiveness of the firm, in terms of product innovation, was labelled as *Agile Product Innovation* (API) which comprises both, firm' financial/market performance and agility capabilities in product innovation. API in concept is related to markets as well as supply chain, and is dependent on the capabilities available within the firm to support the strategy and innovation process. Hence, Agile *Product Innovation* (API) in this research was defined as *the capability of introducing innovative products (new or innovatively modified) which is agile by being flexible and responsive to market requirements as well as to internal and external capabilities;* and its performance was conceived with two dimensions namely *General performance* and *Agility performance*. While general performance reflects the degree of success of a firm's financial and market position as well as customer satisfaction level, agility performance refers to the degree of success of a firm (rooted in capabilities) in being agile and innovative in dealing with new product introduction to the market.

Drawing on findings of earlier studies, API performance was conceptualised (see Section 3.2.1) to be directly and indirectly (e.g. moderating effect) impacted by supplier involvement, market orientation dimensions -proactive and responsive- (e.g. Song and Benedetto, 2008, Atuahene-Gima et al., 2005, Augusto and Coelho, 2009), absorptive capacity (e.g. Tsai, 2009, Stock et al., 2001, Kostopoulos et al., 2011), and environmental characteristics containing technology turbulence, competitive intensity, and market turbulence (e.g. Harris, 2001, Ragatz et al., 2002). Hence, based on this perspective on agile product innovation, the core research questions guiding this study were generated as follows:

1. What are the associations between market orientation dimensions (responsive and proactive) and agile product innovation performance (i.e. general and agility)?
2. Do environmental turbulence factors (i.e. technological turbulence, competitive intensity, and market turbulence) moderate the relationship between supplier involvement and agile product innovation performance (i.e. general and agility)?
3. What is the association between supplier involvement and agile product innovation performance (i.e. general and agility)?
4. What is the association between supplier involvement and agile product innovation (i.e. general and agility) in different stages of innovation life-cycle?
5. Does technological turbulence moderate the relationship between supplier involvement and agile product innovation performance?
6. What is the association between absorptive capacity and agile product innovation performance (i.e. general and agility)?
7. Does absorptive capacity moderate the relationship between supplier involvement and agile product innovation performance (i.e. general and agility)?

In elaborating on these key research questions, an empirical study through online questionnaire survey method were carried out. Hence, drawing on an empirical sample of 233 manufacturing firms located in the UK, a number of statistical analyses was employed to address the abovementioned research questions and related hypotheses. The research was quite successful to draw on a reliable sample of industry and explore answers to the questions with some strikingly new and different results. The results particularly when providing contrasting or revised interpretations reflect the importance of the research to open new dialogues in the subject area as well as timeliness of the work to revisit some existing perceptions under new global economic conditions. A brief and explicit explanation for the aforementioned research questions is provided as follows:

1. **What are the associations between market orientation dimensions (responsive and proactive) and agile product innovation performance (i.e. general and agility)?**

   One of the main goals of this study was to investigate the relationship between market orientation (MO) dimensions (responsive and proactive) and agile product innovation performance. While some recent studies (i.e. Atuahene-Gima et al., *2005, Tsai* et al., *2008) suggested a curvilinear relationship between responsive and proactive market orientations and new product performance, this study found only linear and positive relationship between the two dimensions of market orientation and the agile product innovation performance[15]. The existence of positive and linear relationships between market orientation dimensions and API performance suggests that higher levels of responsive and proactive MO are associated with the enhancement of the general and agility performance of new products of a firm (see Section 6.2.1).*

2. **Do environmental turbulence factors (i.e. technological turbulence, competitive intensity, and market turbulence) moderate the relationship between supplier involvement and agile product innovation performance (i.e. general and agility)?**

   Since the importance of market orientation strategy varies according to the environmental context (Harris, 2001, Rose and Shoham, 2002, Cadogan et al., *2003, Jaworski and Kohli, 1993) it was deemed necessary to examine the impact of environmental turbulence factors on the relationships between MO dimensions and API performance. As a result, the findings of this study suggest that environmental turbulence dimensions play critical roles in the association between two dimensions of market orientation and agile product innovation performance.*

   The statistical analysis claims the consistent behaviour and identical effect of all three environmental factors (i.e. technological turbulence, competitive intensity, and market

[15] The quadratic terms for responsive and proactive market orientation were entered into the regression equation as a post hoc analysis. However, these quadratic terms did not achieve a statistical significant; suggesting that curvilinear associations do not exist between MO dimensions and API performance.

turbulence) on responsive-API performance and proactive-API performance associations. In this scenario, technological turbulence, competitive intensity, and market turbulence positively moderate the association between responsive market orientation and agility performance, while no support was found for their moderating impacts on the relationship between RMO and general performance (see Section 6.2.2.1). In contrast, all three environmental turbulence factors negatively moderate the association between proactive market orientation and general performance, while the statistical findings failed to support their moderating effects on the relationship between PMO and general performance (see Section 6.2.2.2).

3. **What is the association between supplier involvement and agile product innovation performance (i.e. general and agility)?**

Since there is a lack of consensus regarding the relationship between supplier involvement and product innovation performance, the research has re-examined this relationship in the light of agility theory by considering the multidimensional perspective on the performance measurement (general and agility dimensions). The results of study indicate that while supplier involvement has a direct positive effect on agility performance, surprisingly the stronger supplier involvement is related to a decreased general performance of a firm (see Section 6.3.1).

4. **What is the association between supplier involvement and agile product innovation (i.e. general and agility) in different stages of innovation life-cycle?**

Following Johnsen et al. (2006), this study employed the theory of innovation life cycle (Utterback, 1994, Tidd et al., 2005, Abernathy and Utterback, 1978) to better understand the nature of association between supplier involvement and agile product innovation performance. Adopting the innovation life cycle theory enabled this study to further investigate the impact of supplier involvement on API performance in different stages of ILC (emerging, growth, mature). The research findings show that while supplier involvement did not have a significant relationship with general performance in the emerging phase, it showed a negative impact on general performance in the growth and mature phases. On the other hand, SI represented a positive association with agility performance in the emerging and growth phases, *while its impact on agility performance was not significant in the mature stage. These findings suggest that involving suppliers into product innovation process may be more important in the emerging phase in comparison with the growth and mature phases (see Section 6.3.2).*

5. **Does technological turbulence moderate the relationship between supplier involvement and agile product innovation performance?**

The contingent relationship between supplier involvement and agile product innovation performance was further investigated by considering the moderating impact of technological turbulence (TT). The statistical findings revealed that technological turbulence only positively moderate the relationship between supplier involvement and agility performance (no statistical support was found for the moderating impact of TT on the link between supplier involvement and general performance). This means that greater levels of technological turbulence strengthen the positive association between supplier involvement and agility performance (see Section 6.3.3).

6. **What is the association between absorptive capacity and agile product innovation performance (i.e. general and agility)?**

Since dynamic capabilities (here absorptive capacity) of a firm were argued to play a vital role in the innovation process (Zahra and George, 2002, Kostopoulos et al., 2011), this research further investigated the relationship between absorptive capacity and agile product innovation performance. The research finding depicts positive and direct effect of absorptive capacity on both dimensions of API performance (general and agility). Furthermore, post hoc analyses also suggested an invert-U shaped relationship between absorptive capacity and general performance which can offer better explanation for the role of a firm's absorptive capacity in developing innovative product in terms of financial and market related outcomes. In other words, firms may not be able to achieve advantages, in particular financial related advantages, by excessively investing on their absorptive capacity (see Section 6.4.1).

7. **Does absorptive capacity moderate the relationship between supplier involvement and agile product innovation performance (i.e. general and agility)?**

Drawing on a suggestion by Tsai (2009), this research further examine the contingent link between supplier involvement and agile product innovation performance by considering the moderating impact of absorptive capacity as an internal competency and the ability of a firm to identify and assimilate the internal and external knowledge and technology. The result supports the existence of moderating role for absorptive capacity and claims that absorptive capacity negatively moderates the relationship between supplier involvement and general performance. This suggests that at high levels of absorptive capacity, supplier involvement has negative effect on general performance associated with new products. On the other hand the relationship between supplier involvement and agility performance is increasingly manifested as the firm's absorptive capacity increases; suggesting that at high levels of absorptive capacity, supplier involvement has a positive impact on agility performance associated with new products (see Section 6.4.2).

7.3. Contributions of This Research

The research has been a successful attempt to extend the existing literature on "New Product Innovation" and its relationship with suppliers' involvement, market orientation strategy, and firm's absorptive capacity. Introduction of agility concept in the model, as a leading theory to explain dynamics and uncertainties in the business environment, provided a new angle to existing perspectives on innovation in firms which have been revolutionised in the past few years under the influence of dramatic changes in the global economy. The research has re-examined previously reported theories and hypotheses while presented new hypotheses on the subject which typically were supported by the research leading to some interesting and somehow unexpected new insights.

By adopting agility theory, the research conceptualised and modelled the Product Innovation Performance as a multidimensional construct, called, "*Agile Product Innovation Performance*" against the typical single factor employed in previous studies (e.g. Tsai, 2009), in order to include both general (financial and market related factors) performance of the firms and its agility capabilities which is reflected in its product innovation performance.

Indeed, employing multidimensional performance measures for product innovation (PI) provided a better understanding of the relationships between PI and factors affecting its performance, thus covering the lack of consensus and contradictory results (e.g. the impact of supplier involvement on PI performance) stemming from the pertinent literature.

Furthermore, the research contributes to the extant literature by investigating the relationship between MO dimensions (as a newly adopted strategy in market orientation context) in the light of multidimensional perspective on product innovation performance (i.e. including agility performance). The next contribution of this study is to address the shortfall in the literature regarding the impact of market turbulence factor along with other environmental turbulence dimensions (technological turbulence and competitive intensity) on the relationship between MO dimensions and agile product innovation performance which was a first attempt in this context. In line with the findings of Tsai *et al* (2008), the results divulge complex and varied relationships between the two dimensions of market orientation and API performance (general and agility) depending on the intensity of the environmental turbulence factors. As mentioned earlier, the research revealed consistent behaviour and identical effect of all three environmental factors on the links between responsive and proactive orientation and agile product innovation performance. Although the research findings present no strong support for three of the hypotheses related to the relationship between RMO and general performance as well as PMO and agility performance, they disclose some novel and interesting outcomes regarding the impact of environmental factors. The research findings claim that in turbulent environment while RMO can improve a firm's agility performance, proactive MO can negatively impact on the general performance of a firm. The proactive market orientation strategy should therefore not exceed some levels as it begins to fall into a negative effect. This suggestion resonates with findings in some previous studies, particularly by Harris (2001, p. 36) who remarks exhortations to develop high levels of market orientation in order to improve company performance regardless of environmental conditions as unwise. The study also rejects a fixed strategy for market orientation and instead suggests that it should depend on environmental turbulence factors. In principle however employment of a mixed RMO-PMO strategy should be followed in order to cope with turbulent environmental conditions. In particular the study results, which do not support the suggested curvilinear relationships assumed in recent literature, may suggest that a multidimensional measure of new product performance would provide a more consistent platform for analysing and adopting appropriate strategy for firms.

The research also contributes to the literature of absorptive capacity (AC) by providing insights on the impact of AC directly on product innovation performance and capability of the firm (API). This study extends the current literature on absorptive capacity which generally claimed a simple positive/negative impact from AC on new product performance (NPP) (e.g. Kostopoulos et al., 2011) or some suggested an inverted-U relationship between absorptive capacity and NPP (e.g. Stock et al., 2001). The research outcomes, however, assert a more complex effect of absorptive capacity on API performance. First, an inverted U-Shaped relationship is found between absorptive capacity and general performance in which firms may not be able to achieve advantages by excessively investing on their absorptive capacity. On the other hand a positive and direct relationship found between absorptive capacity and agility performance supports the research theoretical stance that greater externally focused capabilities can be achieved built on internal competencies and capabilities. This set of findings provide new angles for the research in this area to connect with the emerging and changing theories of strategic management, i.e. dynamic capability, and innovation, i.e. open innovation.

In addition, the research further contributes to the existing literature on the contingent relationship between supplier involvement and product innovation performance in various ways. The research findings suggest that the relationship between supplier involvement and product innovation performance is more complex than previously theoretically argued and empirically examined in which some scholars suggest a positive and others claimed a negative association. First, the results from this study indicate that while supplier involvement has a direct positive effect on agility performance, surprisingly the stronger supplier involvement is related to a decreased general performance of a firm. Here the contrasting results for the two dimensions of API performance lend support to the research approach in considering product innovation performance as a multidimensional construct. Indeed the value of relations with suppliers should not be sought only in the financial and market aspects (as supported by dynamic capability theories (see Teece et al., 1997)), which happens in this study to show a negative impact. Suppliers may bring other values to the firm's (product) innovation process which in turn would contribute to the success of its innovation ventures.

More importantly, the research contributes to the current literature by arguing that the complex relationship between supplier involvement and product innovation performance is varied depending on factors such as a) innovation life-cycle, b) technological turbulence, and c) absorptive capacity.

a) The employment of innovation life cycle theory (Utterback, 1994, Tidd et al., 2005, Abernathy and Utterback, 1978) enabled this study to further investigate the impact of supplier involvement on API performance in different stages of ILC. This study was a first empirical attempt in the research area to examine the impact of innovation life cycle on the association between supplier involvement and product innovation performance using a considerably large sample size of manufacturing industries (i.e. 233 companies). As a result the research findings claim that involving suppliers into product innovation process may be more important in the emerging phase vis-à-vis the growth and mature phases. This finding expands the knowledge regarding the collaboration with suppliers in product innovation process in current literature and suggests that: innovating firms need to evaluate the form of innovation in which they engage, particularly in relation to the phase of development in order to involve their suppliers into product innovation and development process.

b) Since lack of consensus exist in earlier studies regarding the potential impact of technological turbulence on the relationship between supplier integration and product innovation and development process, this study also examined the moderating effect of technological turbulence on the link between supplier involvement and API performance. The research findings shed more light on this issue and suggest that the greater levels of technological turbulence only strengthen the positive association between supplier involvement and agility performance. In this scenario, firms operating in turbulent technological environment would be able to assimilate the new technologies particularly developed by suppliers into their new product innovation process; hence resulting in not only the increase in a number of developed products, also the enhancement of newness and novelty associated with new products. This finding is in line with some previous studies in this context (Wasti and Liker, 1999, Wasti and Liker, 1997, Lee et al., 2009).

c) Finally, this study also examined the impact of absorptive capacity on the contingent relationship between supplier involvement and API performance. The present study extends the literature on supplier involvement and integration to the contingent role of absorptive capacity in external knowledge acquisition for product innovations through involving supplier in PI process. The research analysis suggests an unexpected result. At a high level of absorptive capacity supplier involvement has negative effect on general performance. However, higher levels of absorptive capacity facilitate a firm to perform better than its competitors in innovation which in turn will lead to increase in a firm's agility performance. This expands the literature on dynamic capability, here absorptive capacity, and supplier involvement context and suggests that innovating firms always cannot expect positive outcomes from excessively investing on their ability to absorb internal and external knowledge and new technology, since it may negatively impact on financial outcomes due to the cost associated with expanding relevant internal competencies. Such view can have major impact on the direction, and hence strategies, firms would take on improving their AC through investing on learning and institutionalising knowledge in the organisation.

Although the study failed to support some of the proposed research hypotheses, it provides new insight into the product innovation context. This study, in general, claims a multidimensional perspective on agile product innovation and, in line with the relevant literature, suggests factors such as market orientation dimensions (responsive and proactive), supplier involvement, and absorptive capacity as influential dimensions in product innovation process. However, impacts from these factors, in particular market orientation dimensions and supplier involvement, on product innovation may be varied depending on external players such as environmental turbulence factors.

In brief, the results show how the changes in the business context is driving the logic and wisdom of running businesses, with a focus on innovation, to new frontiers which present a new landscape of competition on innovation. The results from the research show that any approach to study the strategy and process of innovation in firms and the effects of collaboration with suppliers and other external sources of knowledge should regard the strategies adopted by the firm regarding their business environment particularly the market in terms of agile capabilities. In other words the literature of the subject should include agility in its broad meaning as an essential aspect for determining innovation strategy of the firms. This particularly was evident in the contrasting results arrived at for the two dimensions of product innovation performance, supporting multidimensionality of suppliers' involvement, market orientation, and AC's and environmental factor's moderating effects.

7.4. Limitations and Future Research Directions

As mentioned earlier, the main goal of this study was to further our understanding of PIP through a new and multidimensional perspective on Product Innovation (PI) and by examining how the different dimensions affect PI performance. While this study contributes to the existing literature in various ways, similar to every contribution, the research and the chosen method have been subject to some limitations which may have had effects on the results and hence the concluded understanding of the research.

Firstly, despite utmost care taken to free the data from bias, which was supported by the applied tests, possibility of anomalies in survey data which may have affected the results cannot be rejected. For instance, since data were collected for the dependent and independent variables from a single-informant, a common method bias may occur. The existence of common method bias causes a significant problem for validity of findings in behavioural research (Podsakoff et al., 2003). To deal with this issue several approaches were considered in this research to remedy matters regarding the single informants and common method bias before (procedural remedies) and after (statistical remedies) conducting the survey. However, collecting data for dependent and independent variables from different sources (for instance from firms and their key suppliers) can be targeted for future research in product innovation context to entirely remedy matters with regard to the common method bias.

Secondly, this study focused exclusively on manufacturing industries in the United Kingdom when examining the research hypotheses. This particularity may limit the generalisability of the findings to other populations, considering the competitive, environmental, and cultural differences that exist between different countries and regions (Hughes and Morgan, 2008). Thus, extending the study to other developed regions can be one of the future areas of research. Furthermore, the sample being from the UK, despite the healthy rate of received responses, can be argued to need further validation if to be generalised for the industry at a global level.

Thirdly, this study conceptualised general performance as a reflective construct to be in line with earlier studies (e.g. Langerak et al., 2004, Petersen et al., 2005, Griffin and Page, 1996, Ou et al., 2010, Gotteland and Boule', 2006). However, considering the causality rational this might be a source of limitation, as the measures used in this study might act by forming rather than reflecting the application of the general performance constructs. Thus, general performance may be viewed as a formative construct which should be addressed by future research (see, Diamantopoulos (1999) and Jarvis et al. (2003) for further information regarding the formative vs. reflective subject).

Furthermore, as for the research findings presenting somehow unexpected outcome for the relationship between supplier involvement and general performance one explanation, beside the theoretical ground of the research, could be the timing of the research and survey which was undertaken during the recent financial crises. Considering the economic downturn and its likely effects on the economies of firms in the UK it may be expected that the employed market and financial factors to measure the "General performance" show not strong and healthy signs, and hence provide a potential explanation for the exposed negative relationship between supplier involvement and general performance. Also, supplier involvement construct studied here only indicates the level of involvement of suppliers, and no clear indication was given by the data on the level of effect of SI on company's performance. Hence, setting up new measurements for evaluating the level of impacts from suppliers on firm's performance criteria is a promising topic for future studies.

Moreover, the research model tested impacts of the key influential factors on product innovation performance dimensions (i.e. general and agility) one by one respectively. However, collective effects and comparative contribution from the factors were not analysed through testing all factors (independent variables) together in the model. This may limit the contribution to an overall view of the impacts of the factors and differences of their significance to the performance, and in particular, may lead to risk of omitting other important factors (which may significantly contribute to the variance of the performance) in the model.

Apart from research contribution and its limitations, the study has opened the door to a number of new ideas and further questions to the research community. It is essential to do further work on how new innovation strategies such as open innovation can succeed by obtaining appropriate strategies for developing and managing relationships with suppliers. Also, undertaking more in depth research seems to be essential to identify the main drivers behind the negative effect of absorptive capacity on the relationship between supplier involvement and a firm's general performance.

Furthermore, the research analysis also shows a mixed outcome regarding the impact of supplier involvement on API performance in the growth stage of innovation life cycle. Hence further investigation on the contrasting results for the two dimensions of API performance in the growth phase remains the area of further research in which the longitudinal study on the long-term effect of suppliers on product innovation performance can be in the centre of attention.

Moreover, since the research claimed that environmental turbulence factors negatively impact on the relationship between proactive market orientation and general performance, further research should be undertaken to first identify the main drivers and antecedents of this negative impact and consequently introduce solutions to proactive market oriented firms to cope with this issue.

Finally, while this research presents a two dimension model of firm's innovation performance based on DCT (dynamic capability theory), it is a matter of further investigation whether interaction and causal relationships exist between the elements of API, i.e. general and agility performance in a long term. This also resonates with the propositions in strategic management literature which, while recommend turning of the focus from financial related performance to capabilities, predict a likely effect from financial and market related performance on capabilities (see Teece et al., 1997).

Based on the above discussions the potential directions for future research can be summarised as:

1. Extending the study to other developed regions in order to get a wider perspective and more generlisable picture of the research findings.

2. Collecting data from external sources to companies (e.g. suppliers) to reduce concerns regarding the common method bias.

3. Conceptualising performance variables (e.g. general performance) as formative constructs. This will assist in producing the measure by forming rather than reflecting the application of the general performance constructs.

4. Investigating the interaction and causal relationship between the elements of agile product innovation performance (i.e. general and agility). This view would lead to enriching the measures developed and hence more comprehensive views on API.

5. Investigating how new innovation strategies (i.e. open innovation) can succeed by obtaining appropriate strategies for developing and managing relationships with suppliers.

6. Investigate to identify the main drivers behind the negative effect of absorptive capacity on the relationship between supplier involvement and a firm's general performance. As an increasingly important factor new insights are needed to address the issue for which more qualitative research methods may be applied.

7. Extending the findings in this research by conducting further case study investigation and also doing longitudinal study on the effect of suppliers on product innovation performance (i.e. through different stages of innovation life cycle). Real word examples and experiences will be valuable sources for strengthening the theories and hence the implications for practice.

8. Investigating the main drivers of the negative impact from environmental turbulence factors on the relationship between proactive market orientation and general performance. And furthermore which kind of strategies should be adopted by proactive market oriented firms to deal with this concern.

9. Examining the collective effects of highlighted influential factors in the study (e.g. supplier involvement, market orientation, absorptive capacity) on API performance using structural equation modelling approach to shed light on the overall view of potential impacts of the factors on general and agility performance.

7.5. Chapter summary

The conclusion chapter was devoted to explain the key findings, main contributions and potential limitations associated with this study. This chapter first addressed the research questions introduced in Chapter 1. Following this, the focal contributions of this research were outlined. Finally, the research major limitations were elaborated and directions for future research were also discussed.

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Appendix- Questionnaire

Dear Sirs,

I am a research at the University of Liverpool and have been doing research on the subject of new product innovation. I have the pleasure of inviting you to participate in the research for which we highly appreciate your contribution. This research is set up to introduce an emerging paradigm for successful product innovation process. We define "Product Innovation Process" as *the process of introducing an innovative product which is new or innovatively modified*. The effective product innovation process can offer unique competitive advantages to companies, and as such we hope embedding the results of this research will contribute to improvement of performance of manufacturing organisations.

Along with this letter is a short questionnaire that asks a variety of questions about product development/innovation. The enclosed questionnaire is being circulated to 1200 manufacturing companies based in U.K.

You are selected because of your knowledge and experience on the current company's environment. The survey should take you about 15 minutes to complete. I hope you will take the time to complete this questionnaire and return it. Regardless of whether you choose to participate, please let me know if you would like a summary of research findings. Furthermore, only our research team members can access to your responses, which is guaranteed to remain confidential.

If you require further assistance or information about the attached questionnaire or the research, please do not hesitate to contact us using the details below.

Tell: +44-..., Email address: Tavani@liverpool.ac.uk

Thanks in advance for your help and participation

Sincerely yours,

Saeed Najafi Tavani
PhD Candidate,
University of Liverpool, Management School,

Company profile

Company Name (optional): ______________________

Position of the participant ______________________

Company's Turnover(Please specify Currency): ______________________

Sector you belong to: ______________________

Company's age ______________________

Market size: ______________________

No. of product designed in the past 5 years: ______________________

No. of employees ______________________

No. of key suppliers* ______________________

Total number of suppliers ______________________

* **Note: By this we mean that number of particular suppliers that are most crucial to your business**

If your ***last designed product*** goes through a cycle of innovation, and defined to include stages such as emergence-growth-mature (as defined in the following) where do you consider your product to be?

d) Emerging phase: Radical product innovation under high technological uncertainty; Diverse and often customized production plan ☐

e) Growth phase: Increasing process innovation; illustrated by emergence of a stable dominant design ☐

f) Mature phase: Process innovation and/or incremental product innovation; undifferentiated, standardized products ☐

Part 1:

Please consider your latest NEW product or select one you consider to represent your company's new product, and use the following scale to indicate your extent of agreement about how well the new product you selected has performed	Very poor			Fair			Very good
	1	2	3	4	5	6	7
1.Met sales growth goals.	☐	☐	☐	☐	☐	☐	☐
2.Met market share goals.	☐	☐	☐	☐	☐	☐	☐
3.Return on investment.	☐	☐	☐	☐	☐	☐	☐
4.Customer acceptance and satisfaction.	☐	☐	☐	☐	☐	☐	☐
5.Development costs.	☐	☐	☐	☐	☐	☐	☐
Please tick the number that best reflects how your organization has been doing so far relative to the major competitors in your industry.	Worst in industry			Fair			Best in industry
	1	2	3	4	5	6	7

	1	2	3	4	5	6	7
6. The level of newness (novelty) of our firm's new products.	☐	☐	☐	☐	☐	☐	☐
7. The speed of our new product development.	☐	☐	☐	☐	☐	☐	☐
8. The number of our new products that is first-to-market (early market entrants).	☐	☐	☐	☐	☐	☐	☐
9. The number of new products our firm has introduced to the market.	☐	☐	☐	☐	☐	☐	☐
10. Time-to-market.	☐	☐	☐	☐	☐	☐	☐

Part 2:

Please indicate the extent to which you agree or disagree with the following statements.	Fully Disagree		neither agree nor disagree				Fully agree
	1	2	3	4	5	6	7
1. The general knowledge and education level of our first-line workers is high.	☐	☐	☐	☐	☐	☐	☐
2. The knowledge of our managers is adequate when making business decisions.	☐	☐	☐	☐	☐	☐	☐
3. The communications between people at various levels is extensive.	☐	☐	☐	☐	☐	☐	☐
4. The communication of new ideas between departments is extensive.	☐	☐	☐	☐	☐	☐	☐
5. Our employees tend to trust and support the organisation and each other.	☐	☐	☐	☐	☐	☐	☐
6. We seek to learn from many sources such as routine search, benchmarking, customers and suppliers, R&D.	☐	☐	☐	☐	☐	☐	☐

Part 3:

Please indicate the extent to which you agree or disagree with the following statements.	Fully Disagree		neither agree nor disagree				Fully agree
	1	2	3	4	5	6	7
1. Our suppliers are active in the product development (PD) process & provide input into the PD project.	☐	☐	☐	☐	☐	☐	☐
2. Communications with suppliers on quality considerations and design issues and changes are close.	☐	☐	☐	☐	☐	☐	☐
3. Our company strives to establish long-term relationships with suppliers, and help them in their progress and development.	☐	☐	☐	☐	☐	☐	☐
4. Our company has attempted involving its main suppliers in product innovation through co-investment programmes.	☐	☐	☐	☐	☐	☐	☐
Please indicate to what extent did you involve your main suppliers in the following stages of development of this product?	No involvement			Fair			Extensive involvement
	1	2	3	4	5	6	7
5. Product design.	☐	☐	☐	☐	☐	☐	☐

6.Prototyping and production.	☐	☐	☐	☐	☐	☐	☐
7.Product commercialization.	☐	☐	☐	☐	☐	☐	☐

Part 4:

Please indicate the extent to which you agree or disagree with the following statements.	Fully disagree		neither agree nor disagree				Fully agree
	1	2	3	4	5	6	7
1.We continuously try to discover additional needs of our customers of which they are unaware.	☐	☐	☐	☐	☐	☐	☐
2.We incorporate solutions to unarticulated customer needs in our new products.	☐	☐	☐	☐	☐	☐	☐
3.We innovate even at the risk of making our own products obsolete.	☐	☐	☐	☐	☐	☐	☐
4.We search for opportunities in areas where customers have a difficult time expressing their needs.	☐	☐	☐	☐	☐	☐	☐
5.We work closely with lead users who try to recognize customer needs months or even years before the majority of the market may recognize them.	☐	☐	☐	☐	☐	☐	☐
6.Our strategy for competitive advantage is based on our understanding of customers' needs.	☐	☐	☐	☐	☐	☐	☐
7.We freely communicate information about our successful and unsuccessful customer experiences across all business functions.	☐	☐	☐	☐	☐	☐	☐
8.We constantly monitor our level of commitment and orientation to serving customer needs.	☐	☐	☐	☐	☐	☐	☐
9.We measure customer satisfaction systematically and frequently.	☐	☐	☐	☐	☐	☐	☐
10. We are more customer-focused than our competitors.	☐	☐	☐	☐	☐	☐	☐

Part 5:

Section 5.1:

Please indicate the extent to which you agree or disagree with the following statements.	Fully disagree		neither agree nor disagree				Fully agree
	1	2	3	4	5	6	7
1.In our kind of business, customers' product preferences change quite a bit over time.	☐	☐	☐	☐	☐	☐	☐
2.Our customers tend to look for new product all the time.	☐	☐	☐	☐	☐	☐	☐
3.We are witnessing demand for our products and services from customers who never bought them before.	☐	☐	☐	☐	☐	☐	☐
4.New customers tend to have product-related needs that are different from those of our existing customers.	☐	☐	☐	☐	☐	☐	☐
5.Our customer base and their demand do not change frequently.	☐	☐	☐	☐	☐	☐	☐

Section 5.2:

Please indicate the extent to which you agree or disagree with the following statements.	Fully disagree 1	2	neither agree nor disagree 3	4	5	6	Fully agree 7
1.Competition in our industry is fierce.	☐	☐	☐	☐	☐	☐	☐
2.There are many "promotion wars" in our industry.	☐	☐	☐	☐	☐	☐	☐
3.Anything that one competitor can offer, others can match readily.	☐	☐	☐	☐	☐	☐	☐
4.Price competition is a hallmark of our industry.	☐	☐	☐	☐	☐	☐	☐
5.New competitive moves occur very often in this industry.	☐	☐	☐	☐	☐	☐	☐

Section 5.3:

Please indicate the extent to which you agree or disagree with the following statements.	Fully disagree 1	2	neither agree nor disagree 3	4	5	6	Fully agree 7
1.The technology in our industry is changing rapidly.	☐	☐	☐	☐	☐	☐	☐
2.Technological changes provide big opportunities in our industry.	☐	☐	☐	☐	☐	☐	☐
3.Due to rapid changes it is very difficult to forecast where the technology in our industry will be in the next 2 to 3 years.	☐	☐	☐	☐	☐	☐	☐
4.A large number of new product ideas have been made possible through technological breakthroughs in our industry.	☐	☐	☐	☐	☐	☐	☐
5.Technological developments in our industry are rather minor.	☐	☐	☐	☐	☐	☐	☐

Thank you very much for your participation

We will be pleased to send you an executive summary of all respondents across the top 2000 designed product development oriented manufacturing companies in Europe.

If you would like to receive an executive summary, please complete the following or attach your business card.

Name of contact person:	Postal address:
E-mail contact to be used:	Company: