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CUSTOMER VALUE ANALYSIS AS A TOOL FOR FOSTERING A SYSTEMIC INNOVATION: Case tractor implement connecting interface

Master of Science thesis

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ABSTRACT

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The hi-tech companies tend to lead in the market by satisfying their customer needs. They innovate technological product in a system because technology in isolation cannot deliver value unless having complementary technologies with it to realize the peak performance. Therefore to ensure the long term sustainability in the market, companies have to analyze the customer requirements and innovate products accordingly.

The objective of this study is to discuss utilizing customer value analysis as a tool for fostering a systemic innovation that commits partners for collaboration. Companies who are good at understanding the customer requirements and analyze what is important to their customers are always in a better position to satisfy the customer needs. Therefore, customer value analysis can be utilized for managing the technological innovations.

The key outcome of this study is the establishment of a framework based on literature review that represents customer value analysis as a tool for fostering innovation in a system. Further, the idea of innovative coupling interface is presented to simplify the current tractor implement coupling system that until now requires the physical effort, time and high capital investment. Finally, the thesis framework shows the value proposition of innovative coupling interface, and motivates both tractor and implement manufacturers to collaborate for developing a new coupling interface in a system.

PREFACE

This thesis describes the significance of customer value analysis framework for innovation in a system. The customer value analysis helps companies to know the customers’ needs and motivate the complementary technology providers to collaborate in a systemic innovations. The research was conducted by choosing a case from Tractor Company in Finland.

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CONTENTS

1. INTRODUCTION

1.1 Background

The technological revolution has created a fierce competition among companies. In order to stay competitive and profitable, companies put efforts in the development of products which offer high value to their customers. However, limited number of organizations have knowledge and ability to measure value and get rightful return from delivered customer value (Anderson and Narus, 1999). The knowledge of value is considered critical since it provides basis for business market management. It is challenging for companies to understand the real value of their offerings to the customers.

As the perceived needs of customers change over time, the technology that satisfies those needs evolves as substitute for already existing technology (Fisher and Pry, 1971). Companies' future is vulnerable if they fail to keep their product portfolio innovative and competitive and are surpassed by more innovative competitors (Hartley, 2010). Therefore, to get the competitive advantage, it is essential for companies to determine what drivers create value for customers (Lichtenthal et al., 1997).

According to Munksgaard and Freytag (2011), the development and introduction of innovative products open-up new avenues for companies and make their access to new markets. Therefore, product development is considered as a crucial process for the success of companies (Woodside and Biemans, 2005). Three external elements, intense worldwide competition, fragmented challenging markets and diverse shifting technologies, persuade companies towards new product development (Wheelwright and Clark, 1992, cited in Munksgaard and Freytag, 2011).

Companies sustain their position and stay competitive in international markets through continuous product development. Various models are available for companies to escalate the efficiency of their product development process. Product development is the process that includes the idea generation, design and launching of product in the market (Ulrich and Eppinger, 1995). Product development process also considers feedback from production and product use.

According to Lyly-Yrjänäinen at al. (2009), product development is not merely about fabricating new products, but it is essential learning process for companies. Although product development mainly includes product design and development activities, there are other tasks such as assessment of financial and economic parameters, approval for design patents and customer reviews (Formoso et al., 2002). New product development is, however, resource intensive, expensive and notoriously risky. There has therefore been an increasing need to find ways of reducing the risk and cost of product development. Collaboration between two or more organizations has been identified as one of the ways of achieving a reduced cost of product development and decreased risk of failure (Håkansson and Johanson, 1992).

High technological firms are aware that successful commercialization of significant innovations often depend on the availability of compatible products that work together in a seamless fashion. Small number of high-technology products work in isolation. Most products deliver high customer value in conjunction with other hardware or software upon which they are dependent for realization of peak performance. (Adner and Kapoor, 2010)

A system approach is therefore required for better understanding and control of such technology products. Various authors have explored the technology through systemic approach that highlights the certain aspects of general systems theory. For example, studies of the airplane (Vincenti, 1994, Constant, 1987), electricity supply (Hughes, 1983, Verbong, Geels, 2010) and the automobile (Clark, 1985) have demonstrated a systemic approach on technology. The product system as a whole fulfills customers' needs, despite system elements in isolation.

1.2 Objective of the Study

Firms' business is related to the customers so buyers invest on such products that satisfy their needs and deliver added value to them. Hence, companies' potential to analyze customer value can be a powerful tool to influence the demand for their products. Companies can deliver high value to the customers by managing innovations in a system. Product systems are made up of many interconnected elements (sub-systems and components) usually organized in a hierarchical way and exhibit non-linear and continuously-emerging properties, whereby small change in one part of the system can lead to the alterations in other elements of the system for getting successful change. The objective of this study is…

> … *to discuss utilizing customer value analysis as a tool for fostering innovation in a system that commit partners to collaborate in a systemic innovation.*

This thesis aims to develop a theoretical framework that demonstrates the customer value analysis as a tool to motivate the partners (keystone firm and complementary technology providers) to collaborate in a systemic innovation. Further, this thesis proposes the idea of tractor implement connecting interface by identifying the problems in current tractor implements coupling system. It is realized that the existing coupling is time consuming, laborious and carry the chances for accidents. The farming season in Finland is short because of weather constraints and for the better productivity farmers need to complete the agricultural operations in time. Farmers cannot afford to waste time therefore, they buy additional tractors and keep implements connected for ready to use. Thus, the capital investment of the farmers increase significantly. To address these challenges, the author discusses the idea of innovative tractor implement coupling interface and its value proposition. Finally, thesis framework is applied on this case innovation.

The structure of this thesis as follows. The second chapter illustrates the concept of customer value, customer value models and its evaluation methods. The third chapter explains the product development process and different models for the product development. The fourth chapter primarily focuses on systemic innovations and describes the challenges and tools for managing systemic innovations. The fifth chapter aims to present the business collaborations and network model. Finally, this chapter explains the emergence of business ecosystems for value creation and builds framework for developing innovations in a system.

The sixth chapter proposes the idea of innovative tractor implement coupling interface after studying the existing coupling system. The Chapter 7 gives the overview of the problem and implements theoretical framework for developing the innovative coupling interface and its value proposition. In the end, this chapter demonstrates the case analysis and limitations of the study. The last chapter is the conclusions.

1.3 Data Gathering Methods and Research Process

According to Amaratunga et al. (2002), research refers to the systematic and methodological process of problem investigation to contribute in the existing knowledge or create new knowledge. Minor et al. (1994) argues that research can be done theoretically or empirically. Theoretical research only focus on the existing theories to investigate the research problem or develop a theoretical framework. On the other hand, empirical research refers to collecting and analyzing empirical data and finally representing the findings and conclusions. The first step in empirical research is defining a research question or problem. Then, developing theoretical framework by reviewing the existing literature and subsequently testing the framework in real life situation. Finally, researcher concludes the findings and mentions the limitations of the study. (Simon et al., 1996)

In the field of business and management, researchers gather data and process it into information for company management use in decision making. The data gathered directly in response to a specific research problem is recognized as primary data. Primary data contains direct surveys, observations as well as experiments. The data collected by somebody else is called secondary data that includes company reports, publications, statistics and academic papers (Buglear, 2005).

Business and management research is conducted through various data collection methods, and fundamental distinction is qualitative and quantitative research methods (Moody, 2002). Qualitative methods are more appropriate in building a theoretical framework whereas, quantitative methods are commonly used for theory testing. According to Voss et al. (2002), combination of quantitative and qualitative methods are commonly used to achieve the research objective.

The empirical research strategies are classified into four categories: survey, case study, experiment and post-mortem (Wohlin et al., 2006). Out of these four types, only experiment refers to quantitative research whereas, others are combination of quantitative and qualitative research. Since this thesis focuses on the case study therefore, case-study research method is briefly explained here. Case-study research can be conducted through both quantitative and qualitative methods. However, qualitative methods are widely used. Case-study research is conducted to explore the hidden phenomenon or to develop a better understanding of the complex phenomenon. Gummesson (1993) classified data gathering methods into following five groups that can be used in research on business and management subjects.

- Existing Materials
- Questionnaire Surveys
- Questionnaire Interviews
- Observations
- Action Science

Existing material is generally referred as secondary data and it includes data gathering from books, articles, publications and reports. Second, questionnaire surveys are used to standardize and formalize interviews. Researcher prepares questions for respondents to investigate the research problem. Third, questionnaire interviews are commonly used for case study research. It comprises open ended questions that are asked during the interview flow. Observations and responses are recorded as notes, descriptions or videos to know the gestures and body language during interview. Four, observation method is used by the researchers for gathering information by directly observing the subject case. Next, action science requires the full involvement of researcher in the process and it may comprise other data gathering methods. The research process of this thesis is described in the following paragraphs.

This thesis is the continuation of the studies carried out in different time spans. AW-1 paper was written in 2013-14 which described the concepts of innovation, customer value as well as challenges and models for managing innovation in a system. The empirical research process started in February, 2014 with the AW-2 paper where the theoretical framework development process started by considering the different concepts discussed in AW-1 paper. The second paper was completed in September, 2014. Figure 1 shows timelines for the research process.

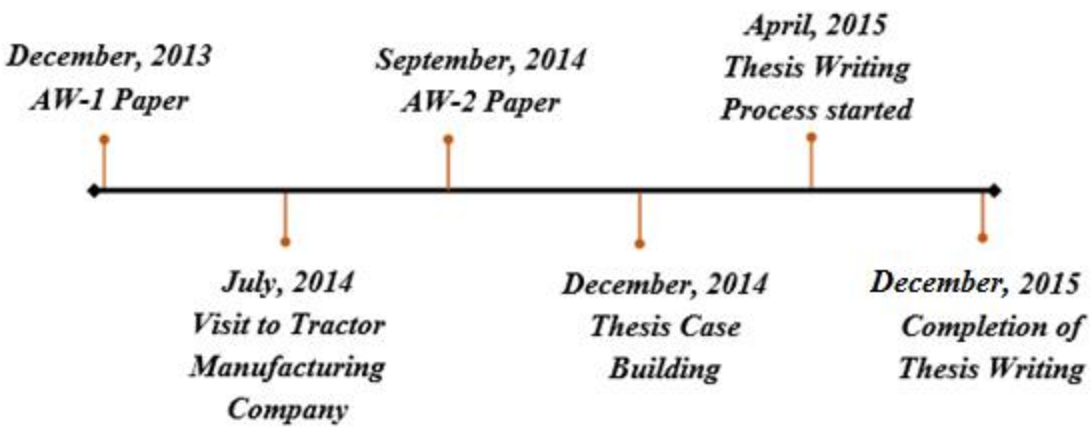

Figure 1. The Research Process.

The objective of this thesis was the development of theoretical framework that commit partner firms to collaborate in a systemic innovation. Then the framework was tested on the cost-reducing innovation - tractor implement connecting interface. To accomplish this thesis, existing materials, observations and action science research methods were used.

Before reaching the idea of innovative tractor implement coupling interface, various problems were identified in the current coupling system. Then, different developments related to coupling system were studied. The author also visited the tractor company in Finland to observe the one of new coupling mechanism introduced by the company. Next, different available technologies were studied that could be used in developing the innovative coupling interface. In the end, the author presented the idea of innovative coupling interface and built its value proposition. The thesis writing process completed in December, 2015.

2. CUSTOMER VALUE

2.1 Concept of Customer Value

The academic literature thoroughly discusses the concept of customer value. The value of products and services in the marketplace is emphasized in different theories of economics. For instance, the classical economic theory reflects that the value of products is intrinsic and associated to the cost of manufacturing inputs such as material and labor and can be assessed through any subjectively determined economic factor (Smith, 1904; Marx, 1967; Ricardo, 1975). According to neo-classical theory, the value is subjective and reliant on or relative to the use of product (Jevons, 1879; Marshal, 1961).

It is believed that neo-classical theory follows the modern economic concept; it primarily assumes that economic actors have access to concrete information and attain value through rational decision making that maximize their utility (individuals) and benefits (firms), and lessen their sacrifices (McKnight, 1994; Woodall, 2003). Contrary to this assumption, some economists believe that economic actors are overwhelmingly optimistic and are not always rational in decision making as they do not have access to perfect information on marketplace (Simon, 1961).

According to the behavioral theory of a firm, firms exhibit collaboration between entities (individuals or groups) with their distinct goals. This theory reflects that optimal and reasonable compromise between entities and their goals under certain circumstances deliver value (Simon, 1952; Cyert and March, 1992). According to this theory, economic actors work under "bounded rationality", that match the economic school of thought which is also based on the notion of bounded rationality. This proposes that actors' capacity for decision making is narrowed by their access to facts and figures, their analytical approach to investigate value of different firms' offerings in detail within available time and resources (March, 1978; Gigerenzer and Selten, 2002; Kahneman, 2003).

According to transaction cost economic theory of a firm, actual goods do not deliver value but reduction in transaction costs (Coase, 1937; Williamson, 1975, 1985). In short, this theory reveals that either firms get added-value through in-house activities or by outsourcing. The resource-based theory (established on the notion of bounded rationality) aims to illustrate that firms own set of distinct resources that can be used to deliver value and competitive edge over competitors (Penrose 1959; Wernerfelt, 1984). It is evident from above, that firms basically deliver value through acquiring and utilizing the prime resources and skills (Barney, 1991; Amit and Shoemaker, 1993; Peteraf, 1993). The acquisition of means and skills is not enough but firm must have the ability to exploit them jointly (Newbert, 2008). Next, unlike the leading economic theories, the social exchange theory demonstrates that value is created through social interaction among players (Thibault and Kelly, 1959; Homans, 1961; Emerson, 1976). This theory mainly focuses on non-monetary aspects such as relationship, entertainment and cultural values (Blau, 1964; Stafford, 2008). The social exchange theory undertakes that players have concrete information and adapt sensible choices.

According to prospect theory, value is perceived from relative benefits and sacrifices, despite the ultimate outcomes (Kahneman and Tversky, 1979; Tversky and Kahneman, 1991). This theory describes how actors decide under risk between substitutes with known results, means how they make choices in real-life settings. For instance, during assessment of potential value of substitutes, actors give more importance to negative aspects rather than positive benefits (Kahneman and Tversky, 1979).

The marketing literature considers customer value as core element in the exchange view of marketing (Sheth, 1976) and selling (Alderson, 1957; Kotler, 1972). This explains that firms offer products that are needed in marketplace and people choose those products that deliver added-value (Levitt, 1983). The sales literature aims to explain that firms satisfy perceived customer needs through their offerings (Rackham and DeVincentis, 1999; Haas et al., 2012). According to relationship marketing viewpoint, firms believe in delivering value through developing the long-term customer relationships (Håkansson, 1982; Dwyer et al., 1987). The purchasing and supply chain literature considers customer value as a core element that effects sourcing choices (Wouters et al., 2005; 2009).

The service literature reveals that service experience mutually established by the user and seller create value (Vargo and Lusch, 2004; Grönroos, 2011). According to management and organizational theory literature, the ability of firm to create value, to analyze what brings value for customers in a certain offering and to manage value over time are fundamental elements of a leading firm's business strategies (Drucker, 1973; Porter, 1985; Prahalad and Hamel, 1994; Slater and Narver, 1998; Desarbo et al., 2001). The concept of customer value is highly important in various fields such as innovation, finance, sociology, industrial engineering (Tzokas and Saren, 1999; Squire et al., 2004; O´Cass and Sok, 2013). According to Holbrook (1994), all marketing activities are based on customer value. Table 1 demonstrates main views on customer value discussed in different theories.

Table 1. Fundamental concept of customer value in different streams of the Literature.

Classical economic Theory	"Value is derived from the object itself".	(McKnight, 1994; Woodall, 2003)
Neo-classical economic theory	"Value is derived from maximized utility and profits".	Jevons, 1879; Marshal, 1961
Behavioral theory of a firm	"Value is derived from optimal compromises under a given set of circumstances".	Simon, 1952; Cyert and March, 1992
Transaction-cost economic theory	"Value is derived from minimizing transaction costs".	Coase, 1937; Williamson, 1975, 1985
Resource-based theory of a firm	"Value is derived from optimal development and deployment of resources and capabilities".	Barney, 1991; Amit and Shoemaker, 1993
Social exchange Theory	"Value is derived from social exchanges between actors".	Thibault and Kelly, 1959; Blau, 1964
Prospect theory	"Value is derived from relative gains and losses, instead of final outcomes".	Kahneman and Tversky, 1979
Exchange view of marketing	"Value is derived from the production and delivery of products and services to customers".	Alderson, 1957; Sheth, 1976; Levitt, 1983
Sales	"Value is derived from the fulfilment of customers' needs by exchanging products and services".	Rackham & Devincentis 1999; Haas, et al., 2012
Relationship marketing	"Value is derived from long-term customer relationships".	Håkansson, 1982; Dwyer, Schurr, and Oh, 1987
Service marketing	"Value is derived from the service experience that is co-created by the supplier and the customer".	Vargo and Lusch, 2004; Grönroos, 2011
Management and organizational theory	"Value is derived from the firm's ability to satisfy its customers better than competitors over time".	Porter, 1985; Prahalad & Hamel, 1994, Slater & Narver, 1998

The concept of customer value is discussed by various authors in different contexts. Researchers have explained it by using different terms such as readiness to pay (Porter, 1985), utilities (Zeithaml, 1990), monetary units (Anderson et al., 1993), perceived quality (Gale, 1994), economic and social gains (Gassenheimer et al., 1998), quality, benefits and worth, (Woodruff, 1997), benefits and costs (Ulaga and Eggert, 2002), and saved time (Leclerc et al., 1995). Table 2 shows different definitions of customer value.

Table 2. Definitions of Customer Perceived Value.

Definition of Customer Perceived Value	**Author**
"The consumer's overall assessment of the utility of a product based on a perception of what is received and what is given".	Zeithaml et al. 1990
"Ratio of perceived benefits relative to perceived sacrifice".	Monroe, 1990
"Perceived worth in monetary units of the set of economic, technical, service, and social benefits received by a customer firm in exchange for the price paid for a product offering, taking into consideration the available alternative suppliers' offerings and price".	Anderson et al. 1993
"The customers' assessment of the value that has been created for them by a supplier given the trade-offs between all relevant benefits and sacrifices in a specific-use situation".	Flint, Woodruff, and Gardial
"Trade-off between desirable attributes compared with sacrifice attributes".	Woodruff and Gardial (1993)
"The sum of transactional cost advantages and constraints together with the emotional cost and benefits in relative to alternative options."	Gassenheimer et al., 1998
"Perceived value is a combination of what customers get in terms of benefits such as quality and what they give away in terms of money, time, and effort."	Lapierre et al., 1999
"Trade-off between the multiple benefits and sacrifices of a supplier's offering, as perceived by key decision makers in the customer's organization, and taking into consideration the available alternative suppliers' offerings in a specific-use situation."	Ulaga and Chacour, 2001
"Customer-perceived value in business markets as the trade-off between the multiple benefits and sacrifices of a supplier's offering, as perceived by the decision-makers in the customer's organization, and taking into consideration the available alternative suppliers' offerings in a specific use situation."	Eggert & Ulaga, 2002
"Customer value is conceptualized as being dependent on benefits received and sacrifices made by customers."	Menon et al., 2005

"Customer value for a business service is defined as an organizational buyer's assessment of the economic, technical, and relational benefits received, in exchange for the price paid for a supplier's offer to competitive alternatives."	Liu, 2006
"An industrial buyer's overall appraisal of the net worth of a particular transaction, based on the buyer's assessment of what is received (benefits provided by the transaction) and given (cost of acquisition and utilizing the transaction)."	Han and Sung, 2008
"Customer value in B2B contexts is defined as the customer's perceived trade-off between benefits and sacrifices within relationships."	Blocker, 2011
Value is the benefits that customer receives relative to the paid price	Smith (Cited in Anderson et al. 2007)
The term value refers to the total savings or satisfaction that customer receives from the product.	Nagle & Holden (Cited in Anderson et al. 2007)
Customer value refers to perceived preferences and evaluation by customers for product features, feature performances, and consequences arising from use that help in achieving the customer's goals and purpose in use situations	Woodruff 1997 (Cited in Smith and Colgate 2007)
Perceived value is the maximum price the customer will pay.	Dolan & Simon (Cited in Anderson et al. 2007)

There is yet no agreement on any of these conceptions of customer perceived value. The customer perceived value influences the purchasing decision of the buyer. Most of definitions described in the table above agree that customers compare the benefits of the products with the cost they have to pay. The customer will not buy the product unless total customer value exceeds total customer costs. Sheth et al., 1991 (See Smith & Colgate, 2007) describe five kinds of core value i.e. functional, emotional, social, conditional and epistemic that effect customer's buying decisions. Thus, customer perceived value plays the role of an incentive to the customer to buy the product (Lyly-Yrjanainen et al., 2009).

Customers avail direct monetary benefit from functional value while rest of value types are related to cognitive benefits. Perceived customer value varies subject to customers choices. However, certain type of value decreases if customer pay more attention to other type of value. This is how customers inter-play or trade-off between different kinds of value. The consumer marketing literature aims to illustrate that customer value is a trade-off between benefits and sacrifice. This is endorsed by Zeithaml (1990) in his definition of customer value, demonstrated in Table 2. This study mainly focuses on customer value in B2B context that is explained in the following section.

2.2 Customer Value in B2B Context

According to the recent business marketing literature, research on customer value is classified into two areas: a) the value of offerings and b) the value of buyer-seller relationships (Hogan, 2001; Lindgreen and Wynstra, 2005; Lindgreen et al., 2012). The first area of customer value research aims to focus on tangible aspects, such as product functionality and durability. The second area is more concerned about intangible aspects such as skill and knowledge (Baxter and Matear, 2004). However, the modern research on customer value shows that relationship value contemplates both tangible and intangible aspects of perceived customer value (Ulaga and Eggert, 2006a; Corsaro and Snehota, 2010; Corsaro et al., 2013).

The theory that emphasizes on the concept of augmented product argue that value is primarily delivered by adding improved features in products and services such as support services and flexible delivery of product offerings (Levitt, 1969, 1980, 1981). According to the Lovelock (1994), features are usually classified into five levels: core, expected, augmented, potential and final product features that can be added to all types of offerings (products or services). Lindgreen and Wynstra (2005) also argue that the concept of augmented product support the notion of value embedded in offerings (products or services) can be classified into core and add-on benefits.

The customer value is basically derived by taking into account three parameters: perceived product benefits, product price and costs of its ownership; the difference between product benefits and costs determine the customer perceived value (Doyle, 2000; Kotler, 2003). The benefits refer to the product quality and performance while product price is the cost that customer has to bear for buying a product and cost of ownership is related to retain the product after purchase such as installation cost, maintenance cost as well as training cost (Doyle, 2000).

In B2B settings, the customer value is regarded as the trade-off between the benefits and sacrifices perceived by the customer firms (Ulaga and Chacour, 2001). The decision makers in firms must consider the diverse nature of customer requirements and understand that the customer value delivered by the same product may vary for different customers under specific usage situations. Thus, firm’s strategic marketing plan must be based on exploring the importance of specific benefits and costs for different customers or customer segments.

The intangible aspect of customer value is the relationship value. According to Westerlund and Svahn, (2008), relationship perspective play a central role in advancing the value research in business markets, it primarily focuses on soft and intangible factors of business relationships but does not contribute enough to anticipate all pertinent elements that create value in relationships. The value perceived by customers in business relationships is derived on the basis of various elements such as economic (higher returns, better business practices), social (knowledge, skills) and strategic (access to new partners and resources) benefits (Biggemann and Buttle, 2012). The modern research has contributed in the better understanding of relationship value, more specifically to figure out the key drivers and dynamics of value creation in business relationships (Menon et al., 2005; Corsaro and Snehota, 2010).

The theoretical literature reveals that the concept of relationship value is discussed by various authors in different angles. Wilson and Jantrania (1995) suggests that economic, strategic and behavioral dimensions are the key elements in relationship value construct. This concept is explained by Ravald and Grönroos (1996) by considering all costs and benefits experienced in a relationship, whereas, Grönroos broadly explains relationship value in terms of core solution and supplemental service value. Flint et al. (2002) argue that relationship value is the judgement or estimation of what customer perceives from supplier's offering. According to Möller and Törrönen (2003), the supplier's potential to create value in relationship is viewed as a continuum pertaining core value, added value and finally, future value.

From empirical perspective, the emerging body of research has studied possible dimensions and drivers of relationship value. Thirteen (13) drivers of relationship value has been suggested by Lapierre (2000) on the basis of study conducted in an industrial service sector. These relationship value drivers belong to benefits (product, service and relationship benefits) and sacrifice (price and relationship cost) dimensions. Ulaga (2003) and Ulaga and Eggert (2005) in their studies (involving purchasing managers from several industries) proposed key drivers of relationship value i.e. product, service, delivery, know-how, time-to-market, social benefits as well as price and process costs. In terms of cost management, Cannon and Homburg (2001) argue that customers endure three major costs (direct, acquisition and operations cost) in business relationships. Menon et al. (2005) have suggested basic elements (benefits, add-on benefits, purchasing price, acquisition and operation cost) of relationship value in business markets.

Ulaga and Eggert (2006b) further investigated the cost management model proposed by Cannon and Homburg (2001) and identified key value drivers (quality of product, delivery performance, service support, supplier's know-how, personal interaction, time to market benefit as well as direct acquisition and operation costs) at supplier relationships level that are comprehended at three different stages: core offering, outsourcing process and customer operations. According to Biggemann and Buttle

(2012), apart from tangible and financial benefits, relationship value carry intangible benefits such as knowledge and strategic benefits. Table 3 presents main studies that have investigated the topic of relationship value.

Table 3. Key drivers of relationship value.

Authors	**Main dimensions of relationship**		**Context of Study**
	Benefits	**Costs**	
Anderson et al., 1993	Economic benefits; technical benefits; service benefits; and social benefits.	Price.	Theory-based
Wilson and Jantrania, 1995	Economic benefits; strategic benefits; and behavioral benefits.	-	Theory-based
Ravald and Grönroos, 1996	Episode benefits; and relationship benefits.	Episode sacrifices; and relationship sacrifices.	Theory-based
Grönroos, 1997	Core solutions; and additional services.	Price; and relationship costs.	Theory-based
Lapierre, 2000	Alternative solutions; product quality; product customization; responsiveness; flexibility; reliability; technical competence; image; trust; and solidarity.	Price; time/effort/energy; and conflict.	Survey among 209 and 129 purchasing executives of the Canadian IT and finance sector.
Cannon and Homburg, 2001	-	Direct costs; acquisition costs; and operations costs.	Theory-based
Ulaga, 2003	Product quality; service support; delivery; supplier know-how; time-to-market; and personal interaction.	Direct product costs; and process cost.	Qualitative study among 10 purchasing Professionals in different manufacturing industries.
Menon et al., 2005	Core benefits; and add-on benefits	Purchasing price; acquisition costs; and operations costs.	Survey among 921 purchasing managers in U.S and Germany.

Ulaga and Eggert, 2006a	Product quality; delivery Performance; service support; personal interaction; supplier know-how; and time-to-market.	Direct costs; acquisition costs; and operations costs.	Qualitative study a survey among 400 purchasing managers in U.S manufacturing firms.
Biggemann and Buttle, 2012	Personal benefits; financial benefits; knowledge benefits; and strategic benefits	-	Qualitative study among 55 managers from 15 different firms, including suppliers and customers.

According to Industrial Marketing and Purchasing Group, the evolution of relationships among partner firms create value through mutual learning and collaboration (Håkansson et al., 2009; Hammervoll, 2012). The customers realize value not only from core offering but also from long-lasting relationships because "exchanges between the supplier and buyer become predictable and reassuring since the actors have learnt how they organize their business operations and the actors' learning and adaptation in the relationship are likely to result in new product or service solutions" (Lindgreen and Wynstra, 2005).

From the sales perspective, researchers argue that service-dominant logic of value co-creation is prevailing in the firms; therefore, value created in business relationships is significant in sales (Plouffe et al., 2008; Sheth and Sharma, 2008; Ulaga and Loveland, 2014). According to Haas et al. (2012), for increased sales, firms' need to move one step ahead from creating value only through range of desired products and services by developing strong customer relationships over time. Firms need to figure out how relationship value approach can be translated into sales. According to Terho et al. (2012), the value-based selling is a remarkable approach in business markets, particularly in complex and service-intensive solution settings. The value based selling is centered on defining the value potential of supplier's offering and how it satisfy the customer needs and expectations in the long run.

Anderson et al. (2006) and Frow and Payne, (2011) argue that customer value aims to illustrate the firms' ability to communicate the value potential of its offerings to customers and stakeholders. According to Rintamäki et al. (2007) customer value is about benefits associated with a certain product or service. However, Ballantyne et al. (2011), Payne and Frow (2014) suggest that offerings must deliver potential value that suppliers and customers can co-create through interaction or collaboration. The solution marketing research suggests that the system as a whole deliver more customer value than individual components in isolation (Sharma and Iyer, 2011). This means that the whole system offers solution (combination of products and services) that deliver added benefits to the customers in order to improve customers' operations and productivity (Tuli et al., 2007; Epp and Price, 2011). The solution offerings guarantee enhanced performance, cost savings and customized services to customers by shifting the responsibilities and risks involved in operations to the suppliers. The successful solution oriented business models are primarily based on earnings logic and put emphasis on value creation in customers' processes despite on delivered products and services (Cornet et al., 2000; Storbacka, 2011).

The customer's willingness to pay the higher prices for solution depends upon the supplier's ability to communicate the value proposition to customers that is created from the offering's functionality and relational processes (Sawhney, 2006; Tuli et al., 2007). Thus customers recognize supplier's offerings as relational processes that are focused on customer's requirements, customization, integration, deployment and post-deployment support and services (Tuli et al., 2007). The above shows that customer value in business markets is not simply linked to the offerings but also assimilated to the value delivery process wherein customers and suppliers interact to each other through sharing resources, skills and knowledge (Payne et al., 2008).

According to Möller (2006), firm's potential for value creation in a relationship increases by sharing the responsibilities and resources with suppliers that leads to increased mutual dependence subject to the complexity of offerings. Windahl and Lakemond (2010) argue that the actors become more dependent on each other while developing complex offerings. When customers prefer purchasing performance over simply buying the products and services, they become more vulnerable to suppliers in term of evaluating the supplier's ability to secure the availability of and access to key modules, technologies and their specialized services (Davies et al., 2007). In business to business markets, customers evaluate supplier's firm offerings, value delivery process and their strategic position within their business network (Ford et al., 2003).

2.3 Customer Value Models

Companies are realizing that their competitive strength is to have relationship with their customers (Laudon & Laudon, 2006). Hence, companies try to figure-out what value means to their customers. This has motivated researchers in the field of customer value to develop frameworks for helping firms better understand value creation (Smith & Colgate, 2007). Khalifa (2004) classifies the definitions of customer value into three groups: value component models, benefit-cost model and means-end models. These models individually do not explain all aspects of customer value but each model put more emphasis on certain dimensions of customer value. Each model is briefly explained in following paragraphs.

Kano’s model of customer perception is one of the renowned value component models that split value elements into satisfiers (performance attributes), dis-satisfiers (threshold attributes) and delighters (excitement attributes). First, the satisfiers are the product characteristics that create added satisfaction by addressing the customers’ needs. Secondly, dis-satisfiers refer to the manifestation of product features expected by the customers otherwise it will bring customers’ dissatisfaction. Finally, delighters refer to the features that bring huge satisfaction by addressing the dormant needs of customers. These product features are not demanded by the customers. (Khalifa, 2004) Figure 2 demonstrates Kano’s model of customers’ perception.

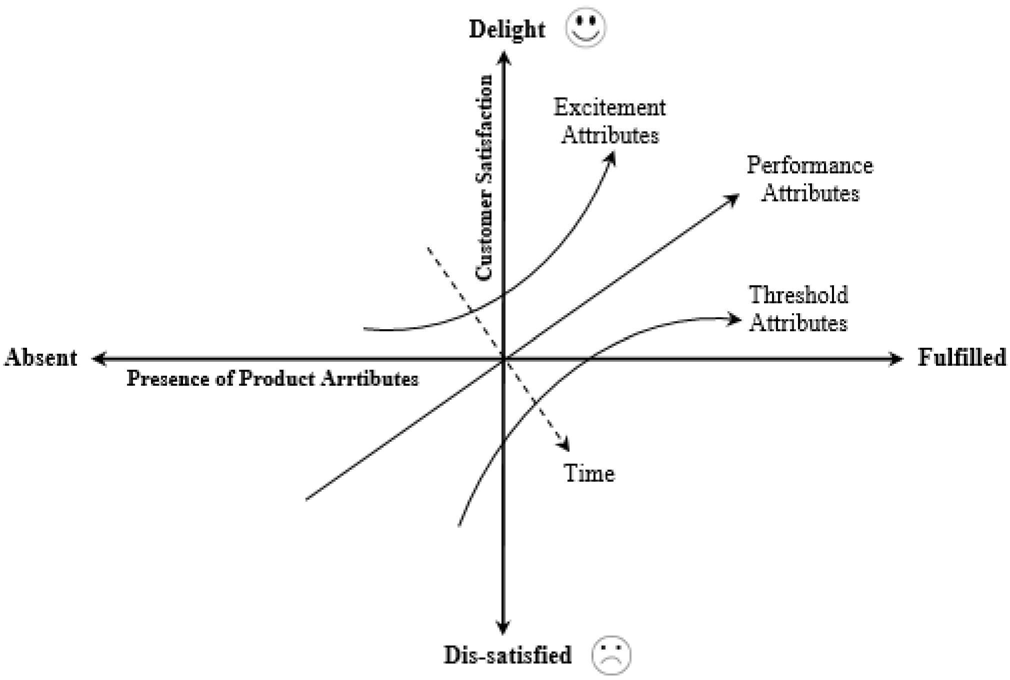

Figure 2: Kano’s Model of customer’s perception.

Another model is proposed by Sheth et al. (1991, See Smith and Colgate, 2007) that explains five values: functional value, social value, emotional value, epistemic value and conditional value. Functional value is measured on a profile of choice attributes. Social value is based on profile of choice imagery. Emotional value measurement refers to the feelings associated with alternatives. Epistemic value is connected to curiosity, novelty and knowledge. Finally, the likelihood of choices determines the conditional value. The model is illustrated in Figure 3.

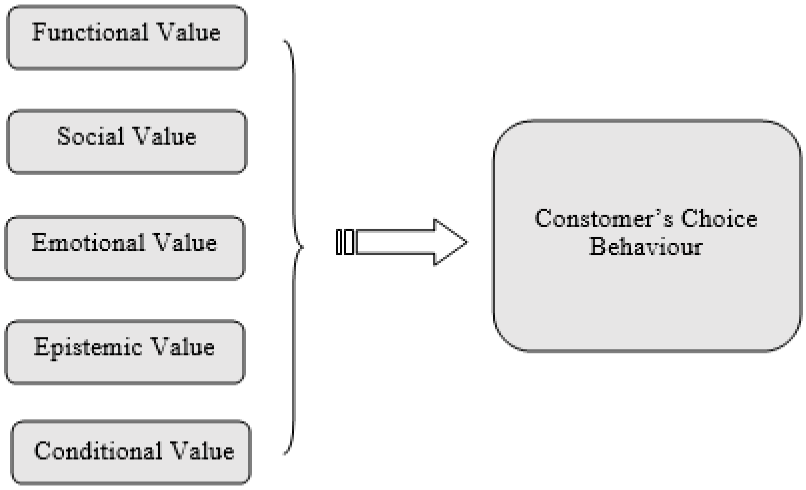

Figure 3. Customer value model (Adapted from Sheth, 1991).

Means-ends models are reliant on the notion that customers buy products to realize the promising ends. In this context, Woodruff (1997) has illustrated the customer value hierarchy in Figure 4. From bottom to top hierarchy, the model represents that customers consider offerings as bundles of product attributes and attribute preferences. By using the product, customers make preferences for certain attributes based on their ability to attain desired consequences, reflected in value in-use and ownership value. Customers also learn to desire certain consequences that help them to accomplish their goals.

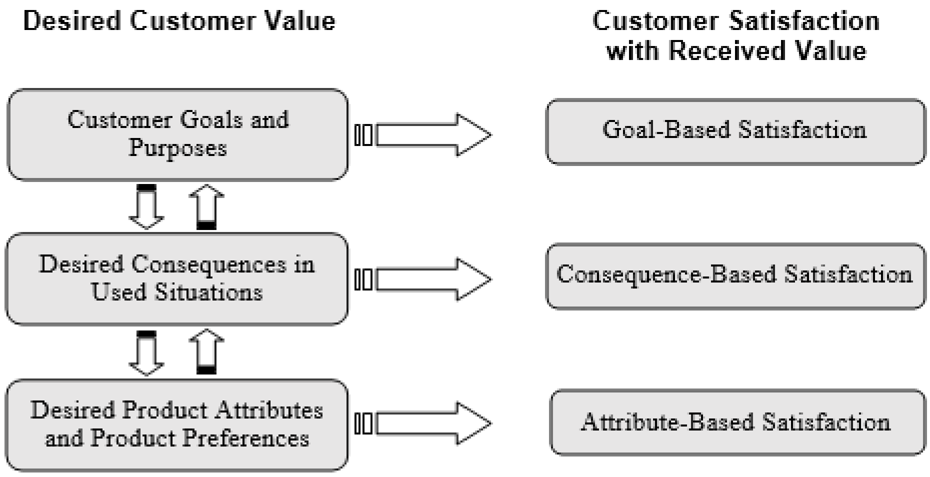

Figure 4: Customer value pyramid (Adapted from Woodruff, 1997).

From top of bottom hierarchy, Woodruff (1997) argue that goals and purposes help customers to attach importance to consequences which then provide guidance to customer in attaching importance to attributes and attribute preferences. According to

Khalifa (2004), mean-end models are effective tool to figure-out why customers give different value to benefits in offerings' assessment process.

Benefit-cost models are primarily based on the concept of customer value that explains value as the difference between benefits received and sacrifices made by the customers. In the previous sections, although this concept is defined by the various authors that provide general understanding of customer value however, it is essential to inquire what are the benefits and sacrifices. The following paragraphs briefly explain the benefit-cost models.

The value exchange model known as benefit-cost model proposed by Khalifa (2004) explains the concept of customer value. The model demonstrates that customers are prepared to take certain risks and invest resources such as time, money and efforts and in response they expect to get benefits that compensate all sacrifices. The difference between total benefits and sacrifices is known as net customer value. According to Khalifa (2004), total customer benefits consist of utility value and psychic value and total sacrifices comprises of financial and non-financial costs as demonstrated in Figure 5.

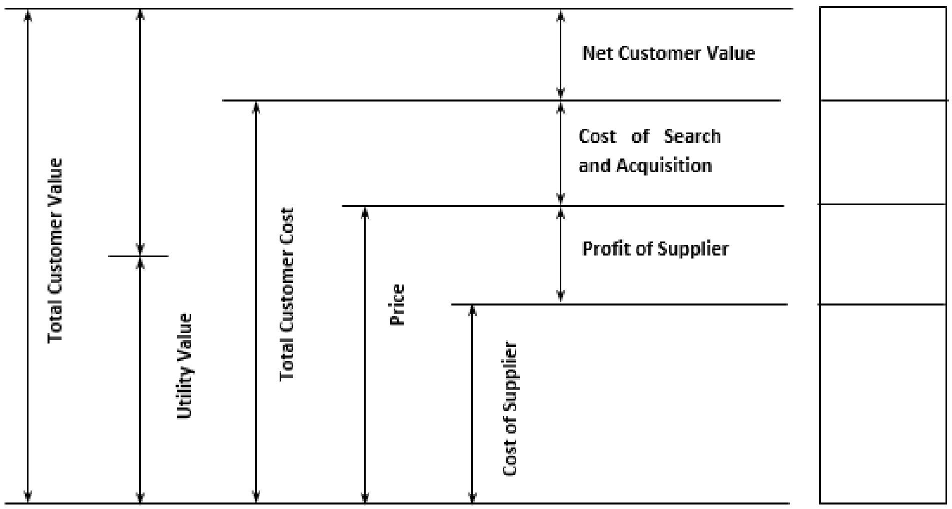

Figure 5. The Value Exchange Model (Adapted from Khalifa, 2004).

It is evident from the figure above that suppliers have to incur some costs to develop their products. Then suppliers set a product price that includes their profit margin. Customers have to bear not only the product or offer price cost but also the searching and acquisition costs. Thus customers expect higher value for them from product than what they sacrifice; therefore, companies must offer products that bring more benefits for customers than sacrifices.

In order to do so, firms need to have clear understanding about factors and features that are important for customers. Smith and Colgate (2007) explains benefit dimensions that contribute to the total customer value. The benefits include functional, experiential and symbolic value that customers avail from offerings by paying a price. Functional value refers to the product attributes that fulfill customer needs. Experiential value is related to the extent to which product creates experience, feelings and emotions for the customers. Symbolic value expresses the customer's psychological meanings attached to a product. The value model is demonstrated in Figure 6.

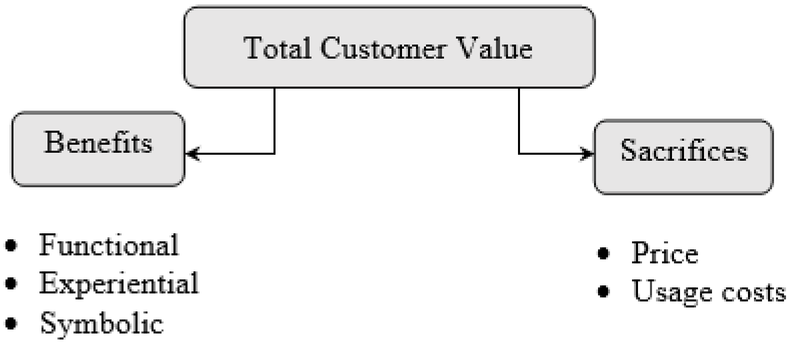

Figure 6. Customer Value Drivers (Adapted from Smith & Colgate 2007).

Similarly, Anderson & Narus (1998) argue that customers have to pay price for getting economic, technical, service and social benefits. The customer value is the net worth of all these benefits. According to the Lapierre (2000), customer value is the difference between benefits perceived and sacrifices made by the customer. Based on a survey among 209 and 129 purchasing executives of the Canadian IT and finance sector respectively, Lapierre proposed key value drivers as demonstrated in Figure 7.

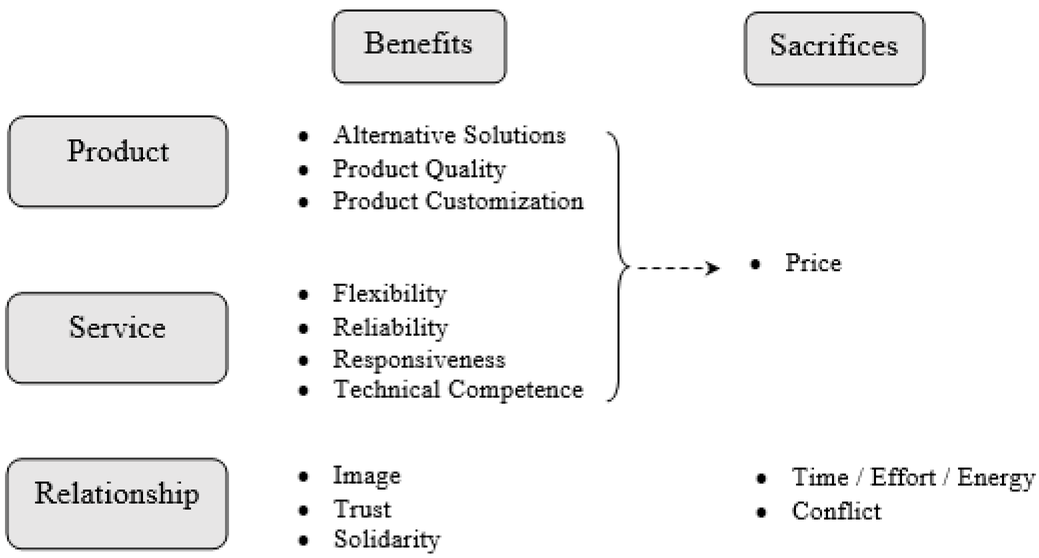

Figure 7. Customer Value Framework (Adapted from Lapierre, 2000).

The benefit drivers are categorized into product, service and relationship drivers. The benefits associated with product include alternative solutions, product customization and quality. Alternative solutions refer to the supplier’s capabilities and customers support that provide variety of solutions to fulfill customer needs and requirements. Product quality is about product reliability, durability and performance parameters. Product customization is related to the provision of customized products by the suppliers.

Service oriented benefits include technical competence, flexibility, reliability and responsiveness. Technical competence is the ability of suppliers to understand the customer needs and requirements and offer them solutions. Flexibility refers to the supplier’s capacity to respond the product changes and adjustments in timely manners. Responsiveness is the supplier’s commitment to address the customer’s issues and reliability is related to precision in business operations and commitments.

The relationship oriented benefits include image, trust and solidarity. Image refers to supplier’s credibility and reputation. Trust is the customers’ confidence on suppliers that is based on the supplier’s performance in terms of fulfilling commitments and information sharing. Solidarity is related to the customer care provided by the suppliers in all situations.

Likewise, there are sacrifice drivers that belong to product, service and relationship. Price is the only sacrifice driver related to product and service that customers have to pay. On the other hand, sacrifice drivers that refer to relationship are time, effort, energy and conflict. Customer firms undergo sacrifices such as spend time, energy and effort in employees training, consultations with suppliers as well as resolve conflicts to accomplish the goals.

Next, customer value is defined by the Menon et al. (2005) in terms of benefits offered by the seller and sacrifices made by the customers to avail those benefits. The benefits are classified as core benefits and add-on benefits while the sacrifices include purchasing price, acquisition costs and operating costs. Figure 8 illustrates this definition.

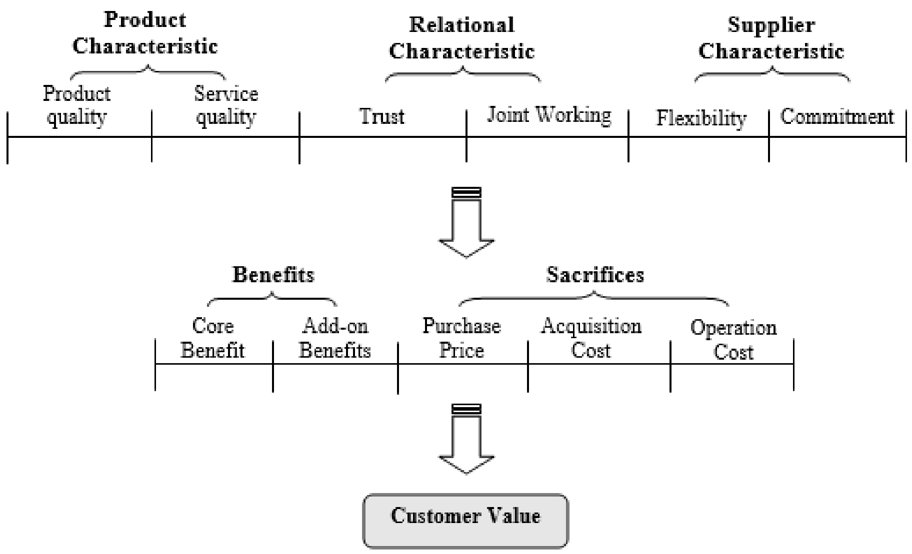

Figure 8. Customer Value Framework (Adapted from Menon et al., 2005).

Menon et al. (2005) argue that product characteristics, relational characteristics and supplier characteristics specify the benefits and sacrifices. As mentioned earlier, model describes the benefits as core benefits and add-on benefits. Thus core benefits refer to the minimum fundamental elements demanded by the customers from suppliers while the add-on benefits are additional features that are not exclusively demanded by the customers and, therefore may vary from supplier to supplier.

Conversely, customer made sacrifices to avail core benefits and add-on benefits such as purchase price, acquisition costs and operating costs. Purchasing price refers to the money paid by the customer for the product while acquisition costs include expenditures incurred on ordering, delivering, storing, performance monitoring as well as coordinating and communicating with suppliers. Finally, operating costs are the expenses related to manufacturing, research and development, internal communication and synergy.

Furthermore, Smith & Colgate (2007) proposed a customer value creation framework based on intensive literature study on customer value. The framework aims to illustrate that a firm can create four types of value for their customers: functional or instrumental value, experiential or hedonic value, symbolic or expressive value and cost or sacrifice value. The framework also describes five sources of value: information, products, interactions, environment and ownership.

This framework can be applied in formulating the strategies for value creation. First, functional value refers to the product features that perform anticipated functions. Woodruff (1997) sort out functional value into accurate attributes, appropriate performance and appropriate outcomes. Second, experiential value of product address the customers' feelings and emotions. Sheth et al. (1991) demonstrates four characteristics of experiential value: sensory, emotional, social and epistemic.

Third, symbolic value refers to extent of psychological meaning to a product demonstrated by the customers. There are five value aspects that comes under symbolic value: self-identity, personal meaning, self-expression, social meaning and conditional meaning (Sheth et al., 1991, Holbrook, 2005 cited in Smith & Colgate, 2007). Fourth, sacrifice value is regarded as sum of costs related to transactions. Sacrifice value comprises of four dimensions: economic costs, psychological costs, personal investment and risk (Grönroos, 1997, Sweeny, 1999, Woodall, 2003, Walter et al., 2003: cited in Smith & Colgate, 2007). Next section focus on building of customer value model based on theories and customer value model presented by Lyly-Yrjänäinen et al. (2009).

2.4 Building Customer Value Model

Customer value creation models help marketers to analyze various factors that contribute to the total customer value of the product (Smith & Colgate, 2007). As described in the previous sections, the concept of customer value is connected to the benefits received by the customers through the use of product. These benefits could be functional, economic, relationship or other type depending upon the user and product. There are two main types of customer value i.e. total customer value and customer perceived value. Total customer value is linked only to benefits associated with the product and customer perceived value considers also what the customer has to pay or sacrifice to get the benefit. Figure 9 demonstrates total customer value and relationship between customer perceived value and profit. The customer perceived value is the difference between total customer value and total customer cost.

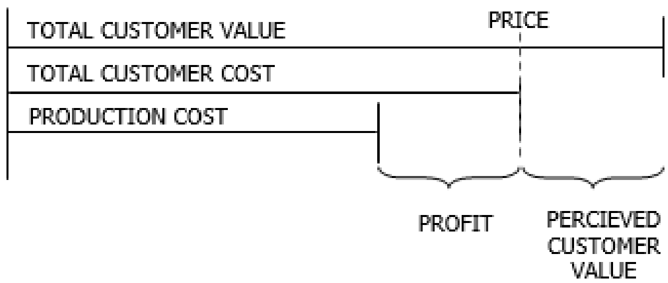

Figure 9. Perceived customer value (Adapted from Lyly- Yrjänäinen et al., 2009).

The above model by Lyly-Yrjanainen et al. is a suitable tool for better understanding the customer perceived value especially in B2B markets. Total customer value is the value of all benefits provided by a product. In order to receive this value, customer has to bear costs such as costs of purchase, usage and disposal. The sum of these costs determines the total customer cost. The customer perceived value is the difference between total customer value and total customer cost. This model also explains that companies should set the product price in a way that total customer cost must not exceed the total customer value.

On the basis of literature review on customer value in B2B context, it is observed that many authors have similarities in their models however, they use different terms for the same concept. For example, price is the one of main sacrifices stated by various authors in their models but Lyly-Yrjänäinen et al. (2009) use term economic sacrifices for the same concept. Thus, by combining the similar ideas, a new categorization of benefits-sacrifices value drivers is demonstrated in Figure 10.

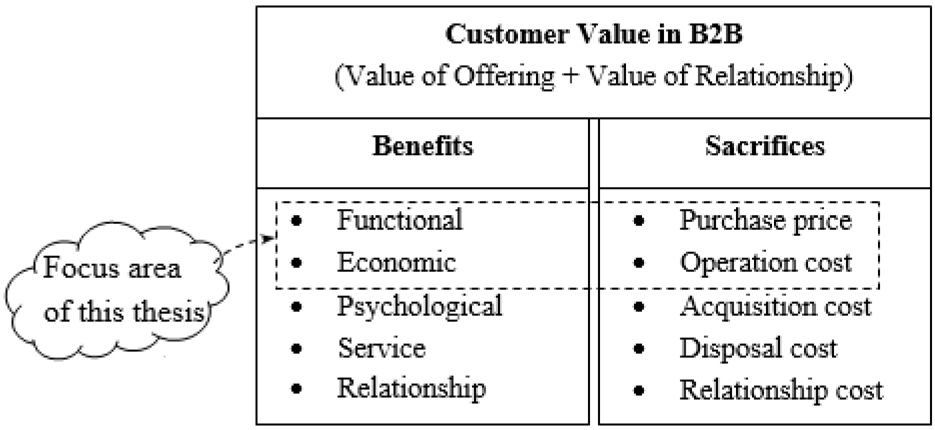

Figure 10. Categorization of benefits-sacrifices value drivers.

The above figure shows that both benefits and sacrifices value drivers are categorized into five groups. The benefits associated to a product can be functional, economic, psychological, service and relationship benefits. Similarly, customer sacrifices are purchase price, acquisition cost, operation cost, disposal cost and relationship cost. The above categorization is useful in evaluation of benefits and sacrifices. The focus of this thesis is on functional and economic benefits along with purchase price and operation cost.

In order to understand the concept of customer value, new categorization of benefits-sacrifice drivers is combined with the customer value framework by Lyly-Yrjänäinen (2009). The reason for choosing the Lyly-Yrjänäinen et al. framework in building the customer value model is its simplicity to explain the concept of customer value. Figure 11 demonstrate the framework for customer value by taking into account the new categorization of benefits and sacrifices drivers.

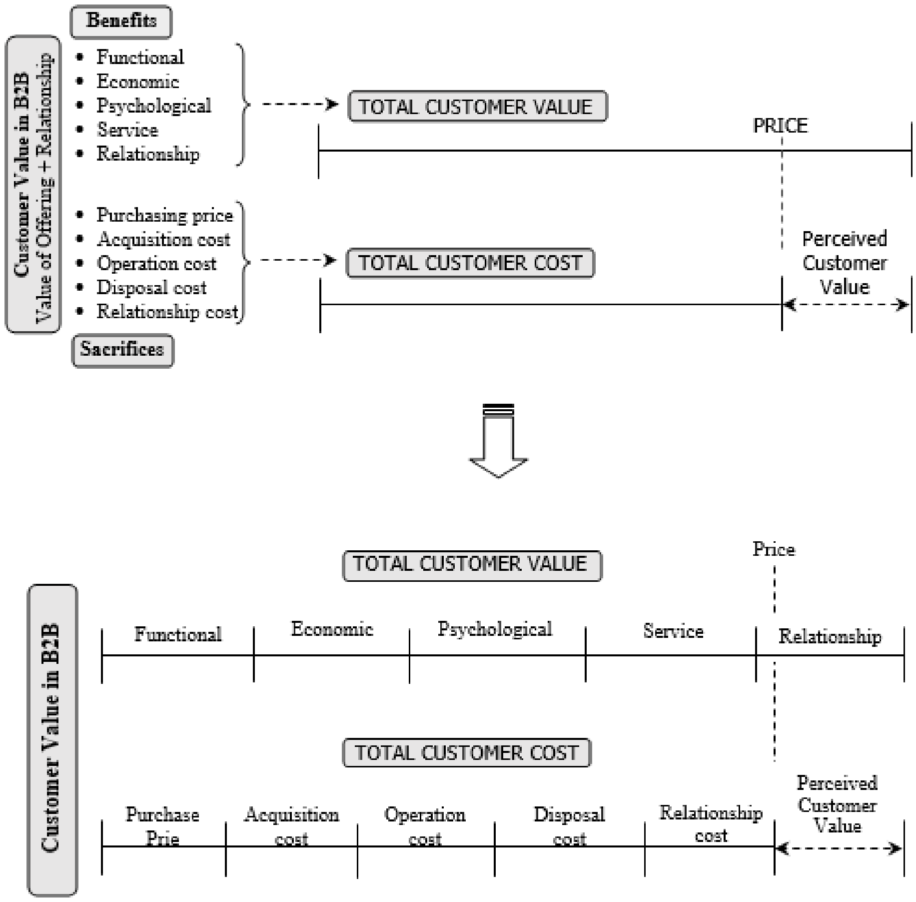

Figure 11. Customer perceived value framework.

For the simplicity of demonstration, the above figure shows that customer value drivers contributing to total customer value and total customer cost are equally important but in real life importance rating of each of these value drivers varies for different customers. According to Woodruff (1997), it is crucial for the companies to evaluate how their offering create value for their customers. Companies develop their product on the basis of customer needs therefore, clear understanding on customers' preferences is required to deliver them desired value. Van der Haar et al. (2001) proposed a framework to differentiate the supplier's and customer's value perception. The framework is presented in Figure 12.

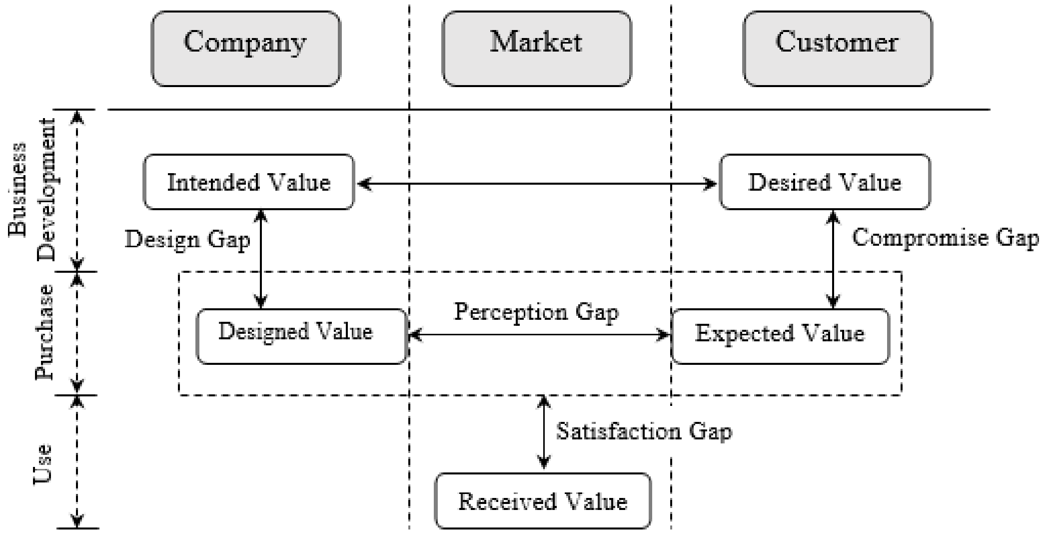

Figure 12. Customer value framework (Adapted from Van der Haar et al., 2001).

At the early stage of product development process, the assessment or perception of firms might be vague about customers' needs and what to offer (intended value) to the customers. It is highly important that supplier firms' intended value must be aligned with the customers' needs and desires (desired value). The lack of information on customers' needs and requirements may create information gap between intended and desired value. After development, the supplier's firm introduces product to the customers and the value of product at this stage is known as designed value from supplier's point of view. The difference between designed and intended value is referred as design gap that may occur due to technical limitations or miscommunication between actors.

The customers prefer products that are up-to their expectations but the expected value of products may be different from actual desires. The difference between the expected value and the desired value is called compromise gap. The firms will be in better position to get new customers if the compromise gap is smaller. The usage of product determine the value of product for customers. The gap between received and expected value is denoted as satisfaction gap. In order to minimize these gaps, firms need to focus and analyze the customer perceived value because value can be perceived by current and potential customers whereas, customer satisfaction is related to existing customers only. The next section explains customer value analysis methods.

2.5 Customer Value Analysis

As mentioned in the previous section, it is really important for companies to have a clear understanding about the customer perceived value. In other words, companies need to know what is important for customers in their offerings. According to Brady (1995), generally there are six steps in customer value analysis study.

- Orientation phase
- Data collection or establishment of study
- Functional analysis
- Search for new ideas
- Evaluation of ideas and solutions
- Implementation

First, orientation phase involves identifying the objectives of study such as quantification of the duration, budget and cost. Second, in data collection phase, the information is collected across a wide spectrum such as user requirements, market size, competition, legislation and standards, cost of components, future technological developments and organizational limitations. Third, functional analysis involves examination of the object itself where the ideal is set as a benchmark to know the difference between the existing and potential product. Fourth, from the search for ideas stage, companies explore new and alternative solutions. Fifth, evaluation of ideas and solutions phase governs short listing of most promising ideas and solutions. Sixth, the implementation stage involves the execution of most promising ideas from the short listed solutions.

According to Anderson et al. (2006), customer value assessment is the critical process that leads firms to create credible value propositions for customers and capturing rightful return on delivered value. The value proposition delivers monetary benefits to the customers as well as demonstrates the relationship between satisfaction of customers' needs, the performance of firm's offerings and total customer cost over the relationship's life cycle (Payne & Holt, 2001). The authors (Anderson and Narus, 1998; Payne and Frow, 2005) explain that firms need to undertake value assessment to figure out whether their value proposition is perceived as superior customer experience.

Since the main focus of this thesis is on the value of physical products therefore following nine customer value assessment methods presented by Anderson et al. (1993) are discussed here.

- Internal engineering assessment
- Field value-in-use assessment
- Indirect survey questions
- Focus group value assessment
- Direct Survey questions
- Conjoint or tradeoff analysis
- Benchmarks
- Compositional approach
- Importance ratings

First, internal engineering assessment involves, product value is estimated by implementing laboratory tests in supplier's firm with a limited or without direct customers' input. The application of this method is based on information and knowledge that firms have about usage of their products. Without having sufficient knowledge, internal engineering assessment will not provide worthy estimations. Second, field value-in-use assessment method demonstrates that interviews are conducted in customer firm in order to specify a comprehensive listing of cost elements related to the usage of product. The success of this method highly depends on the willingness of customer firm for information sharing.

Third, in indirect survey firms are asked how changes in the present product would affect them. Estimation of the value of each product change is possible by combining the firm previous knowledge and customer firms' feedback. The success of this method like previous one also depends on the customer firm cooperation. Fourth, focus group value assessment explains that potential products or product concepts are presented to the customer firms to know the value of product or concept to them. According to Calder (1977) this method can provide deep understanding about the customers.

Fifth, direct survey question method includes a narrative about potential products or a concept is provided to the respondents to know the value of these products or concepts to their firms. In order to find the estimation of value, respondents must be willing to answer the direct questions and they must also have ample understanding on the topics otherwise the validity of the estimation will be vague. Sixth, conjoint or tradeoff analysis method demonstrates that companies provide purchase preference ratings after evaluating the potential products with respect to their purchase preference. Then these ratings are transformed to value by applying statistical analysis.

This method facilitates researchers to acquire fundamental values by splitting the respondent's overall perspective. However, for some industries, it is less attractive method because of its complexity. Seventh, benchmarks method provides the detail of a product offering to the respondents, normally demonstrating the present industry standard that works as a "benchmark" offering. Then customers are asked about their willingness to pay more for additional features in a product or vice versa. This method also provides fundamental values for researchers, the same as conjoint analysis. However, this method is more economical and easier to practice than conjoint analysis.

Eighth, compositional approach explains that firms give value to the selected levels of features of their firm which subsequently are to be summed up to estimate an overall value of different products. This method is easy to use but companies' reluctance to reveal precise information may affect the rationality of outcomes. Finally, importance rating illustrates that customer firm rate supplier firms with respect to their performance to them. Thus it provides a competitor analysis of the value provided by each supplier. One of the shortcomings of this method is that it does not arrange for monetary estimation of perceived worth of a product. Focus group value assessment and importance ratings are used more often than other methods in business markets. However, it should be considered that none of these methods is comprehensively successful in practice (Anderson et al., 1993). The application of customer value analysis methods to obtain customer perceived value is shown in Figure 13.

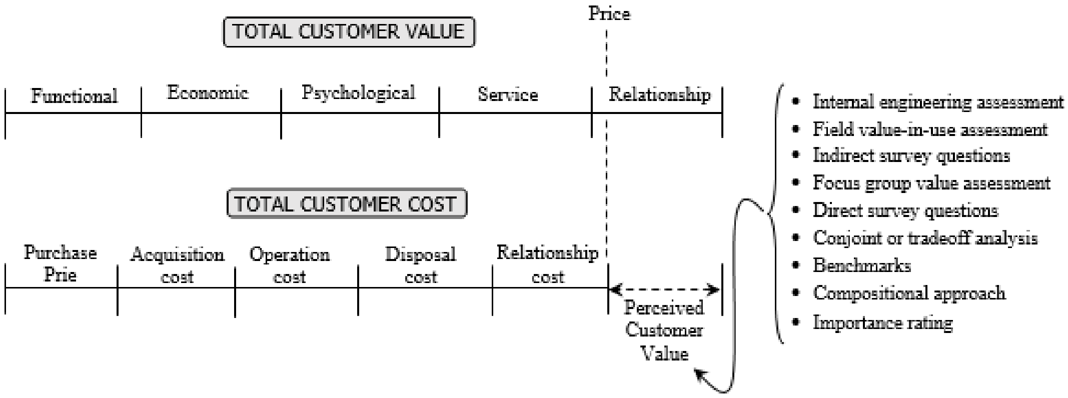

Figure 13. Utilizing customer value analysis methods to obtain customer perceived value.

The customer value approach can be applied to the whole innovation process from product definition to launching of a product. The focus of this thesis is to present the customer value analysis as a tool for fostering a systemic innovation. Moreover, this thesis aims to present an idea of cost-reducing innovation - tractor implement coupling interface. This innovation will slightly affect the operation cost and other customer cost drivers. However, it has more obvious and substantial impact on purchase price as demonstrated in Figure 14.

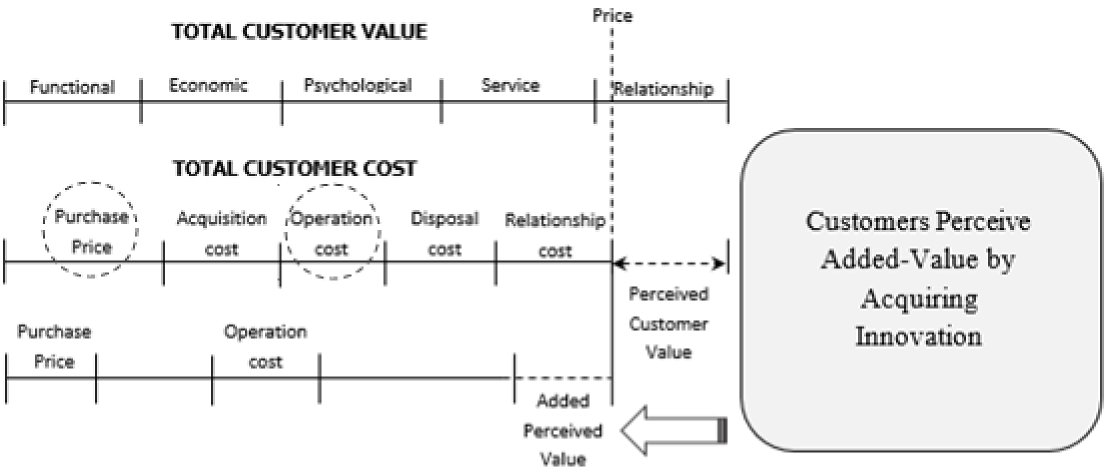

Figure 14. Customer value analysis model communicating the added perceived value.

By acquiring the cost-reducing innovation, customers get more benefits as compared to the total customer cost. However, these benefits will not come for free since it requires some investment from the customer. The customer's investment on innovation is a trade-off between benefits and sacrifices. According to Woodruff (1997), customers need to acquire the innovation to experience and evaluate the product features and performance.

It is also important for the supplier firm to motivate customers by showing how the cost-reducing innovation will add value for the customers. Thus, the customer value analysis is a useful tool both for suppliers and customers in making the investment decisions. In this chapter, customer value models were described to have a better understanding about this concept and finally nine methods by Anderson et al. (1993) were introduced for assessing the value of products. The following chapter explains the product development process and innovation model for making the cost-reducing products.

3. PRODUCT DEVELOPMENT

3.1 Product Development Process

It is highly important for the companies to keep their product portfolio innovative according to the customer needs that help companies to be competitive in the dynamic environment. The ability of a firm to compete successfully on the increasingly competitive global markets is largely influenced by their ability to introduce cost effective quality products in a timely manner. Smith and Morrow (1999) also believe that long term sustainability of firms lies in the successful development of products. Customers prefer to buy products that satisfy their needs in a better way. Therefore, firms' competitive advantage is reliant on the successful product development. According to Phillips et al. (1999) firms adapt new business strategies, processes and technologies to facilitate the product development process.

According to Lyly-Yrjänäinen et al. (2009), product development is not simply to come up with new products but it is an important learning exercise for the firms. Product development process includes different activities such as product design, design patent, evaluation of financial and economic aspects as well as customers' feedback (Formoso et al., 2002). The product development is defined by the Ulrich and Eppinger (1995) as the process where product is conceived, designed and launched in the market as well as followed by the product feedback from production and product users.

As mentioned earlier, cost evaluation or management is an important factor in the product development process as it affects the competitive position of the company. The cost structure analysis of companies shows that product development costs are not that much; in most of companies it ranges from two to five percent of the total sales. Although product development cost do not represent the high percentage of overall cost structure of the company, cost implications of different product development stages can be significant and must be carefully taken into account.

Generally, it is assumed that 80% of costs are committed at the design Phase. Turney (1991) argues that Ford Motor lock in 60 to 80 percent of the product life cycle costs on the completion of design phase and costs jumps to 90 to 95 percent on the completion of production process design. In other words, once the product reaches the introduction phase in its life cycle, there are minimum chances to cut the costs further. Figure 15 illustrates the cost structure of the product development process.

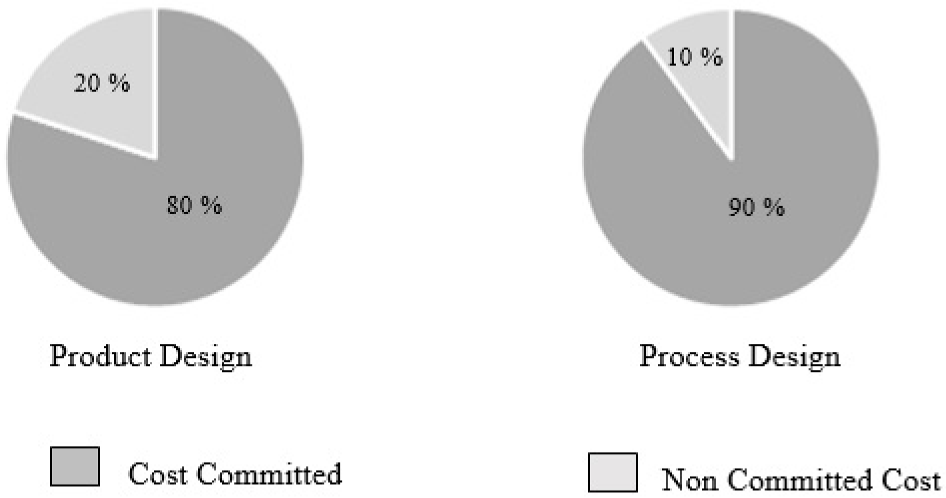

Figure 15. Costs committed in the product development process (Turney, 1991).

According to Belay (2009), about eighty percent (80%) of costs are locked in at the design phase that reaches to ninety five percent (95%) when product enters the production phase. Nevins and Whitney (1989) explain that in the product development process, seventy percent (70 %) costs such as cost of material, manufacturing cost, usage and disposal costs are estimated at design phase. Dowlatshahi (1992) is of the view that seventy to eighty percent of the total product costs are estimated at design phase. Therefore, cost control activities are effective at early stage of the product development.

As soon as the production process is defined, the possibilities to reduce the product costs are even more limited. Therefore, product developers and designers must have intensive knowledge about material options and production practices. Figure 16 demonstrates the percentage of costs committed and costs incurred at different phases of the product development.

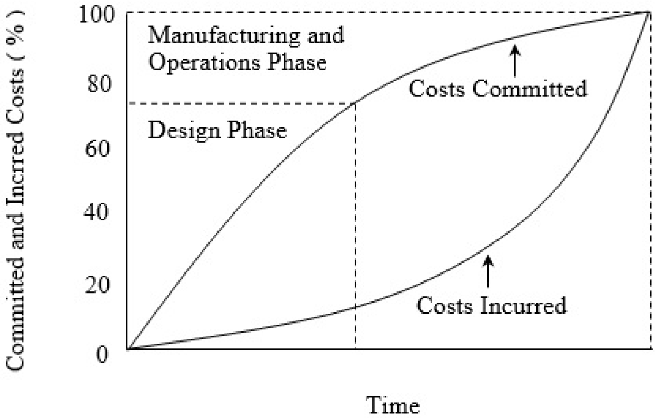

Figure 16. Demonstration of costs committed and incurred at different phases of product development process (Adapted from Belay, 2009).

It is evident from the figure above that about seventy to eighty percent of costs are committed at the design phase of the product. This number reaches to hundred percent at the manufacturing and operations phase, meaning that, for cost management companies must do efforts at early stage of the product development. Next, this chapter explains the different models for the product development process.

3.2 Product Development Process Models

The first generation of the product development system was introduced by NASA in 1960s. NASA Phased Project Planning (PPP), now known as Phased Review Process (PRP), was a detailed system that used to help NASA to work with their suppliers and contractors on plenty of space projects. The same system was under the use of U.S. military to develop the weapons with its suppliers.

The PRP system splits down the development into distinct phases which are accompanied with review process at the end of each phase. The project only could move to the next phase, if it fulfills the certain prerequisites at review points. The system was designed to ensure that every stage of project is running smoothly in timely manners. This scheme was primarily applied to the physical design and development of the product that solely deals with technical risks but not the business risks. (Cooper, 1994)

History witnessed different reviews about the Phased Review Process. There are some positive reviews such as Hewlett Packard (HP) still using the improved version of this system with little changes. The PRP ensures the completion of tasks and lessens the technical risks. On the other hand, different review points at various stages slow down the project completion time as projects held up at various points for management review. This system approach is narrow as it deals only with the product development phase despite the entire process from the idea generation to launch. Figure 17 illustrates the phase review process model.

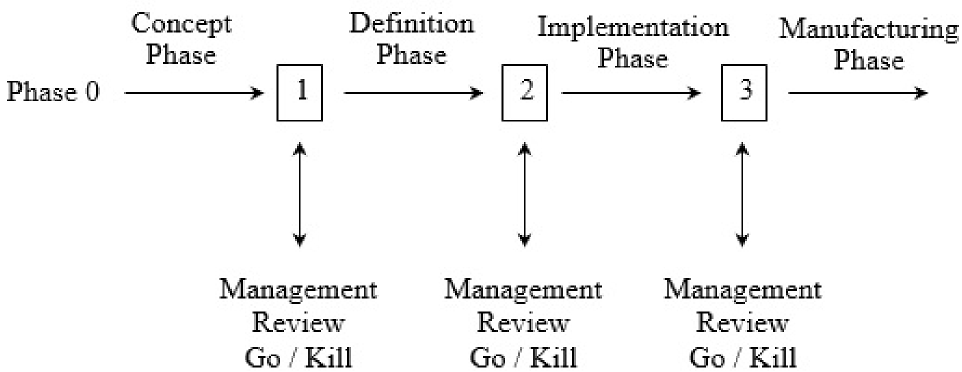

Figure 17. Phase review process (Adapted from Hughes et al., 1996).

The second generation of product development models comprises of Stage-Gate models that somehow resemble the Project Review Process from 1960s. Stage gate models consist of identifiable stages preceded by the review points or gates. Various success factors have been identified over the decades that separate successful firms from the ineffective ones. Table 4 illustrates the few examples of stage gate models presented by the various authors.

The discussion on stage gate models is incomplete without mentioning the research of Cooper. On the basis of lessons learned from research investigations and personal experiences, Cooper (1983) states the success factors and the reasons, why products fail in the markets. He proposes that significant changes must be done in the product development process.

Firstly, the product development process must be detailed enough that help managers as a guide to take actions. Secondly, market orientation and customers’ voice must be included in the development process. Thirdly, effective internal communication among the partners is an essential component of development process. Finally, there must be evaluation and check points to figure-out the potential projects and eliminate the dead ones.

Table 4. Stage-gate models.

	Cooper & Kleinschmidt (1986)	**Wheelwright & Clark (1992)**	**Griffin (1997)**	**Cooper (1994)**	**Song & Montoya-Weiss (1998)**	**Cooper (2008)**
Idea Stage	Initial screening	Idea generation	Idea/concept generation	Idea generation	Idea development & screening	Discovery stage
			Idea screening	Preliminary assessment	Business & market opportunity analysis	Idea screen
Concept development & testing stages		Product definition and selection		Concept		Scoping
						Second screen
Analysis & evaluation stages	Preliminary market assessment		Business analysis			Build business case
	Preliminary technical assessment					
	Detailed market study/ research					
	Business/finan cial analysis					
						Go to development
Develop ment stages	Product development	Build & design prototypes	Development	Development	Technical development	Development
						Go to testing
Testing stages	In-house product testing		Test and validation	Testing	Product testing	Testing and validation
	Consumer product tests					
	Test market/ trial sale					
	Trial production					
	Pre-commercializat ion on business analysis					
Launch/ commercializ ation stages						Go to launch
	Production start-up	Manufacturing ramp up	Commercializ ation	Launch	commerciali zation	Launch
	Market launch					Post Launch review

On the basis of research findings, analysis of previous models and a review of sixty flow charts of history cases of new product projects, Cooper (1983) presented activities based seven stage model as demonstrated in Figure 18.

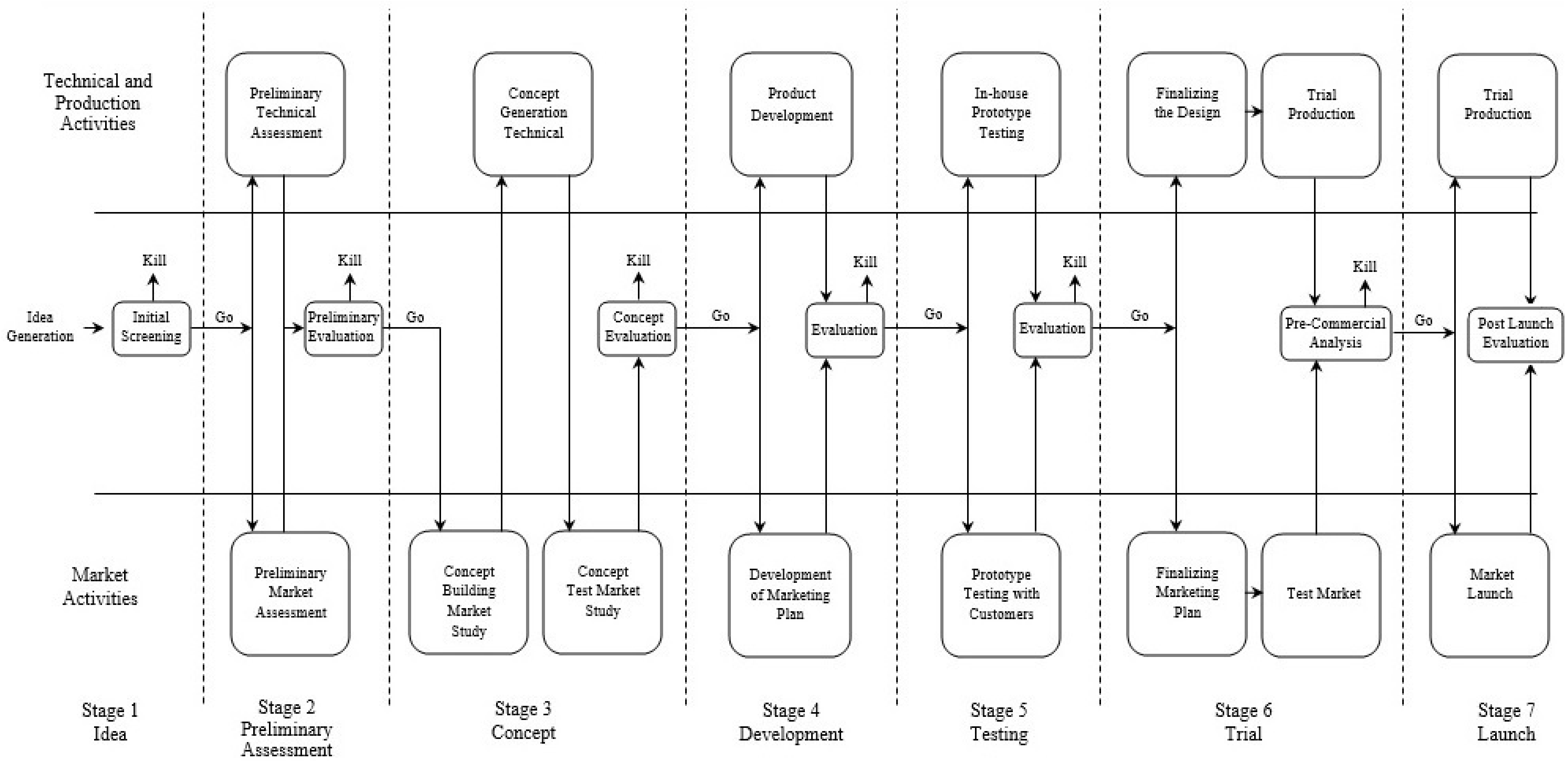

Figure 18. Schema of seven-stage new product process model (Adapted from Cooper, 1983).

Activities based model presented by the Cooper (1983) provided the systematic insight to manage the new product development process. Cooper further identified the standardized approach for development projects and presented the second generation stage gate model as shown in Figure 19.

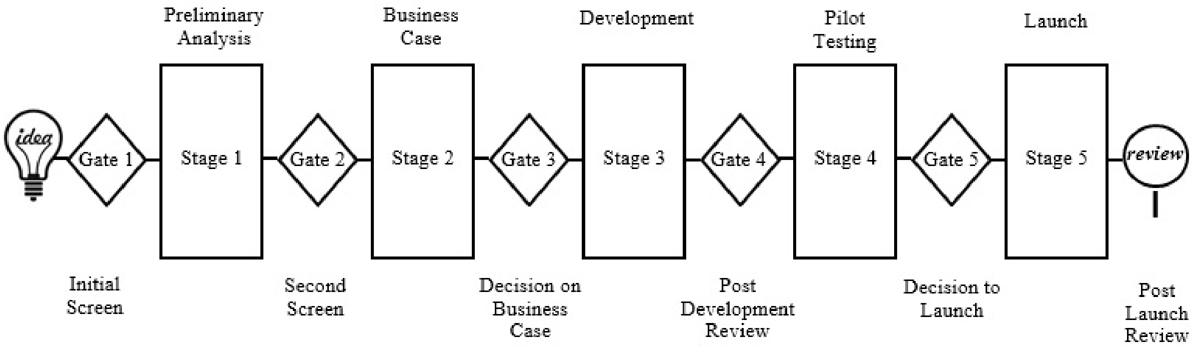

Figure 19. Stage gate model (Adapted from Cooper, 1990).

Stage-gate model is a simple tool that supports the product development process from the idea generation to launching of the product. This is adopted by seventy three percent (73%) of companies in North-America (Stage-Gate Inc., 2007; cited by Barringer and Gresock, 2008). Stage-gate model comprises of various stages and each stage analyzes the information gathered at the previous stage of the development process. On the basis of the information analysis, it is decided that either project will be continued or declined. According to Phillips et al. (1999), number of gates and their titles may vary in different stage-gate models. However, all of them support product development process in efficient manners.

First step for the development of new product is idea generation. It is challenging for companies to come-up with ideas that are finally successful for business. According to the Cooper (1999), the major criterion for the idea selection at this stage is reliant on various parameters such as strategic alignment, project feasibility, market attractiveness, competitive advantage and project alignment with the company policies. Preliminary assessment is done at first stage that includes information gathering, feasibility analysis and realizing the significance of the project. At this stage, only potential ideas are considered while impractical ideas are filtered out (Lyly-Yrjänäinen et al., 2009).

The potential ideas are further investigated by various entities such as technical, financial and manufacturing experts at business analysis stage. Business analysis stage defines the product or service, target market, financial prospects and comprehensive plan for next step (Barringer and Gresock, 2008). Ideas are rigorously analyzed at business analysis stage and only small number of ideas reach the development and testing phase (Lyly-Yrjänäinen et al., 2009).

Before going to the development stage, third gate is making decision on the business case. Management team takes decision for further investment on the project. Development is third stage in the above model where companies develop a prototype or a sample product. Cooper (1999) explains that marketing plan and its supporting elements such as advertising, distribution and services must be finalized simultaneously.

Fourth gate is post development review, since it ensures the compatibility of the developed product with the original definition of product (Cooper, 1999). Following to the post development review, testing stage begins where product design and development is completed and different tests are applied to ensure the functioning of technologies (Edgett, 1996). Various tests are done to evaluate the actual operation of the product (Lyly-Yrjänäinen et al., 2009). Moreover, company sells product to the selected customers to identify the customers’ response towards the product (Barringer and Gresock, 2008).

Fifth gate is pre-commercialization business analysis where management team makes sure that they are in the right direction and, if not, they can decline the project (Cooper, 1999). Next is the full production stage where company goes for the commercial production and implements the marketing plan. At this stage, product is commercialized and launched at large scale (Edgett, 1996). Finally, companies monitor the performance of the product in terms of sales, market share and customers response.

Companies can get lot of benefits through the implementation of stage-gate process during the development of products. The stage-gate model leads to the successful development as it improves the team work among members, reduces rework and identifies the flaws and bottlenecks during the product development (Kleinschmidt & Cooper, 1991).

Although second generation models are better than first generation model, however, they have some problems. For instance, project could be held up at the gate until all tasks have been completed before moving to the next stage. For smaller projects where low risk is involved, stage-gate model may cause the unnecessary delay. Further, stage gate models pay less attention to projects prioritization and allocation of the resources.

3.3 Variations in Product Development Models

Third generation models evolved from the second stage gate models to address the deficiencies (Cooper, 1994). New models were focusing on the efficiency, speeding up the process and efficient allocation of development resources. Third generation model have four fundamental Fs and is presented in Figure 20.

- Fluidity – the model is adaptable and fluid. It consist of fluid and overlapping stages for greater speed.

- Fuzzy Gates – it features conditional Go decisions depending on the situation.
- Focused – it monitors the entire project portfolio rather focusing on the single project at a time to allocate resources to the best ones.
- Flexible – it is flexible in terms of review gates as each project is unique and has its own requirements.

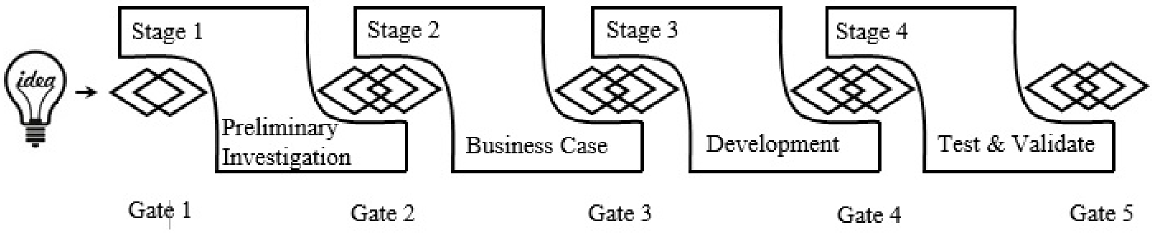

Figure 20. Third generation development model (Adapted from Cooper, 1994).

The third generation systems have aforementioned pros. However, they can make the process more complicated as there is some freedom and reliance on discretion. Therefore, implementation and operation of such sophisticated and smart systems demand for talented professionals.

Companies have developed variations in stage-gate models depending upon their needs and requirements in order to make it flexible, adaptable and fit to the different projects (Cooper, 2008). Figure 21 presents the two variations: stage-gate press and lite.

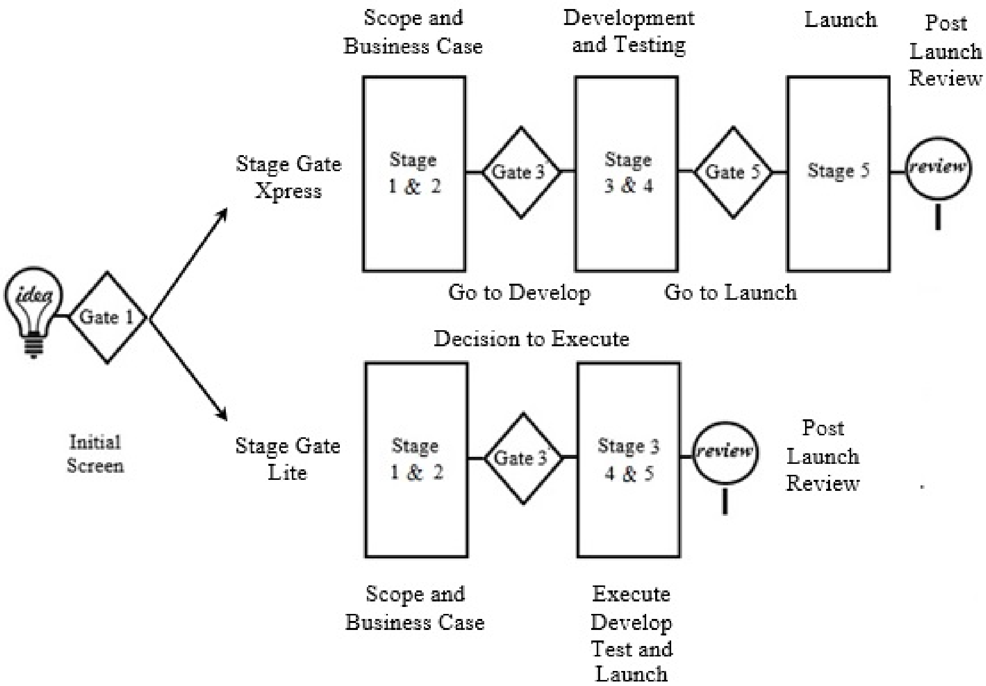

Figure 21. Xpress and lite variations of stage-gate model (Adapted from Cooper, 2008).

Xpress model is used to handle the moderate risk projects such as line extensions and modifications, whereas lite model is used to address the minor changes suggested by marketing and salesforce. Execution of both models make process risks adjustable and scalable. Now many firms have implemented this approach: skipping gates, overlapping gates and making conditional choices.

3.4 Developing Framework for Product Development

This thesis aims to utilize the customer value analysis as a tool in the product development process. Therefore, it is necessary to discuss Cooper's spiral development concept that incorporates the customers' contribution in the development process. Spiral development concept allows the information to come into the firm as well as continual changes to the product design throughout the development process. Hence, it mainly focuses on the customers inputs than a traditional stage-gate model. Figure 22 illustrates the spiral variation of the stage gate model.

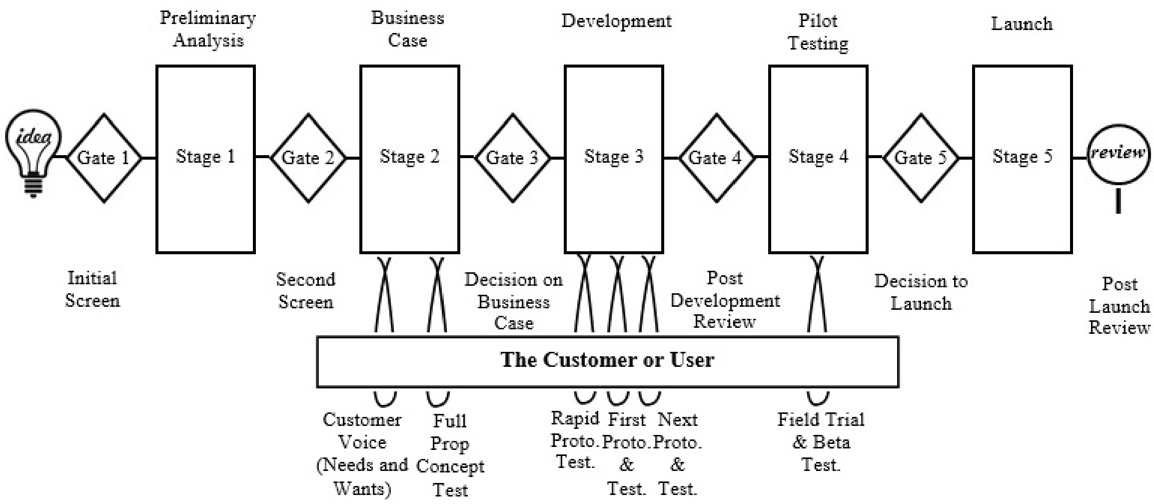

Figure 22. Spiral variation in stage-gate model (Adapted from Cooper, 2008).

The inclusion of spiral variation in stage gate model addresses the various limitations observed in the linear stage gate models. The first loop represents the needs and wants of customers. The product development team listens to the customers to identify their problems and needs. Next, product development team offers a solution to the customers in form of a simple mockup or computer aided design. Thus customers perceive an idea about the product design and functioning.

By taking into account the voice of customers, company alters the product definition and design until it best fits to the customer needs. The advanced version of a product is developed by utilizing the iterative loops in the product development stage. The last loop represents iterative field trial of the product where product is tested by various customers and their feedback give clearer picture about the success of a product in the market. (Cooper, 2008) The above model is more comprehensive as it considers the customers feedback in the innovation process. However, all the product development efforts and processes are carried out inside the boundaries of a firm. In order to increase the realm of product development process to the external resources, Chesbrough (2003), introduced a concept of open innovation. Figure 23 represents the open innovation model.

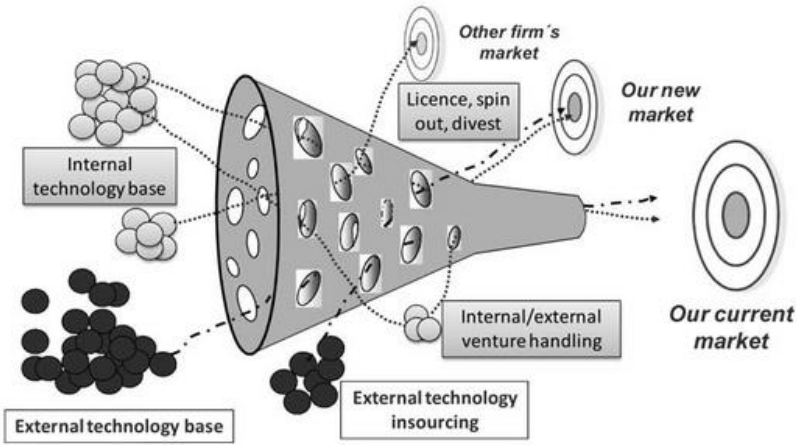

Figure 23. Open innovation model (Chesbrough, 2003).

Open innovation model not only considers the internal ideas and efforts of a firm in the product development process. However, it contemplates the external ideas and development resources equally in the innovation process. Through the open innovation, firms may have a large base of ideas, resources and technologies to drive their internal growth. Open innovation model suggests that companies can create value for their customers by utilizing both internal and external ideas as well as treating R&D as an open system. Moreover, to understand the customer requirements, customer value analysis approach can be applied to the whole innovation process from product definition to launching of a product. Thus, customer value analysis model can be integrated with the open innovation model for having a clear understanding about customer requirements during the innovation process as demonstrated in Figure 24.

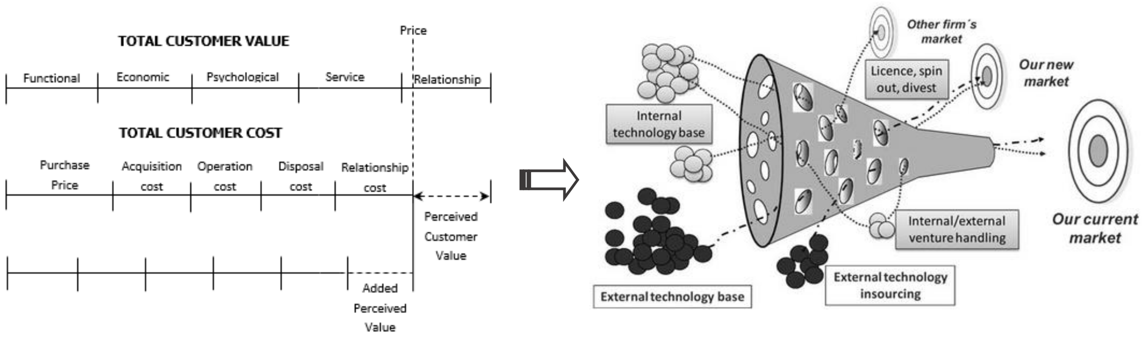

Figure 24. Utilizing customer value analysis in the open innovation model.

The above figure illustrates that firms can analyze their customer requirements by utilizing the customer value analysis tool, and can develop cost-reducing innovations through the open innovation model. The next chapter explains the concept of systemic innovation and tools for managing a systemic innovation.

4. MANAGING SYSTEMATIC INNOVATIONS

4.1 Concept of Innovation

To understand the concept of innovation, it is important to know the difference among idea, invention and innovation. The idea refers to new arrangement of old modules (Young, 1992, cited in Foster, 1996). The concepts of invention and innovations are used interchangeably; they must not be because, invention infers coming up with something novel, it is the bringing an invention to life what makes an invention different from innovation (Gattorna, 1977, p. 2; Davila, 2006). “According to Norman (1993), invention is new man-made device or process. The new device which qualifies as an invention may take such forms: a new physical product, a new biological life form or a new piece of software.

Rubenstein (1989), explains innovation as a process whereby new or value added products, processes, materials and services are established and repositioned to the places where they are suitable. Thus, innovation is a well commercialized creation. The above definitions reflect that idea refers to novel thought generated in mind. When idea or thought is transformed to a physical product or process it becomes an invention. The successful commercialization of invention in the market is considered as innovation (Twiss, 1992, cited in Cumming, 1998). Figure 25 illustrates the idea, invention and innovation.

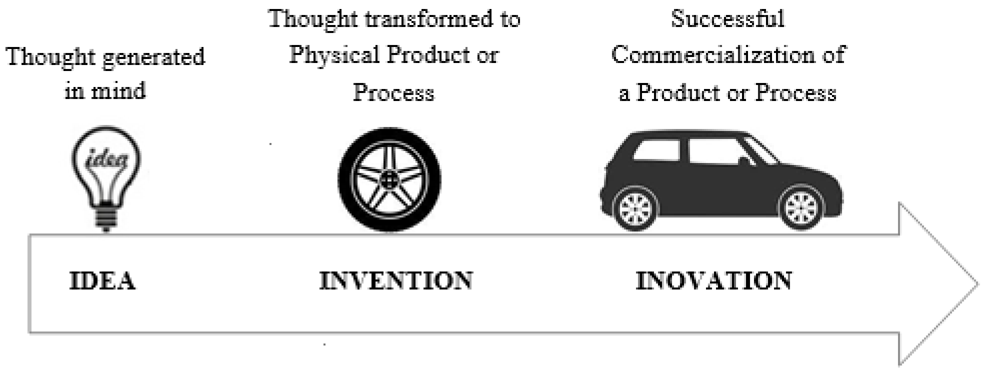

Figure 25. Demonstration of idea, invention and innovation.

Innovation can happen in two forms. One way is incremental innovation or continuous innovation, in which innovation is gradually enhanced with small improvements (White et al., 2007). Figure 26 presents the incremental innovation.

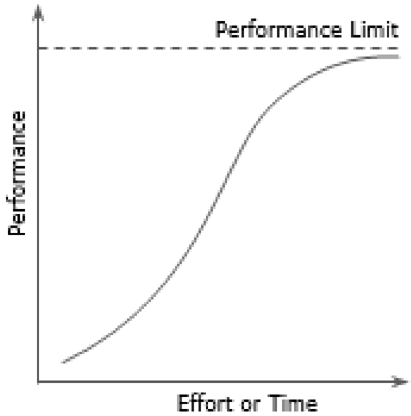

Figure 26. Technology S-curve (Adapted from Foster, 1986).

Incremental innovations are related to well-established companies but in today's environment of rapid technological change firms cannot rely on the incremental innovations only. Hence, for long term competitiveness, companies must come up with new ideas and transform them to innovations which substitutes the existent products, services, processes and even concepts. This form of innovation is called radical innovation, also known as disruptive innovation. The radical innovations are linked with researchers, field experts and entrepreneurs (Maidique, 1980, Dodgson et al., 2008). Figure 27 demonstrates the radical innovation.

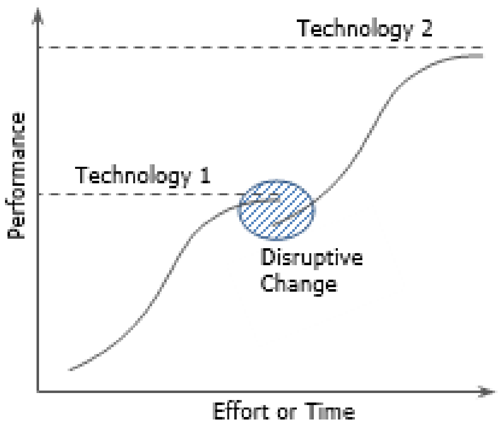

Figure 27. Demonstration of radical innovation (Adapted from Foster, 1986).

The radical innovations have potential to shift market structure by incorporating entirely new and complex technologies that require user learning as well as bring significant behavioral changes on users' side (Urban et al., 1996). For developing radical innovations, companies need to rely on the technological competencies and should follow the structured way. There are various sources that contribute towards innovation by generating and transforming novel ideas to successfully commercialized products or services. Drucker (1985) proposes following seven sources for innovative opportunity of which four are inside the business and three are outside the organization or industry:

- Unexpected success, failure or outside event.
- Incongruity between reality as it actually is and reality as it is imagined.
- Innovation on the basis of process needs.
- Changes in industry structure or market structure.
- Demographical changes such as market population and their demands.
- Changes in perception, meaning and mood – what is in valued today? Can company respond on time?
- New knowledge: both scientific and non-scientific.

Hippel (1988) suggests that in company settings, there are basically two means of innovation. The first refers to the internal efforts of the company such as indigenous R&D and the second is related to external people such as customers, partners, suppliers, research institutions, external experts, universities and online communities. It is difficult to determine the main sources of innovation as it is highly dependent on the nature and structure of the industry. The process of innovation is dynamic in nature and requires intensive knowledge resources. The constant increase in market demand and competition require better collaborative efforts from internal and external partners. The understanding of knowledge management practices and know-how of intangible nature of knowledge assets equip managers to innovate in a system through collaboration. The next section explains the systemic innovations.

4.2 Systemic Innovations

A systemic approach has been adopted by various studies to understand the complexities that trigger the development of technologies. For example, studies on electricity supply (Hughes, 1983), aero-plane (Vincenti, 1994; Constant, 1987), PC (Christensen 1997; Wade 1995) and automobile (Abernathy and Clark 1985). All these exhibit a technological system composed of parts or sub-systems integrated in a structured way. Technological systems demonstrate the properties of General System Theory (Simon, 1962).

According to General System Theory (GST), technological systems consist of nested interdependent elements or sub-modules that work together in a seamless fashion. These interdependent elements interact each other within the lines called boundary of a system, and outside of the boundary is the environment. Constant (1987), exemplifies the aero-plane technological system that consist of major sub-modules including the jet engine - made of smaller modules, such as turbine, combustion chamber and compressor which are further composed of smaller sub-modules.

The complex interaction among components or sub-modules of the system suggests that characteristics of independent modules cannot justify the holistic properties of a system, meaning that the holistic system has new and emergent characteristics compared to its sub-systems. However, system and its properties are created by the sub-modules (Tushman and Murmann, 1998). For example, the electricity supply system can be examined by studying the generator, transmission lines and capacitors. The performances of these sub-modules are combined at the system level to distribute the electricity (Hughes, 1983). According to Tushman and Murmann (1998), the sub-modules specialized for specific functions are interdependent at all levels of a system hierarchy. For example, the PC system's hard disc drive, central processing unit and software are interlinked and influence each other (Christensen, 1997).

Huges (1983), argues that technological systems are goal oriented and evolve overtime. For instance, electricity supply system has been evolved to supply the electricity to the increased area, the PC system to escalate the computational power (Christensen, 1997) and the aero-plane to increase the flight speed (Sahal, 1981). The evolution of a system is reliant on the development of sub-modules (Hughes 1983; Murmann and Frenken 2006). Figure 28 demonstrates a technological system that consist of interconnected components (C1 and C2) such that a change in one component (C1 to C1N) leads to the alterations in other component (C2 to C2N) and finally new technology (C1N+C2N) emerges in a system.

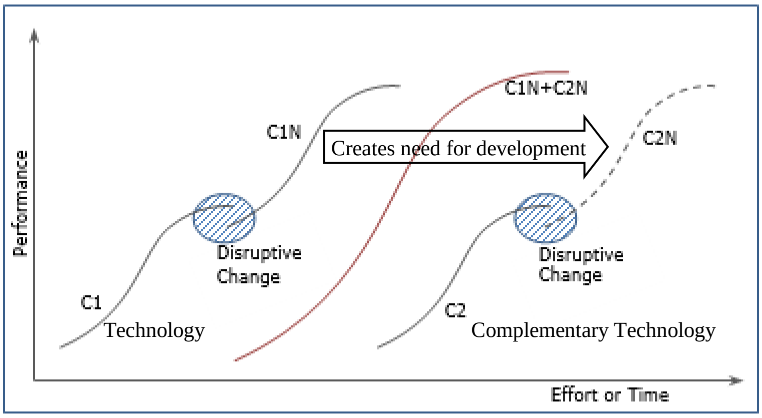

Figure 28. Innovation in a system.

The above figure shows that the development of holistic technological system is subject to joint and interdependent cause and effect development of all sub-modules. The technological development of one component creates need for the development of another component in a technological system. This process of development is known as co-evolutionary, since it suggests the balanced co-evolution of components to achieve the desired development (Huges, 1983). The overall progress of a system depends on the collective evolution of subsystems, meaning that when different subsystems achieve high performance level, the overall system automatically deliver the high level performance. Conversely, the lower rate of development in a subsystem at any stage prevents the holistic system to achieve the desired performance level, such problematic subsystem is referred as reverse salient (Hughes, 1983). Differences in the rates of development of subsystems create technological imbalance. However, technological imbalance act as a focusing device and firms attempt to close this imbalance through innovation. Hence, the evolution of holistic system depends on the necessary developments in subsystems. The following sections explain the challenges and tools for managing a systemic innovation.

4.3 Challenges in Managing a Systemic Innovation

According to the Mogee (1993), most firms do not see the innovation management as a specific issue or one that must be handled systematically. There are no standard accepted practices for managing technological innovations. On the basis of previous research (1950s-1970s) on innovation management, Rothwell (1992) proposed a following list of challenges that must be coped to acquire the capabilities necessary for success and effective management of innovations.

- Effective internal and external communication
- Treating innovation as a corporate wide task
- Efficiency in development work
- Implementation of planning and control procedures
- Market orientation
- Presence of key individuals

First, effective internal and external communication involves the establishment of a good communication system in order to have effective relations with the sources of scientific and technological know-how as well as to get the external ideas and inputs. Second, treating innovation as a corporate wide task makes sure the effective functional integration. Since it involves all departments in the innovation process from the initial stage. Third, efficiency in development work includes putting the quality control procedures in place and taking benefits of joint production facilities.

Fourth, Implementation of planning and control procedures is about establishing the effective planning system and control procedures throughout innovation process. Fifth, market orientation refers to the companies' strong focus on identifying and satisfying the customer needs and involving leading customers in the product development process. Sixth, the presence of key individuals in firms is highly important because it is challenging for companies to find and retain the specific key individuals such as product champions and technological gatekeepers who push new ideas and concepts. Figure 29 demonstrates challenges arise in managing innovation in a system.

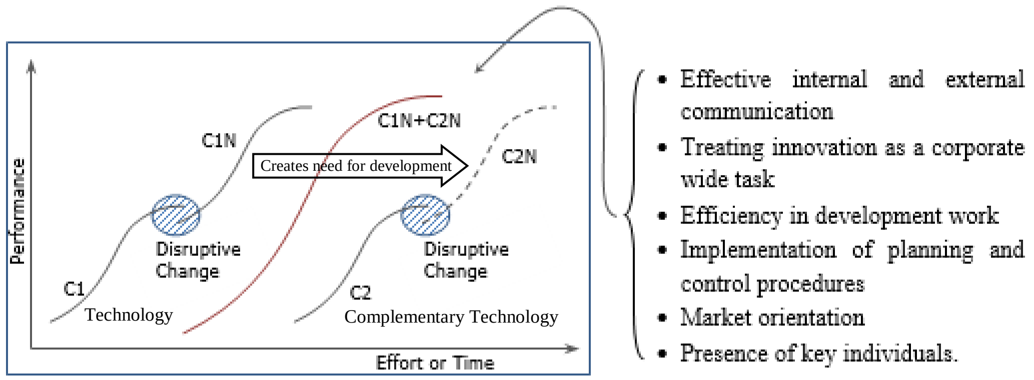

Figure 29. Challenges in managing a systemic innovation.

According to the Rothwell (1992), successful innovation management is not only about being good at R&D, buying in technology, recognizing customer needs and just good at radical innovation at the expense of incremental change. Innovation is required to be viewed as a system since it needs to be managed in an integrated way. The situation in each firm is different and each firm needs to develop own subsets and ways for managing systemic innovations (Mooge, 1993). The next section explains the tools for managing innovation in a system.

4.4 Tools for Managing a Systemic Innovation

Innovations happen as a result of interaction between science and technology base, (dominated by industry and universities) technological development (dominated by industry) and needs of the market (Trott, 2008). The conceptual framework of innovation considers three factors as mentioned in Figure 30.

Creation of new knowledge, dominated by universities and large science-based organizations	Technology development dominated by organizations	Consumers express their needs and wants through the consumption of products

Figure 30. Conceptual framework for innovation (Adapted from Trott, 2008).

To manage the innovation process, a wide range of tools, techniques and methodologies have been introduced. The range includes those, which aim to increase the general understanding of whole process such as conceptual models of the innovation process to those intended to manage the specific parts of the innovation process. For instance, to capture the customer needs, to promote the creativity, to design the new product, to monitor and control the development projects. Rothwell (1992) demonstrates summary of innovation models from 1950s to early 1990s, represented in Table 5.

Table 5. Five models of the innovation process (Adapted from Rothwell 1992).

Generation	Type of Model	Characteristics of Model
First Generation	Technology Push	Simple linear sequential process. Companies focus and rely on R&D.
Second Generation	Need Pull	Focus on marketing. R&D has reactive role and all ideas come from market.
Third Generation	Coupling Model	This model is sequential but with feedback loop. Push or pull or push/pull combinations. Focus on integration at marketing and R&D interface.
Fourth Generation	Integrated Model	Parallel development with integrated development teams. Strong upstream supplier relations. Close ties with leading edge customers. Focus on horizontal collaboration as well as integration between R&D and manufacturing.
Fifth Generation	Systems Integration and Networking Model	Fully integrated parallel development. Use of simulation modeling and expert systems in R&D. Strong ties with leading edge customers. Strategic integration with primary suppliers including co-development of new products. Horizontal linkages (joint ventures, collaborative research groups, collaborative marketing). Focus on corporate flexibility and speed of development.

As illustrated in Table 5, technology push models were linear and sequential in nature and explain the process of innovation by focusing on R&D, engineering and manufacturing. Such models do not take in to account the role of market place. The mid-to late 1960s, role of market place was emphasized by linear demand pull models. In such models, innovations arise by focusing on the customer needs while R&D plays reactive role to develop the products.

According to Rothwell (1992), in 1970s, available innovation models were regarded as over simplified and a typical representations of a more general process coupling science, technology and market place. These coupling models were sequential in nature and incorporated feedback loops. R&D and marketing also appeared more in balance. The coupling model is shown in Figure 31.

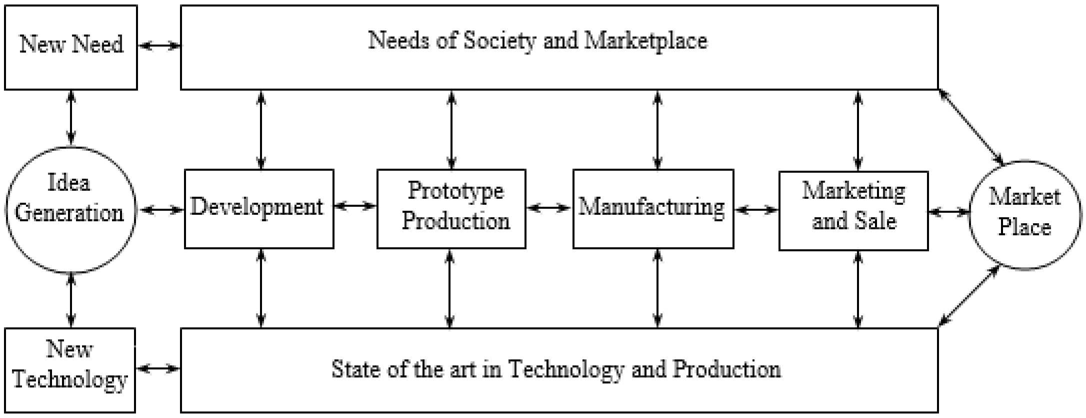

Figure 31. Coupling model of innovation (Adapted from Rothwell, 1992).

The coupling model shows the confluence of technological competencies and market requirements or needs within the innovating firm. Forrest (1991) cites “Twiss Activity Stage Model” as one of the first which makes improvement over the linear models as shown in Figure 32. This model acknowledged the importance of activities in the management of innovation that occur at different steps of the innovation process. It also took into account the influence of both internal and external environments on the activities at various departments involved in the innovation process.

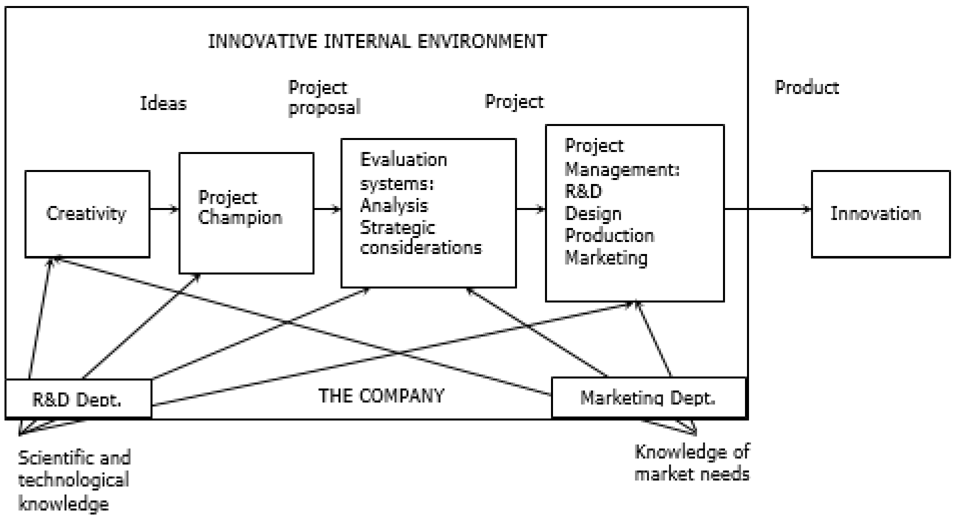

Figure 32. Activity stage model (Adapted from Twiss, 1980).

According to Rothwell (1992), mid 1980s witnessed shift in the process of innovation from sequential basis to parallel innovation involving, for example, R&D, prototyping and manufacturing. Thus, integrated models of innovation focus on the integration of R&D and manufacturing as well as closer collaboration between manufacturers, suppliers and leading clients.

Figure 33 refers to the systems framework mainly focusing on two types of inputs: decision inputs and implement inputs (Brown and Karagozoglu, 1989). Moreover, they explain that technological innovation occurs within a meta-system of an organization, since it includes various elements which serve as dynamic inputs to the innovation process. These inputs include for example, overall company strategy, policy for technology, values of top management, organization structure, information and manpower flow.

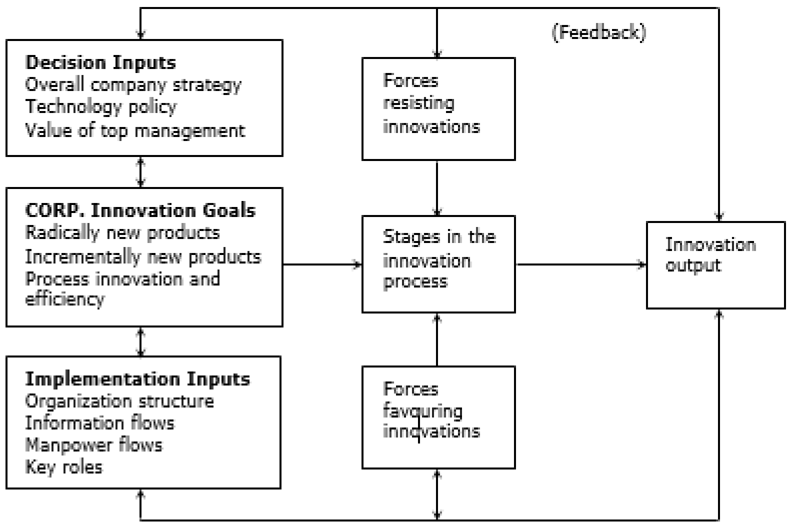

Figure 33. A systems model of technological innovation (Adapted from Brown and Karagozoglu, 1989).

According to Brown and Karagozoglu (1989), firm’s long term strategic orientation has an impact on the decision inputs, since they influence and exercise control over the behavior of implementation inputs. The overall company strategy, technology policy and the values of senior managers are major decision inputs. Major implementation inputs include organizational structure, quality of information flow, relevant manpower and determination of key roles for innovation. They further explain that actual management and control of corporate innovation activities are enhanced by understanding the overall system, and particularly the dynamics of inputs at various stages in the process. Figure 34 refers to a framework for innovation system which attempts to integrate the various sub-systems in the innovation process (Bessant, 1994).

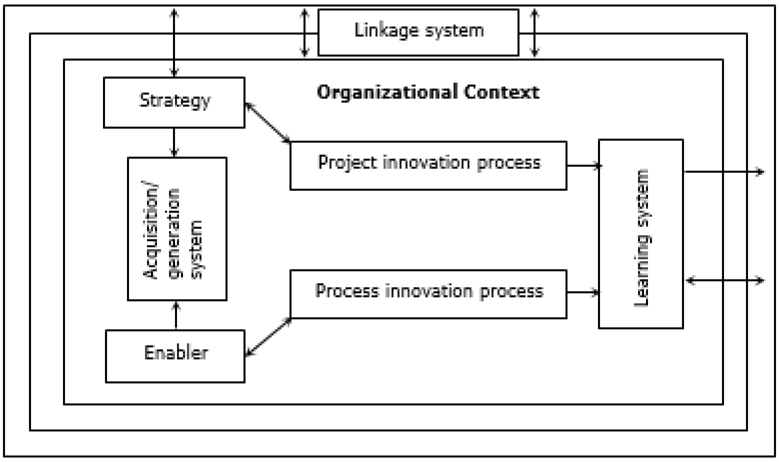

Figure 34. A model framework for innovation system (Adapted from Bessant, 1994).

The above framework has following systems: First, strategy system takes information regarding environment in terms of economic, technological and political forces. These forces figures out opportunities and needs for the innovation in light of overall business strategy. Second, enabling system includes both tangible and intangible resources such as time, money, people, equipment and top management support for innovation process to take place.

Third, acquisition system consists of technology strength of innovation process. Firm's technological strength includes core competence in a particular field which depends on firm's internal knowledge base and R&D capabilities. These competencies help to generate new technology and its networks and processes for transferring technology in from outside.

Fourth, product development system takes ideas for new products and progress them through various stages of development to the final launch. Fifth, process development system provides the platform (structure, culture) where innovation processes take place. Next, linkage system connects the firm to the outside world such as government, finance, education and other organizations.

Finally, learning system ensures the knowledge of organization by reviewing and capturing facts from the past experiences and experiments. There are multiple interactions between various parts of innovation system and each sub-system can be improved in isolation. However, an effective innovation process that delivers new products depends on managing sub-systems altogether as a complete system.

The instigation of fifth generation network model started in 1990s that attempted to address the complexities of the innovation process. The main characteristics of network model includes the impact of effective communication and external environment on the internal environment. Figure 35 demonstrates an example of network model.

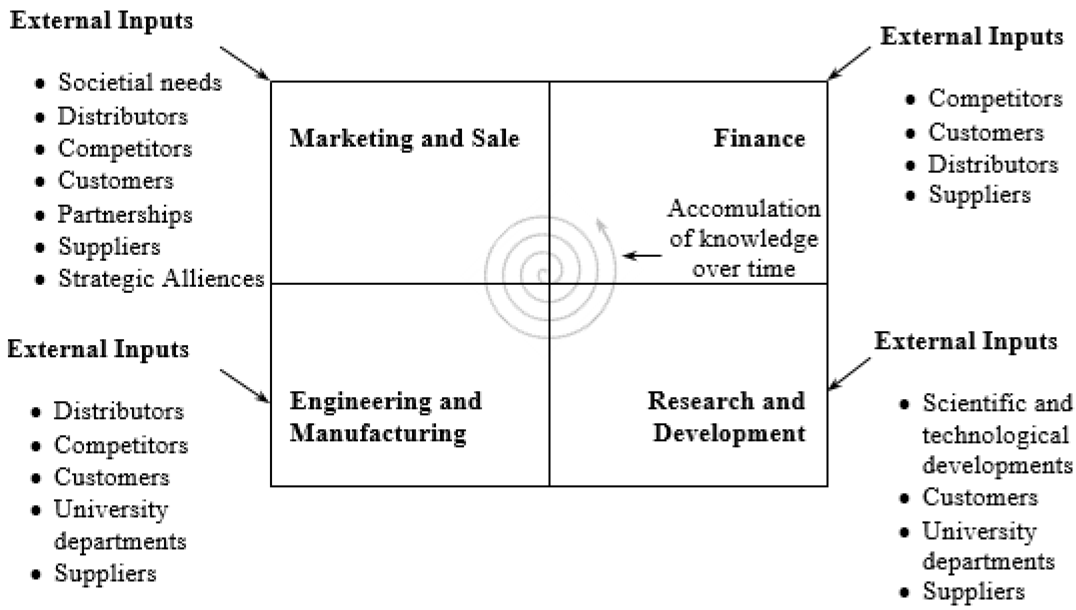

Figure 35. The network model of innovation (Adapted from Trott, 2005).

Stakeholders in the network of internal and external environment are responsible for innovation. Therefore, strong link between all key players must be established. Another fifth generation network model was presented by Galanakis (2006). He believes in system thinking in defining the innovation process that is termed as “creative factory concept”. Figure 36 represents the model where key firm (generator and the promoter of the innovation in the market) is shown at the middle. The model defines innovation process in following three steps:

- Knowledge creation.
- Transformation of knowledge into new product through product development process.
- The successful launching of product in the market that depends upon the product functionality and the competency of firm to produce quality product at reasonable price.

The innovation process is effected by the internal and external factors of a firm and national innovation environment such as corporate strategy, organizational structure, national infrastructure and regualtions.

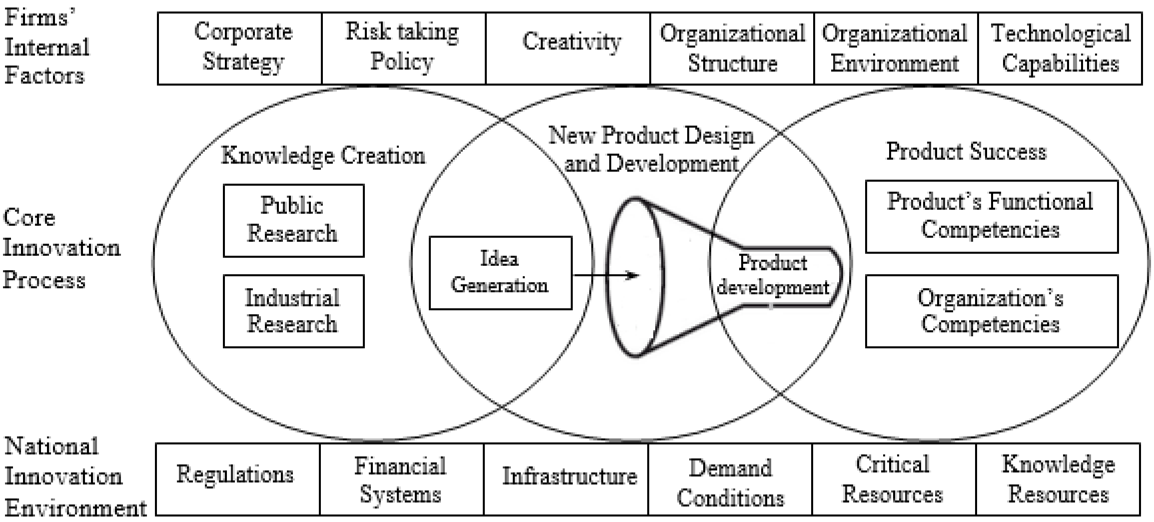

Figure 36. Creative factory systems innovation model (Adapted from Galanakis, 2006).

The fifth generation models are considered as closed networks of innovation, since all product development processes and marketing of the products take place within a firm. Therefore, employees come up with innovative ideas and keep them confidential. To conclude, Figure 37 demonstrates various management tools for managing a systemic innovation.

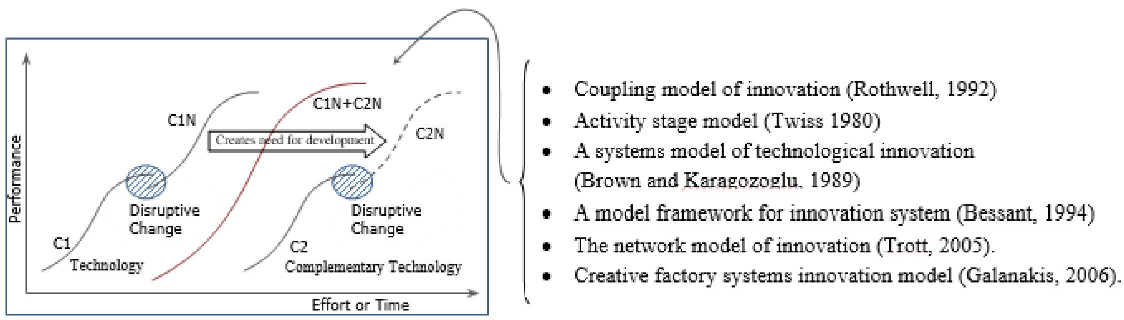

Figure 37. Mangement tools for managing a systemic innovation.

A number of approaches have been developed to manage the product innovation process. The network paradigm suggets companies to exploit both linear and coupling processes depending upon their requirements. Therefore, it demands for new ways of collaboration among companies even they are competing at the same time. For achieving the high level performance of a systemic system, it is important to identify the technological development imbalance in subsystems (technology and complementary technology) and subsequently reduce the imbalance through incremental or radical innovations (Hughes, 1987). According to Tidd (2006), collaborative innovation efforts stimulate the holistic innovation system. Therefore, customer value analysis and open innovation model can be utilized to develop the cost-reducing innovations in a system. Customer value analysis approach helps in identifying the needs, and open innovation model reffering collaboration among partners as demonstrated in Figure 38.

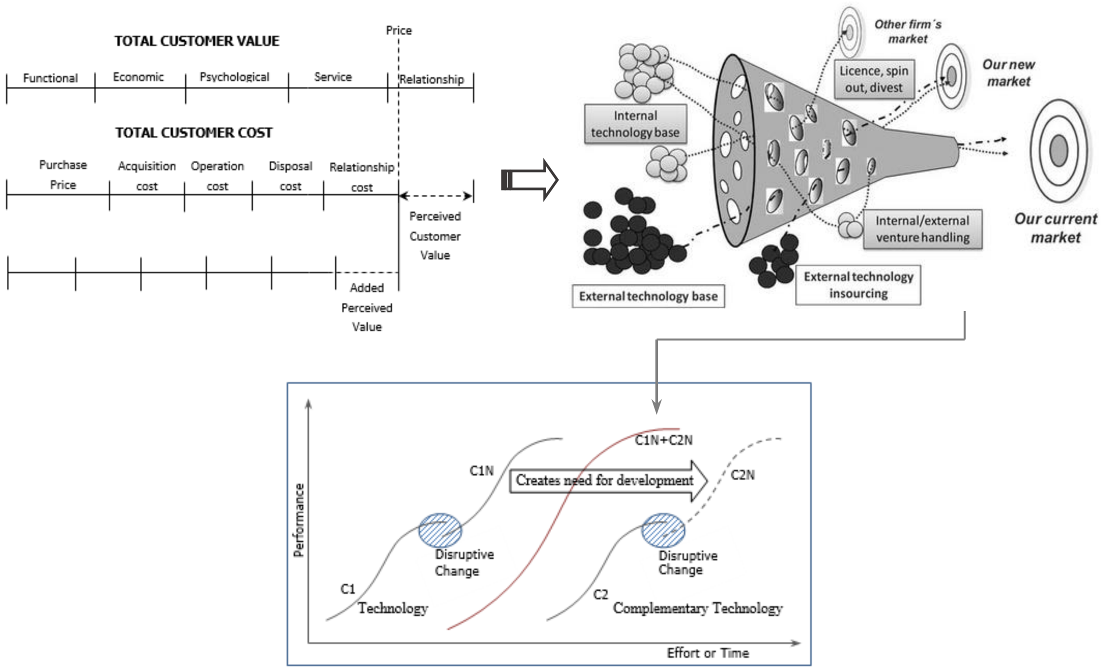

Figure 38. Utilizing customer value and open innovation models in developing a systemic innovations.

The open innovation model links the network of actors, institutions and resources to find the ideas and solutions. It considers both internal and external ideas and development efforts in the innovation process. Since, the innovation practices has long been recognized the role of internal and external partners throughout the innovation process therefore, next chapter explains the business collaborations among partners.

5. BUSINESS COLLABORATIONS

5.1 Interdependencies and Connectedness in Business Relationships

The main relationships of the organization to its customers, suppliers and third parties are connected in a way that, if something happens in one relationship, it affects the interaction in others too. Every organization engages different actors, activities and resources with varying degree of mutual fit. According to Håkansson and Snehota (1995), the development of every company is affected by the following interdependencies encountered in business relationships:

- Technology
- Knowledge
- Social relations
- Administrative routines and systems
- Legal ties.

Generally, different interdependencies are linked to each other and affect the business relationships. Therefore, companies exploit interdependencies in different ways. Organizations in industrial markets operate in the realm of available technology. Therefore, technical knowledge and use of technology are important to business activities. Connecting technologies in use create specific problems and makes some activities and adaptations more significant than others. As the relationship grows, potential technical misfit must be avoided.

Technical development within a company depends upon the technology of other companies. It is facilitated or constrained not only by those with whom company has direct relationships but also by the technology of third parties (Håkansson and Snehota, 1995). According to Hånkansson and Snehota (1995), relationships with other companies contribute towards the technical development as technology employed by the involved parties not only influences the characteristics of products and services but also the ways to do business. They further explain that relationships of company based on technical connections are often very strong.

Moreover, every organization relies on human and physical assets to run the business. Therefore, the performance of industrial companies depend upon the combination of individuals' knowledge and skills. Therefore, tacit knowledge of individuals is generally regarded as one of the main assets. The knowledge of organization reflects not only the competence of its employees but also of its network to which it is connected through business relationships. According to Hånkansson and Snehota (1995), a company attains much of knowledge from its relationships with other companies, to perform its activities. Knowledge sharing and development of new knowledge is only possible because of good business relationships with other actors, since it determines the competence of a company. Further, they argue that social ties are important for mutual trust and confidence among individuals who interact on the behalf of their organizations. The social network of individuals can be used in different ways to develop and strengthen the business relationships.

Next, administrative routines and systems refer to activities such as meetings, paper work, data recording and processing carried out to comply with business practices, and to facilitate the coordination among different parties. According to Hånkansson and Snehota (1995), exchange and processing of business information is costly and extensive. Therefore, administrative rules, standards and systems are put in place to improve the efficiency of business activities. For example, if a supplier wants to sell to the automobile manufacturer, it probably requires automobile manufacturer to join the supplier’s information system. It will be convenient for the supplier to serve those customers who use the same system as supplier does. The same applies to the industry standards, norms and administrative systems, since it creates link among relationships.

Finally, legal ties build relationships with customers, suppliers and third parties. Similar to general administrative rules and systems, legal ties can connect different units in business organizations. Particularly, this applies to the ownership controls and agreements among different parties. For example, legal interdependencies are different formal cooperation agreements among parties, from joint ventures to licensing agreements.

After discussing the interdependencies of business relationships, it is also important to describe the connectedness among relationships. The concept of interdependencies of business relationships generically refers to, if something happens in a relationship has an impact on other relationships. Apart from interdependencies, there are particular connections among relationships, and connectedness refers to those links. It is anticipated that there is a connection among relationships, if they are affected because of change in one of the relationships. (Hånkansson and Snehota, 1995)

Hånkansson and Snehota (1995) explain that people dealing with the business relationships in a company recognize the connectedness of a specific relationship for strong relationship development and better performance of a company. Companies build relationships with technology providers, component suppliers, clients, rival players, banks and research bodies. The legal agreement in customer relationships can be of an advantage or disadvantage. For instance, it is regarded as strength, if customer is a complementary technology provider, else it may be seen as threat, if customer is a competitor. Companies strive to build relationships not only to develop their capabilities and strengths but also to offer the required performance in a certain relationship. According to Kalwani and Narayandas (1995), in long term manufacturer supplier relationship, manufacturer gets access to the supplier's assets, resources and skills.

5.2 Model of Industrial Networks

According to (Turnbull, 1996), the importance of business networks has been increased significantly in the past years. Therefore, organizations perform business activities in networks. The unprecedented alliances of firms are being formed every year that are not limited to few industries. Business alliances occur broadly in manufacturing, transportation, finance, ICT firms and even in services industries. The rapid changes in technology, economic situations and globalization are responded by firms with the formation of strategic alliances (Doz and Hamel, 1998). Organizations embedded in strategic networks enjoy significant advantages in terms of business development and expansion through interaction and collaboration with other players (Håkansson and Johanson, 1992).

Next, this section aims at analyzing the stability and development in industry by explaining the model of industrial networks proposed by the Håkansson and Johanson (1992). Stability is usually perceived as opposite to the transformation and development. However, model of industrial networks considers stability as important element for industrial development. Further, this model explains the relationship between stability and development, and provides the basis for studying the role of actors in the process of industrial development. The model of industrial network comprises of three interconnected variables: Actors, Activities and Resources as demonstrated in Figure 39.

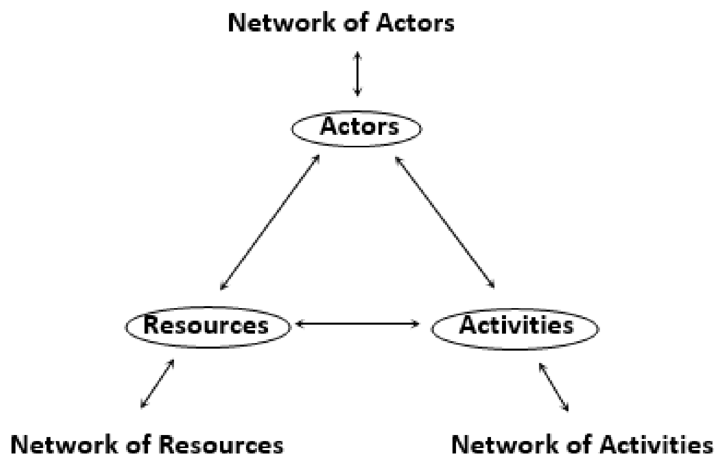

Figure 39. Schema of industrial network model (Adapted from Håkansson and Johanson, 1992).

According to the above model, actors are responsible to control the resources and perform activities. Whereas, resources are means used by the actors to perform the activities and activities utilize resources to change the other resources in numerous ways. This explains that network of actors, network of resources and network of activities are interlinked. According to Håkansson and Johanson (1992), actors can be individuals, group of individuals, firm, part of a firm and group of firms, and they are responsible to manage the resources and activities. In industrial network of organizations, actors perform at various levels. For instance, actors at lower part of the organization can be connected to the actors at upper stage. Otherwise, they perform independently at certain level.

Actors exhibit five types of characteristics. Firstly, actors alone or together utilize resources to execute and regulate the activities. They decide about activities and determine way-out to perform those activities. Secondly, actors in a network develop relationship with other actors and get access to the combined resources through exchange process. Thirdly, actors' activities are based on their control over resources, and control can be direct or indirect depending upon the position of an actor. Ownership brings up direct control, and dependence or association with other actors transmit indirect control. The presence of multiple actors at various levels of network makes it unclear which actor has control on which resources. Different actors have varying perception regarding scope of actor's control over resources. The difference of opinion on the degree of actors' control over resources is the important characteristic of industrial networks.

Fourth, actors are goal seeking, and their generic aim is to boost the control over resources in order to achieve the control over activities in the network. Fifth, actors carry versatile resources and knowledge to perform the activities in network. Further, they have many common and conflicting goals that can be achieved through relationships in network. In network settings, actors have different characteristics, skills and resources that are shared, combined and exchanged to generate the activities in the network. According to Håkansson and Johanson (1992), the network activities are mainly of following two types.

- Transformation activities
- Transfer activities

The transformation activities somehow change the resources, and are always controlled by the actors individually. The transformation activities of different actors are connected to other actors through the transfer activities. Transfer activities shift direct control on resources from one actor to another, and are not controlled by the actors individually. Therefore in networks, the type of relationship among actors effects the transfer activities. All individual activities are connected to each other and complete activity cycle is not entirely controlled by a single actor. The complete activity cycle comprises of various transformation and transfer activities. Sometimes, transformation activities are performed to ensure the transfer activities and vice versa. (Håkansson and Johanson, 1992) happen

The interdependence of activities in a network may be strong or loose depending upon the situation and nature of activities. For instance, actors will have direct relationship, if activities are directly linked to each other. On the other hand, if activities are connected to each other via intermediate activities, actors will have indirect relationship. The single activity performed by a specific actor in a network is not indispensable, meaning that the operation of a network continues even with the disappearance of a single activity because other actors manage to take the control of the missing activity. (Håkansson and Johanson, 1992)

The activity network always evolve in a way that new activities, replacement of old activities and reorganization of activities bring improvement. The same applies to the whole network or part of a network or single activity performed by the individual actor. Changes always take place, therefore it is pointless to talk about optimum activity systems or arrangements. Resources are needed to perform the transformation and transfer activities. In networks, diverse resources are combined together that require additional resources. (Håkansson and Johanson, 1992)

Resources are either managed by individual actor or mutually by several actors. Since, resources are used for multi-purposes therefore, it is not possible to specify the use of resources. Transformation resources are required to perform transformation activities and transfer resources are needed to carry out the transfer activities as shown in Figure 40.

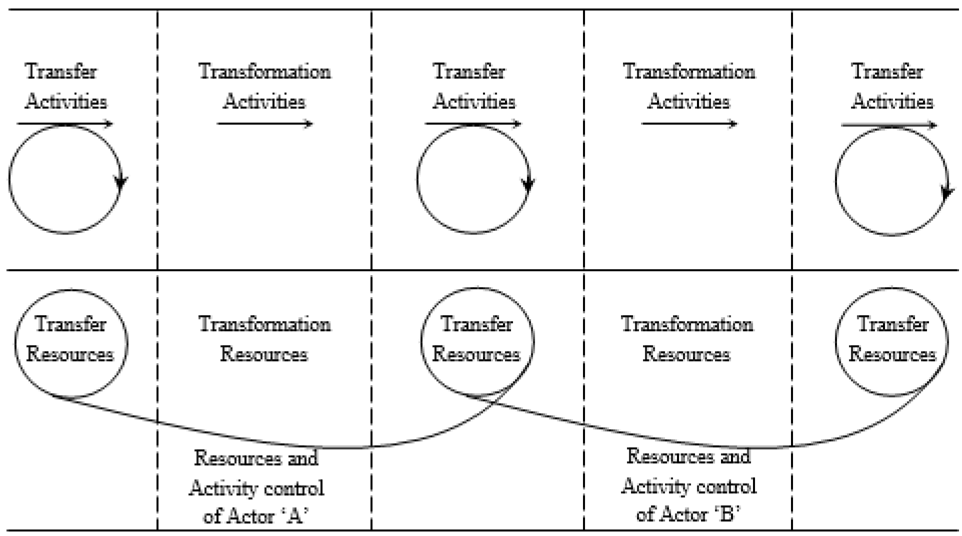

Figure 40. Transaction Chain (Adapted from Håkansson and Johanson, 1992).

It is evident form the figure above that transformation and transfer resources are communally reliant on each other. The use and significance of a particular resource depends on the activity cycle, its role in various transfer chains and networks where it is combined with other resources. When different resources are pooled, the joint performance upturns through acclimatization. This is applicable both on small and large scale projects where particular resources are grouped to perform the specific activities, or bunch of resources controlled by single actor is combined with other bunch of resources. The combination of versatile resources brings new knowledge, since it creates opportunities for value added combinations.

The new approach for managing resources may disrupt the existing activity cycles and transfer chains. However, it provides a platform for change and development in industrial networks. Single actor alone or a group of actors mutually controls the resources. Resources can either be controlled directly or indirectly. Resources can be managed indirectly by those actors who have ties with actors directly managing the resources. If the availability of resources is limited then actors struggle to get the control over them. On the other hand, if resources are abundant, actors probably will not do the extra effort to get the control.

Firms in networks have superior knowledge processing capabilities and are considered as better learning organizations. Network organizations are embedded to each other to build up their capabilities, and to offer the required performance in the certain relationship. Thus, firms strengthen themselves and improve performance significantly (Snehota, 1995). The connectedness of firms leads to the notion of a business ecosystem.

5.3 Business Ecosystem

In today’s corporate world, companies are more concerned about their business ecosystems. Firms believe that partnership and collaboration approach is more practical than supply chains to satisfy the customer needs. The concept of business ecosystem is derived from the ecological system in biological sciences. Business ecosystem is a network of firms, since it creates value for customers by producing the holistic technological systems (Bahrami and Evans, 1995; Basole, 2009; Lusch, 2010; Teece, 2007).

Business ecosystem firms believe in co-creation and develop the capabilities and technologies to innovate new products or services. The pharmaceutical ecosystem (Garnsey and Leong, 2008), the cell phone ecosystem (Basole, 2009; Sugai, 2005), the internet ecosystem (Zacharakis et aI., 2003; Nehf, 2007; Javalgi et aI., 2005), Amazon's ecosystem (lsckia, 2009), Google's innovation ecosystem (lyer and Davenport, 2008), Cisco's business ecosystem (Li, 2009), Deutsche telekom's open innovation ecosystem

(Rohrbeck et aI., 2009) and the automotive leasing ecosystem (Pierce, 2009) are few examples of network firms.

Organizations following the business ecosystem approach contribute for the wellbeing of a system holistically (Iansiti and Levien, 2004). Business ecosystem may include distributors, financial institutions, investors, research bodies, suppliers and complementary technology providers (Adner and Kapoor, 2010; Li, 2009). Figure 41 depicts the players of business ecosystem.

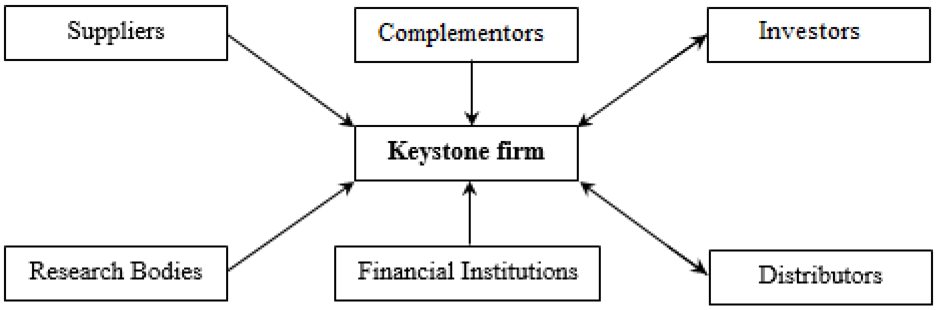

Figure 41. Actors or players of business ecosystem.

As evident form the figure above, the main player is known as 'keystone' or a key member (Iansiti and Levien, 2004). Keystone is responsible for carrying out the overall function of ecosystem, and its role defines the success or failure of all other players in the ecosystem. The keystone is also known as ecosystem leader (Moore, 1993) or platform leader (Cusumano and Gawer, 2002). According to (Moore, 1993), keystone exercises extensive role within the ecosystem and takes a major share of the overall business profits. For instance, Apple, Microsoft, Wal-Mart and Mozilla have been playing vital role to ensure their success as well as overall continuous development of the ecosystem (Iansiti and Levien, 2004; Moore, 1993; Cusumano and Gawer, 2002, Tiwana et al., 2010).

With the help of ecosystem approach, organizations can evaluate their business strengths against competitors with respect to suppliers and partners in cooperation. The business ecosystem interacts with different industries despite supporting a particular industry. For instance, Apple is a member of the ecosystem comprising of personal computers, consumer electronics, information, software and communication industries (Moore, 1993).

Business ecosystem firms co-evolve and develop their offerings through sharing the tools, techniques, knowledge, services and platforms. According to Iansiti and Levien (2004), Microsoft's operating system has empowered many software developers to develop the programs for Windows. Moreover, Tiwana et al. (2010) explain that Apple and Mozilla have developed huge ecosystems around iPhone operating system (iOS) and Firefox browser respectively. They provide thousands of add-on extensions and applications. Next, keystone's strategy is the value creation and subsequently sharing it with counterpart organizations in the ecosystem. Thus, keystone becomes able to hold the partner firms for the development of ecosystem (Moore, 1993). Further, the role of keystone is to ensure the stability in operations. For instance, Wal-Mart has introduced a procurement system, since it allows suppliers to access the demand range and quantity related information (Iansiti and Levien, 2004).

Accordig to Cusumano and Gawer (2002), players who challenge the keystone for the governance of ecosystem are known as wannabes. For example, in personal computer ecosystem, Intel may be regarded as keystone player and AMD as wannabe. When the wannabe aims to play more active role in managing the ecosystem and dominate other players of ecosystem through vertical and horizontal integration, it is called as dominator. If the dominator has ability to control various firms in network, the chances to develop an effective ecosystem decreases (Iansiti and Levien, 2004). Niche players in ecosystem provide support to keystone with vast contribution in innovations and value creation, therefore, known as complementary organizations.

Niche players in ecosystem can produce their own specialized offerings by using the platform of keystone and technologies of complementary partners. For instance, Nvidia, a designer of graphic accelerator card for computers is a niche player in computing ecosystem, since it focuses on designing the quality products, marketing and customer support. Two keystone players of the ecosystem: IBM and Taiwan Semiconductor Manufacturing, provide platform to Nvidia to design the products, and at the same time Nvidia can get benefit from complementary players who assemble and test their designed hardware (Iansiti and Levien, 2004).

The emergence of business ecosystems depends upon the internal and external dynamics. The basic force in business ecosystem is the co-evolutionary process among players of ecosystem. The interdependent firms in business ecosystem mutually co-emerge through sharing knowledge, resources, manufacturing facilities and services (Bahrami and Evans, 1995; McCarthy et al., 2000; Tsatsou et al., 2010; Vidgen and Wang, 2006) as demonstrated in Figure 42.

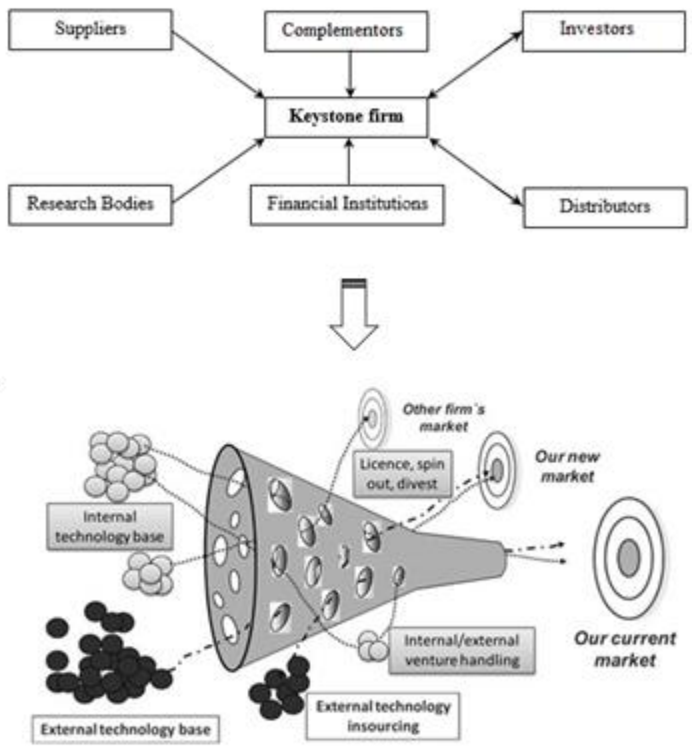

Figure 42. The co-evolution of business ecosystem players.

In business ecosystems, co-evolution can be clearly observed when complementary technology providers develop technological sub-systems, and keystone provides platform architecture to connect all sub-systems in a seamless fashion (Li, 2009). According to Tiwana et al. (2010), keystone players are responsible for ecosystems' architectural design as they ought to encounter the future changes in the ecosystem because architecture design is mostly irrevocable (Makinen and Dedehayir, 2012).

According to Makinen and Dedehayir (2010), the platform design or architecture can be decayed into subsystems in a hierarchical manner to know the particular functions performed by the sub-systems. This decomposition decreases interdependence in the evolutionary processes of components. Thus, it speeds up the evolution process of sub-systems and at the same time lessens the complexity. The degree of interdependence between the sub-systems is highly important in construct of the ecosystem.

On the other hand, modular systems theory explains, systems that reflect the higher rate of modularization normally exhibit higher development rate because sub-systems possibly emerge without relying on coordination and internal functioning of other modules of the ecosystem. The module can be designed in relation to the other modules based on sufficient information provided through standards. Modular systems must follow the design rules set by the platform owners as these rules are important for the functioning of entire system. Other internal factor that influences the emergence of ecosystem is the platform governance. The main idea of platform governance is the extent to which the platform owner must transform the decision making and control to other players of the ecosystem. The decisions must be regarding the functioning of each sub-module and players accountable for functioning of sub-systems (Tiwana et al., 2010). The external factors that affect the business ecosystems are generally comes from the environment of ecosystem. For instance, changes in social and economic environment influence the pace and direction of ecosystem's evolution (Nehf, 2007). Other factors may include technological changes (disruptive, radical and discontinuous) in the environment of ecosystem.

5.4 Emergence of Business Ecosystem for Value Creation

The previous section explained the evolution of ecosystem and its precursors both internal and external. This section primarily focus on the emergence of business ecosystem by describing the ecosystem as a hierarchical network of several firms. The network is formed of firms producing sub-systems that are integrated in a hierarchical way and each sub-system can be a part of higher level system. The keystone firm sets rules (for the design and structure) which are followed by the sub-system producing firms in developing their technologies to operate at integrated level. The large ecosystem may consist of many keystone firms at different levels of hierarchy but the firm that integrates the ecosystem's whole product is positioned at the top level. (Makinen and Dedehayir, 2010)

The keystone firm continues to strive for innovations unless firm has dominated its segment. Otherwise, it will face competition from rivals who are producing same products and are embedded in the separate ecosystems. In multifaceted ecosystem, the realization and value creation of keystone firm's innovation is highly dependent on the required level of components development and complementary technologies, meaning that with insufficient performance of component suppliers and complementary technology providers, keystone will not be able to demonstrate the full potential performance of the holistic system generated for the end users (Adner and Kapoor, 2010). Figure 43 demonstrates the development of innovation in a system including complementary technology.

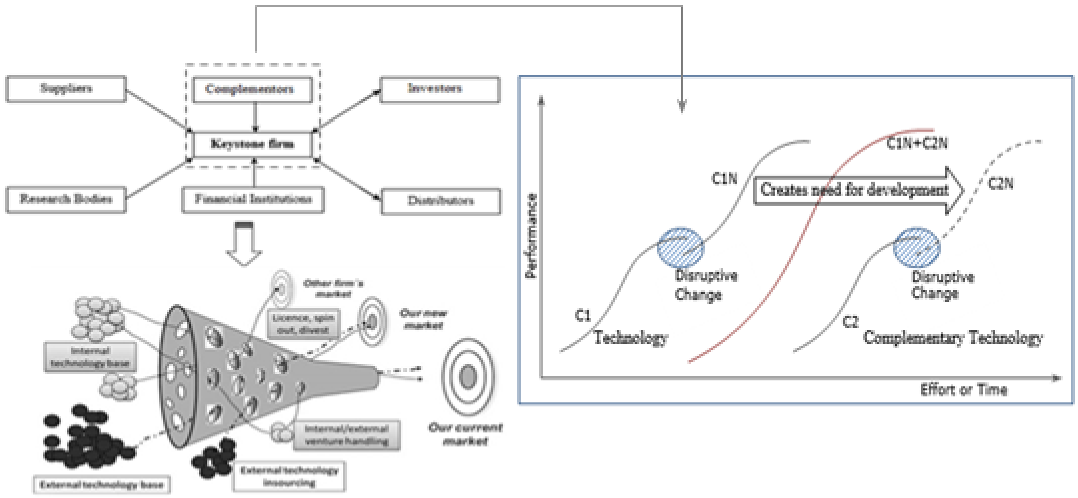

Figure 43. The collaboration of business ecosystem players in developing a systemic innovation.

The above figure shows that during the course of innovation, partner firms collaborate (keystone and complementary technology providers) to innovate in a system. The success of holistic system is reliant on the development of related technologies. The innovation interdependence is exemplified by the Adner and Kapoor (2010) through their assessment of Airbus's A380 project. They demonstrated that the success of keystone firm (Airbus) depends not only on their innovation capacity and also on the capability of components suppliers. For instance, engine and navigation system suppliers as well as complementary technology providers such as runways and aviation services.

According to Sugai (2005), bottlenecks at certain stage restrain the development of holistic ecosystem, and their elimination moves towards ecosystem evolution. This emphasizes that component suppliers and complement organizations must invest in order to enhance their product technological performance. Also, keystone firm needs to coordinate with sub-module providers to evade their reluctance to invest on incremental technology and innovation. According to Adner and Kapoor (2010), the bottleneck dynamics and consequences could be different depending upon their position in the ecosystem.

Bottlenecks arise at components suppliers end are comparatively easy to fix for the technology platform leader by improving the components of sub-modules. On the other hand, complementary obstructions limit the performance and decelerate the propagation of emerging technology. The technology leadership of focal module is affected afterwards. Resultantly, the rival firms may avail the opportunity to catch up the market with their own innovations and null the first mover advantage of a focal firm (Adner and Kapoor, 2010).

The organizations can deliver more value to their customers through cooperation (working in network) despite functioning in isolation. On the other hand, ecosystems demand for significant strategic contemplation because of associated challenges. In ecosystems, firms are no more independent to innovate and generate value for customers. As mentioned above, innovation struggle of focal firm cannot be capitalized without enough development from the complimentary component suppliers. Adner (2006) proposes the number of imperative strategic implications for organizations doing business in ecosystems.

The most important is the timely investment of resources on firm's own innovation as well as developing the complementary technologies and components, meaning that firms must pay attention to the development of its own innovation before supporting the component suppliers and complements. For instance, HDTV technology has been developed by the TV console manufacturers (Sony, Philips and Thompson) in 1990s but the propagation of this technology was not up to the expected level because of insufficient development in complementary technologies. The supporting technologies infrastructure such as signal processing technologies, programs recording and broadcasting facilities took over a decade to develop, that could support the high definition TV technology.

According to Adner (2006), although companies had invested lot of resources on the development of HDTV technology to take the first-mover advantage in the highly competitive environment but the late development of complementary technologies limited the growth potential of HDTV innovation. Adner (2006) emphasizes on the evaluation of risk factors associated with the collaboration in the ecosystem and focus on three kind of risks: initiative risk, interdependence risk and integration risk. The initiative risk is regarded as evaluation of success prospects and feasibility of innovation. In order to understand the interdependence risks in ecosystem, companies need to analyze what complementary technologies are required to be developed in timely manners to exploit the success of innovations. The above HDTV example illustrates the importance of timing factor. The interdependence risk evaluation must be done in timely manner to ensure the availability of complementary technologies.

Such assessments help organizations to follow the right strategy. For instance, if interdependence risk is too high, the keystone firm may find new partners or suppliers to avoid the lock-in of cooperation with high risk actors of ecosystem. The likelihood of integration risk rises with the multiple stages in the ecosystem. This phenomenon is described by the Adner (2006) by quoting an example of Michelin's run-flat tire. The tire was innovated in 1997, however, it took over a decade for its integration in automobiles. The reason for this delay was the tire integration at multiple stages such as car companies, car dealers and garages. The assessment of above mentioned risks set direction for companies to adopt the right innovation strategy.

For instance, risk analysis allows companies to decide either to invest more resources on their own innovation or allocate resources to develop the partner firms. Moreover, companies may choose to change their target market, involve in responding government or regulatory authorities as well as integrate vertically or horizontally within the ecosystem. Companies cannot have much performance expectations from their innovations unless the availability of complementary technologies. Therefore, collaboration among partners is required to develop the complementary technologies well in time in order to deliver the added value to the end users. Figure 44 demonstrates the framework for developing a systemic innovation.

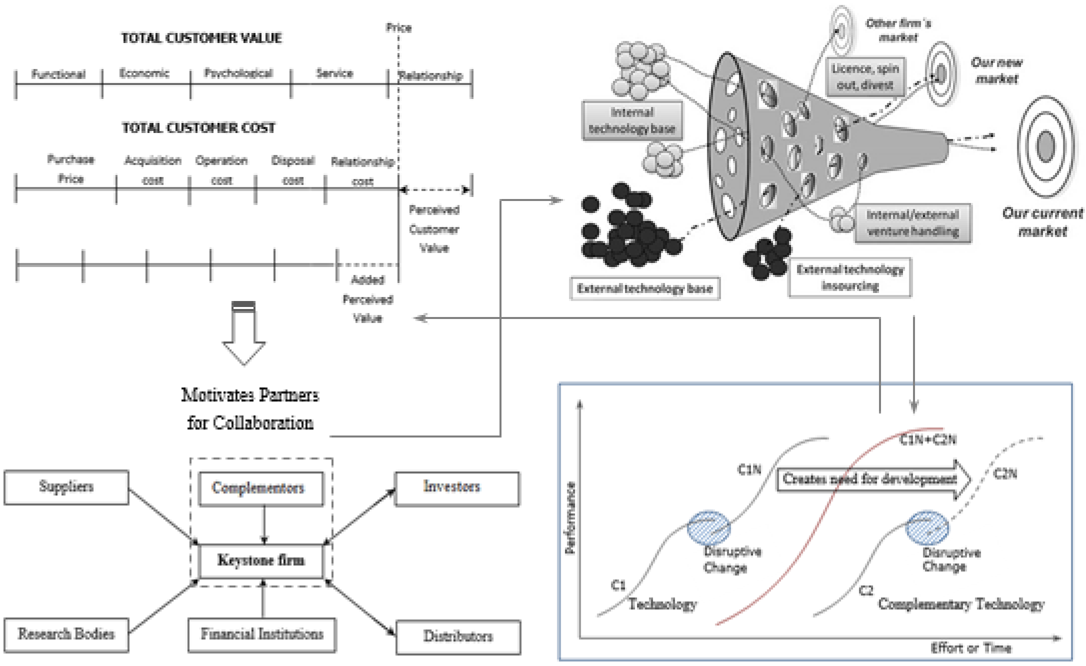

Figure 44. Framework for developing a systemic innovation.

It is evident from the figure above, the customer value analysis motivates keystone firm and complementary technology provider to collaborate in a systemic innovation. Companies can deliver added value to the customers by developing the complementary technologies well in time. Thus, firms exploit the full advantage of their innovation. The following chapters explain the case innovation and its reflection on the above theoretical framework.

6. CASE: TRACTOR IMPLEMENT COUPLING INTERFACE

6.1 Environment in Scandinavian Fields and Tractor Use

Finland is the world's north most agricultural state with climate similar to other northern countries of the world. Geographically, the location of Finland on latitude is around 60th to 70th parallel lines like Alaska, the southern tip of Greenland and Siberia. The neighboring countries of Finland are Russia, Norway and Sweden as well as the quarter of land is situated on the north of the Arctic Circle. Russia is situated on the north-east side, while Norway and Sweden are on the north-west side of Finland.

The total area of Finland is 390920 km². Seventy eight percent is dry land which is mostly covered by forests, and the small portion (approximately 8%) is used for farming. The remaining one fourth part of the country is water in the form of sea and inland waters. According to Agricultural census Finland (2010), the utilized agricultural area of Finland (due to severity of climatic and soil conditions) is mostly dedicated for cereals (43.7%) and fodder crops (28.7%).

The characteristic feature of northern and eastern land that favors for cultivation is the barren soil, since it is mostly flat and leveled, exception is the small steep rocky area in the east and Lapland with round hills and fells. The arable area ranges from coastal lands that is mostly covered by forests of deciduous trees, to the boreal zone and ultimately reaches to the northernmost part of country with completely treeless areas. In addition to the land characteristics, northern climate opportunities and peripheral location of this area, also favor farming. The overall extreme weather conditions in winter shortens the growing season in Finland as demonstrated in Figure 45.

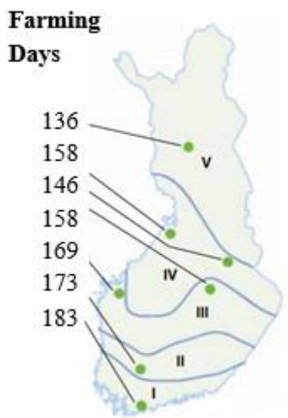

Figure 45. Farming Zones and length of farming season in Finland (Adapted from Agrifood Research Finland MTT, Finnish Meteorological Institute).

The growing season continues 160 to 190 days in the southern part of country where effective temperature sum is 1400°C. Whereas, in the northern region, farming season lasts 110 to 150 days with the temperature sum of 500 °C. Also, there is a period when sun light stays round the clock. The temperature varies significantly ranges from +30°C to -30°C in a year. The growing season becomes shorter due to less temperature and nigh frost at early and late summertime that effect the ripening of crops. The North Ostrobothnia and Lapland are the highly effected areas with respect to plant growth in such climatic conditions.

The Finnish climatic conditions do not allow the start of spring field work before May unless ground frost and snow melts away. Therefore, to take the full privilege of spring humidity, cultivation process needs to be done quickly. Clay texture of soil in southern Finland cannot retain moisture long enough. Since it limits the sowing period. Spring is mostly clear while rainfall starts in autumn that demand quick completion of harvest and autumn work in a few clear days. In order to complete the farming activities (land preparation and harvesting of crops) in time, tractor implements are extensively used as presented in Figure 46.

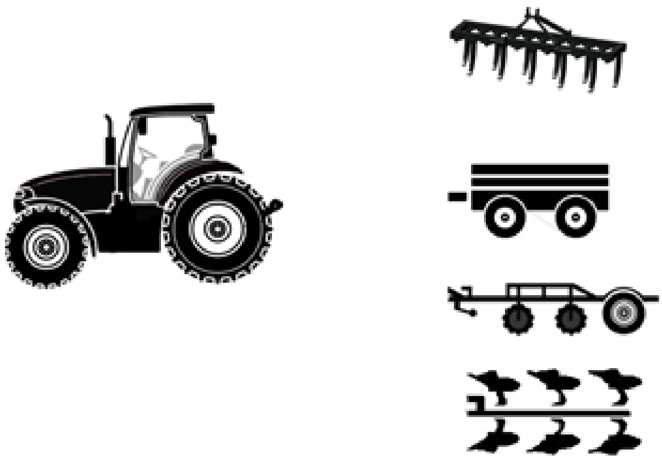

Figure 46. Tractor as a systemic innovation.

Tractor is a multi-purpose machine, used to perform the various jobs such as agricultural operations, construction works, haulage and building of highways. Implements such as cultivators, trolley, disc plough, moldboard plough are necessary elements that are coupled with tractor to perform these operations. It is important that implements must be compatible to the tractor and best fit to perform a specific task.

6.2 Problems in Existing Coupling System

This section aims to illustrate the problems in the existing tractor implement coupling system. Therefore, it is important to first understand the three point linkage system of a tractor because many implements used for agricultural operations are connected at the rear end of a tractor with three point linkage system. Three point linkage system refers to the way, implements are linked to the tractor and it works along with several components such as tractor’s hydraulic system, lifting arms, connecting points and stabilizer chains, working together. Three point hitch is composed of two lifting arms and center top link as shown in the Figure 47. Both lifting arms are powered by the tractor’s hydraulic system.

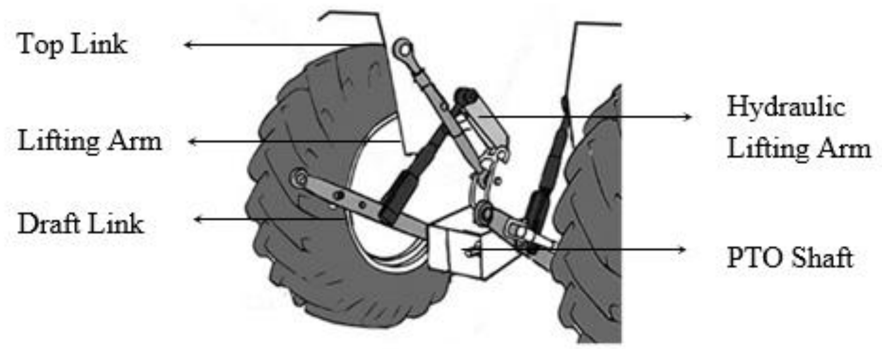

Figure 47. Tractor’s three point linkage system.

The center top link is adjustable, provides mounting point and is not powered by a tractor's hydraulic system. The top link has manual adjustment to achieve the optimum angle between the implement and tractor. Most of tractor implements are connected through three point linkage system and are classified as power take off (PTO) powered, non-powered and hydraulic-powered implements. Some implements use combination of PTO and hydraulic power to perform the desired tasks. The stepwise coupling process is as follows:

1. Ensure that the tractor’s draft link is on “depth control” setting.

2. Reverse the tractor towards implement at lowest possible speed.

3. When tractor comes close to the implement, adjust the draft link to the height of the lower implement pins and make sure that tractor will not move after engaging the park brake.

4. Leave the tractor cabin to inspect the relative links and pins alignment both horizontal and vertical. Note the extent of misalignment.

5. Go back to the tractor cabin and make the necessary lower link alignments and any required steering correction based on estimated side to side offset and then slowly reverse the tractor to the correct position. The driver may need to repeat this step several times in small increments to reach the accurate position.

6. After the draft links and implement pins are aligned, lock them with pins.

7. Install the retained clips on the pins.

8. Finally, align the tractor's top link with the implement's top pin by turning the threaded adjustment on the tractor top link. Once aligned, install the safety lock and lock retainer. Figure 48 demonstrates the coupling process.

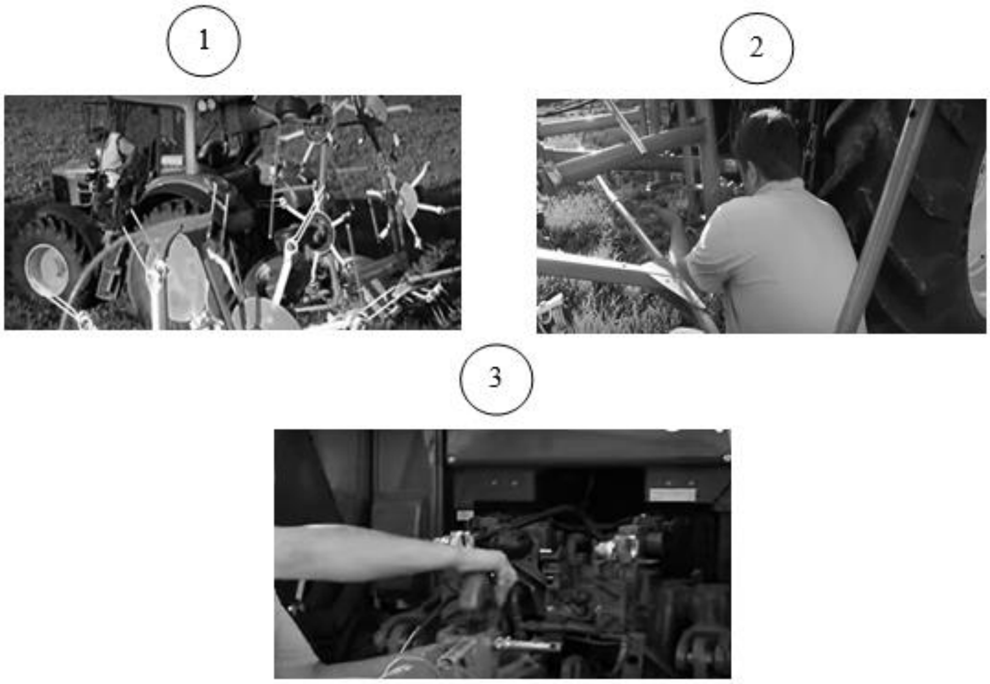

Figure 48. The coupling process of tractor implement with three point linkage system.

Some agricultural implements require power take off (PTO) connection to operate. The large number of PTO driven implements are first connected to the three point linkage system in a same way as demonstrated in Figure 48. Then tractor PTO drive shaft is attached to the implement PTO shaft by aligning the splines of shafts as shown in Figure 49. Finally, safety is ensured by checking the position of PTO guard and attachment of safety chain.

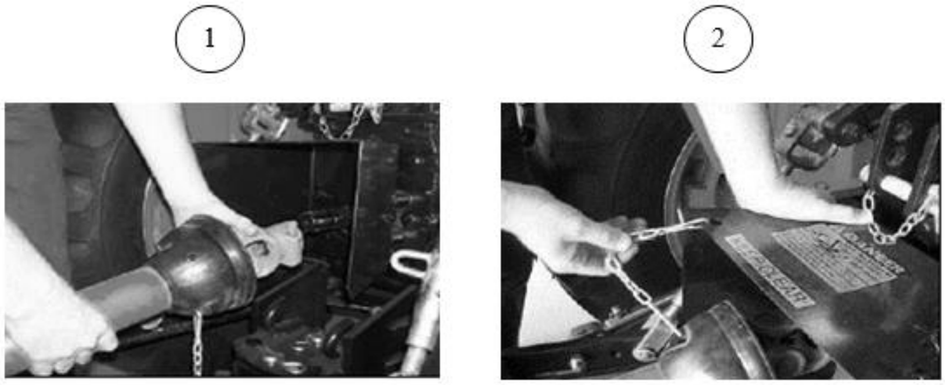

Figure 49. Demonstration of PTO connections.

Implements, that require hydraulic power to operate, are also connected to the three point linkage system in a same way as described earlier. Once implement is coupled with the three point linage system, hydraulic hoses of implement are attached to the right hydraulic connections on the tractor as shown in Figure 50. The principle for attaching hydraulically driven implement to three point linkage system is same. However, in some cases more robust top link is used.

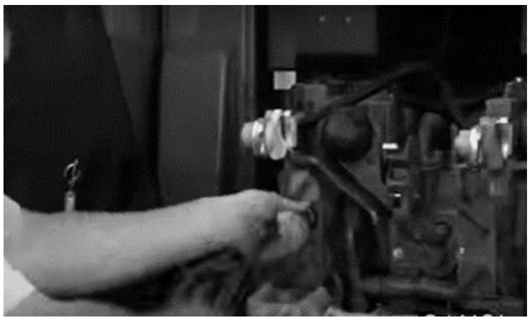

Figure 50. Demonstration of implement hydraulic connections.

As described in the previous section, the farming season in Finland is short. Therefore, the coupling and loosening of tractor implements should be quick to complete the job in time. Conversely, the above coupling process is inconvenient in terms of effort, time and safety. The operator struggles to align the tractor with implement and often it requires help from another person to make it through. The coupling process requires great precision from the tractor operator to drive up to the implement accurately within the range of centimeters. Moreover, bad weather and darkness makes coupling process more challenging which causes large number of injuries every year.

Suutarinen (2003) describes that in Finland tractor accidents are 3-4% of all compensated accidents. The occurrence of tractor accidents varies throughout the year, especially in May, it reaches at its peak. The reason being is the short sowing season in spring. The time period from May to August account for 68% of total tractor accidents. He further explains that coupling and uncoupling of implements is the main reason for tractor accidents, because operator has to leave the cabin. The usage of access path to or from the cabin also add to the accidents. More than 30% tractor accidents occur during the coupling and uncoupling of implements and same percentage is seen in the cabin access path usage related accidents. One of the official from tractor manufacturing company mentioned:

> *"The coupling and uncoupling of tractor implement is the challenging task for farmers, since it account for 30 % tractor related injuries in Finland"*

Suutarinen (2003) argues that farmers are unable to work for 26 days on average because of all tractor accidents, while tractor cabin access path usage accidents cause inability to work for 33 days. The most common injuries are contusions of limbs, strain and sprain of the limbs, resulted from coupling and uncoupling of implements and usage of the tractor's access path respectively. The varying and seasonal nature of farming causes the tractor accidents. The main reasons for injuries include unsafe and laborious process of hitching and unhitching tractor implements. The other reasons are jumping, slipping or falling during exit from the tractor cabin. To cope with all these challenges, farmers keep tractor implements connected for ready to use in farming days, since it requires additional tractors as demonstrated in Figure 51.

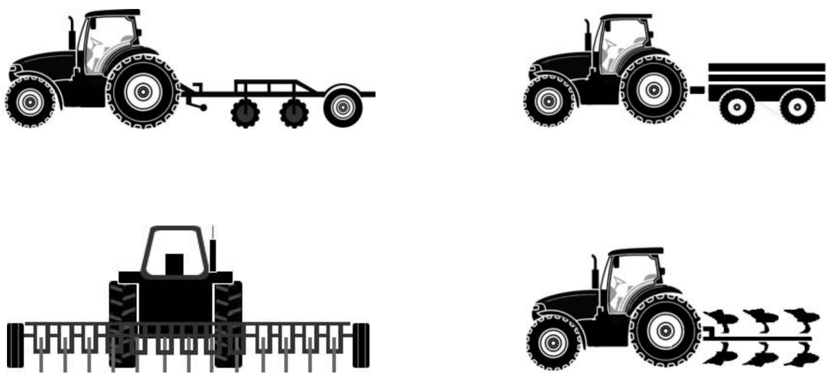

Figure 51. Tractor with agricultural implements.

By having the additional tractors, although farmers become able to save time and avoid injuries from repetitive coupling and uncoupling of implements. However, buying additional tractors require huge capital investment. In order to make the coupling process easy, quick, safe and cost effective, the idea of innovative coupling interface is presented in the following section.

6.3 Idea of Innovative Coupling Interface

This thesis presents the idea of developing innovative coupling interface to connect the tractor implements automatically with the little input from the tractor operator. Before reaching to the idea of innovative coupling interface, the existing coupling process was studied in detail as described in the previous section.

It was realized that existing coupling process time consuming, laborious and carry the chances of accidents. The operator often struggles to align the tractor implement hitching points. Therefore, he leaves the tractor cabin to inspect the relative links and pins alignment both horizontally and vertically. After observing the extent of misalignment, operator goes back to the tractor cabin and make the necessary lower link alignment as well as steering correction based on the estimated side to side offset. Then, slowly reverse the tractor to the correct position. The driver possibly repeats these steps several times in small increments to reach the accurate position. During this process, operator enters into the danger area which increases the chances of injuries.

In order to avoid the injuries and complete the agricultural operations in time, farmers use additional tractors and keep implements connected for ready to use as demonstrated in Figure 51. Thus, they avoid frequent coupling and uncoupling of implements while performing the farming operations. Although, farmers can save time and avoid accidents by using the additional tractors, however, it requires huge capital investment. On the other hand, various attempts have already been made by several manufacturers to make the coupling process easy. One of the solution is provided by the Gangl Docking Systems. The coupling system from Gangl Docking Systems comprises of two coupling modules, one for the tractor and other for the implement. Coupling modules shape (triangle) is based on the three point linkage system and is demonstrated in Figure 52.

Figure 52. Gangl Docking System.

The above coupling system allows the tractor operator to combine the hydraulics and drive shaft with simple push of a button in seconds. During coupling process, tractor’s triangle approaches the implement and adds itself to the opposite triangle. Once both triangles are anchored together, drive shaft and hydraulic system connect automatically. Figure 53 presents the complete coupling process.

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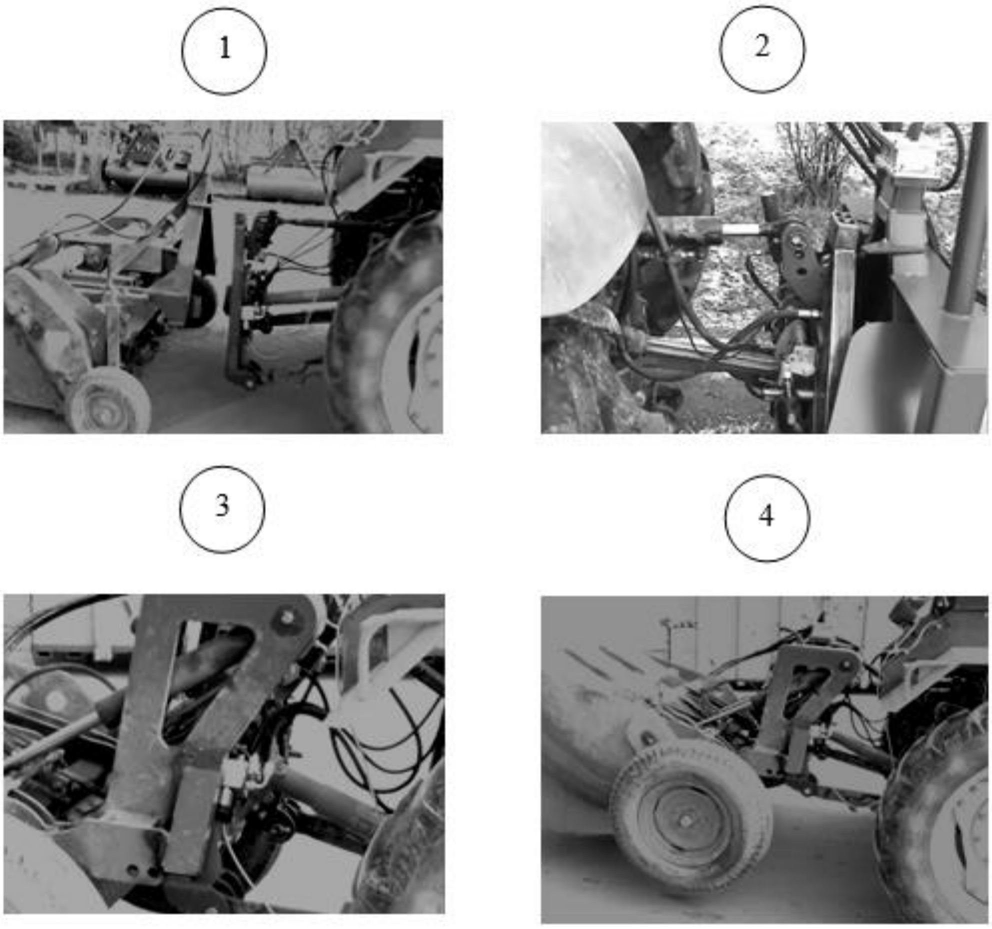

Figure 53. The coupling process (Gangl Docking Systems).

The Gangl Docking Systems have made the coupling process simple and easy which until now required physical effort and time. The operator can conveniently couple and uncouple the working implement without leaving the cabin. Although, Gangl Docking Systems have revolutionized the coupling process, however, still it requires the highly skilled operator to connect the coupling modules (triangles). Therefore, the coupling process can further be automated by incorporating the self-parking car technology which will eliminate the need of a highly skilled operator. The self-parking car technology is explained in the following paragraphs.

Automobile parallel parking has never been an easy task for the drivers. Since, everyone has to do this on daily basis, therefore parking a car in a small space is the vital skill for drivers. Limited skill of drivers in parallel parking may lead to the traffic jams and fenders collisions. The technology has made it easy for the drivers to find the perfect parking place and squeeze car into the small space with simple press of a button, sit back and relax.

The automakers use self-parking car technology to increase the comfort and safety of driving in odd situations where extra skill and responsiveness is needed to direct the car. The maneuvering of a car is done automatically through coordinated control of steering angle, since it considers the real time situation to ensure the accident free movement within the available parking space. The demonstration of self-parking car is demonstrated in Figure 54.

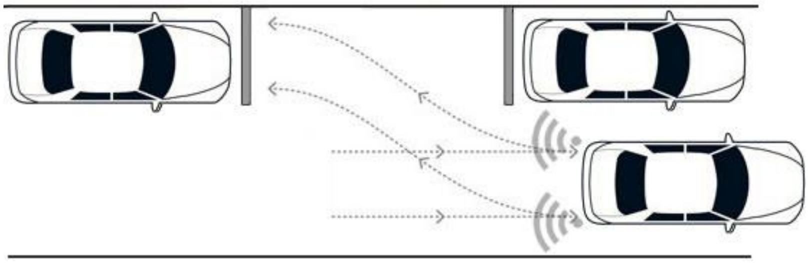

Figure 54. Demonstration of automatic self-car parking system.

A self-parking system uses various technologies to sense the objects around the vehicle and ensures collision-free parking into the smaller space, since most of the drivers cannot manage on their own. The self-parking system allows the same number of cars to take up the fewer spaces. Self-parking car systems are not completely automatic and driver controls the speed of vehicle by pressing and releasing the brake pedal. When the process of parallel parking begins, the on board computer takes the control of vehicle. The car moves parallel to the front car and computer signal warns the driver when to stop. Then, the driver shifts the transmission into reverse position and releases brake gently to move backwards. The computer controls the steering system and maneuvers the car into the parking space.

The automakers use different self-parking systems to sense the objects around the vehicle. Some use sensors installed in the front and rear bumper of the car that act as both transmitters and receivers. Other systems use radar or cameras mounted on the car bumpers to spot the objects. In the end result is same. Similar technology can be replicated in tractors to control the movements during the coupling process, meaning that in aligning the tractor and implement hitching points as demonstrated in Figure 55.

Figure 55. Demonstration of automatic coupling of tractor implement.

The sensors technology and auxiliary connecting interface may attach the implement automatically in few seconds, simply by pressing a button. During the entire coupling process, the maneuvering of tractor can be done automatically through sensors. Thus, extra skills are not required to complete the coupling process, and driver no longer needs to leave the cabin and enters into danger area between the implement and tractor. The next section analyzes the value proposition and implications of the innovative coupling interface.

6.4 Value Proposition and Implications of Coupling Interface

Communicating the value of a product or service is highly important in business transactions, and value proposition is a useful tool for this purpose. According to Rintamäki et al. (2007), value proposition must communicate the benefits to the customers as compared to the sacrifices, they perceive. According to Lanning and Michaels (1988), value proposition is a construct of product benefits for customers in turn of product price. Figure 56 represents the value delivery system framework adapted from Lanning and Michaels (1988), comprising three steps: choose the value, provide the value and communicate the value to present the idea (See Ballantyne et al., 2011).

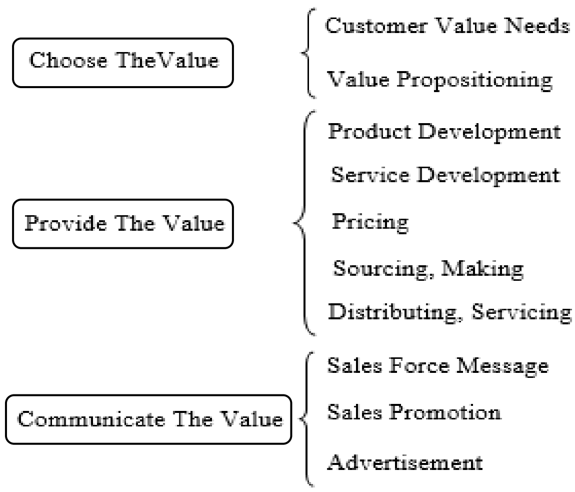

Figure 56. Value delivery system framework (Lanning and Michaels, 1988).

In the above framework, the first step is to analyze the customer needs and market place, since it provides the basis for defining the value proposition. In the second step, customer and market requirement are fulfilled through product development, service development and pricing. Therefore, sourcing and distribution are the activities carried out at this stage. Finally, firms substantiate the value and communicate it to the customers through sales promotion campaigns, advertisement and publicity. This way customer can easily understand the value of products and services. (Lanning, 2000)

According to Anderson et al. (2006), value proposition building can be categorized into three types: all benefits, favorable points of difference and resonating focus. First, all benefits value proposition refers to all benefits that offering can deliver to the customers despite targeting the specific customer segments and market requirements. Thus, firm may claim the benefits those are not appreciated by the customers. This shows firm's inability to communicate the differential features of offering over competitors' offerings.

Second, favorable points of difference value proposition acknowledges that company considers the alternative solutions and focus on differential features of offering in comparison to alternative solutions. Firms promote those differential features they feel valuable despite realizing the customers' actual needs. The major drawback of this approach is that firm's assessment might differ from the customers' views about valuable features of offering. Consequently, firm may invest resources on promotion of product features that are not highly appreciated by the customers. (Anderson et al., 2006)

Last resonating focus value proposition differs from previous types of value propositions in two ways. First, this approach put emphasis on the limited number of differential features (one or two) that are most valuable for the customers. Second, resonating focus value proposition focuses on similar features of offering which are also present in the competitors' offerings. This helps customers in buying decisions, while comparing the different product options. Although resonating focus value proposition approach is effective, however, it demands deep understanding and knowledge about competitors' offerings and customers. (Anderson et al., 2006)

In case of cost-reducing innovations, manufacturers need to build a value proposition in a way that benefits of offering surpass the customer costs. By calculating the cost savings (Δ), the supplier can claim that their machine can reduce total customer costs. For building the value proposition, it is also important to calculate the depreciation of a machine. There are various methods to calculate the depreciation. The simplest method is straight line method.

$$\text{Depreciation} = \text{Assets Purchase Price} - \text{Salvage Value} / \text{Asset's Life}$$

Depreciation is the cost, resulting from the wear and tear of a machine. In depreciation calculations, the economic life and accumulated working hours of a machine are important elements to determine its salvage value. Economic life of a machine is the number of years over which costs are calculated and depreciation must be added to the total customer costs. A supplier can build and communicate the value proposition by considering the total customer costs both for old and new process. Customers can easily compare the costs and perceive added value by acquiring the cost-reducing innovation. Since this thesis presents the idea of innovative coupling interface therefore, to communicate the value proposition, it is important to understand the implications of the innovative coupling interface.

The innovative coupling interface will simplify the attachment process to the push of a button that until now requires physical effort, time, and highly skilled operator. Farmers can conveniently couple and uncouple the implements just in few seconds without leaving the tractor cabin and entering into the danger area between the running equipment. Consequently, farmers can avoid injuries. Apart from this, innovative coupling interface will eliminate the need of additional tractors that keep the implements connected for ready to use as demonstrated in Figure 57. Thus, farmers can save a huge capital investment on extra tractors.

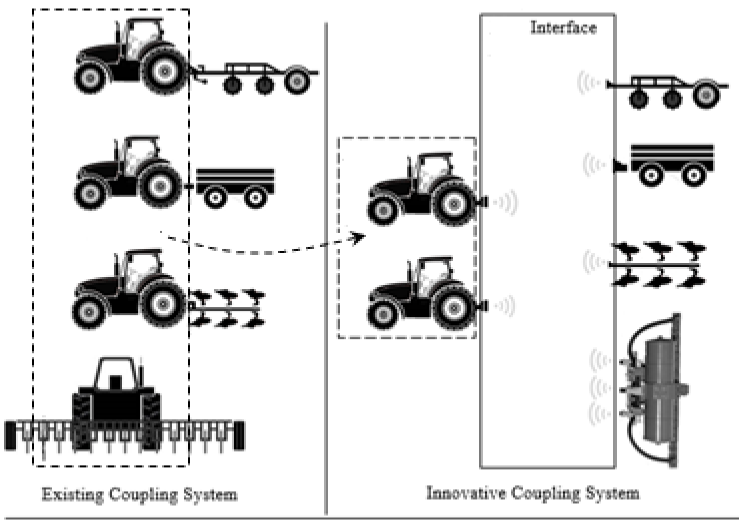

Figure 57. Demonstration of coupling interface and need of tractors in a farming season.

It is evident from the figure above, the innovative coupling interface will reduce the need of additional tractors and the work done by four tractors can be managed with two tractors. The development of innovative coupling interface will be beneficial for tractor manufacturers to communicate the added customer value in terms of cost savings, safety features and productivity enhancement in a growing season.

As described earlier, company can create the convincing value proposition based on the features that are most valuable for the customers and same can be reflected in the case innovation. On the basis of cost savings (Δ), farmers can perceive added value by acquiring the cost reducing innovation. For the cost analysis purpose, it is assumed that by acquiring the coupling interface, a farmer needs two tractors in place of four to perform the same amount of work in a year as shown in Figure 57. The average price of the tractor and the innovative coupling interface is assumed as €75,000 and €25,000 respectively. While other costs assumed to be remain unchanged both for the old and new coupling system. The average life of the tractor and coupling interface is assumed as 15 years. The salvage value of tractor is considered as 25 percent and 15 percent of the purchase price in old and new coupling systems respectively. The salvage value of tractor with old system is considered more because of less working hours of a tractor as compared to the tractor with a new coupling system.

Annual depreciation of four tractors with the old coupling system:

(75,000 – 18750) x 4 / 15

= €15,000 / Year

Annual depreciation of two tractors with the new coupling system:

(75,000 – 11250) x 2 / 15

= €8,500 / Year

Annual cost savings by having a new coupling system (Δ): 15,000 ─ 8,500

Δ = €6,500 / Year

The above calculation shows that farmer can save €6,500 in a year by acquiring the new coupling system, yet this cost saving is not coming for free. Farmers have to pay €50,000 to acquire the coupling interface for two tractors. By assuming that interface salvage value is 15 percent of the purchase price, the annual depreciation is calculate as under:

Depreciation of two coupling interfaces: (25,000 – 3750) x 2 / 15

= €2,833 / Year

Net annual cost savings by acquiring the coupling interface: €6,500 ─ €2,833

= €3,667 / Year

On the basis of the cost savings, innovative coupling interface supplier can communicate resonating focus value to the customers, since it provides an alternative solution to the farmers and enable them to complete the job in time. Apart from the cost savings, the innovative coupling interface will make the coupling process simple and easy, with less chances of accidents. Figure 58 shows the sales material for communicating the value proposition of the innovative coupling interface.

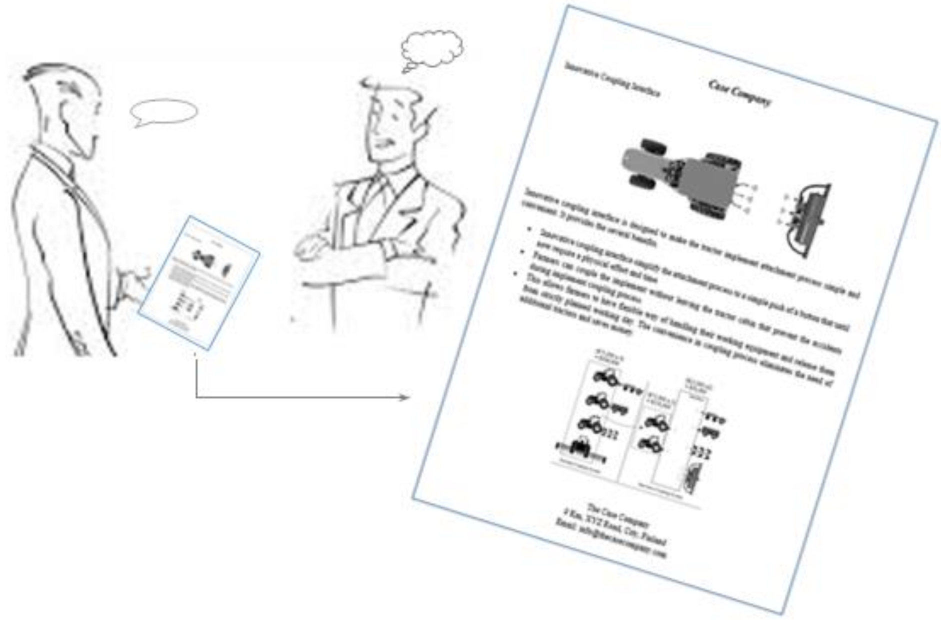

Figure 58. Sales material for innovative coupling interface.

The sales material helps sales team in introducing the new offering to the customers. The customers get information about the product features and understand how a new product can bring value for them. This chapter explained the innovative coupling interface and its value proposition for the customers. The following chapter demonstrates the application of thesis framework on the innovative coupling interface as well as describes the limitations of the study.

7. DISCUSSION

7.1 Overview of the Problem and Framework

In today’s competitive environment, companies tend to focus on the development of products that satisfy customers changing needs. It is challenging for manufacturers to oversee the users varying requirements, and keep their product portfolio innovative accordingly. Companies find out what “value” means to their customers and emphasize on technological innovations to ensure their long term sustainability in the market. According to Khalifa (2004), product attract the customers only, if the total customer benefits surpass the sacrifices made by the customers.

According to Munksgaard and Freytag (2011), the development of innovative products open up new avenues for companies and make their access to the new markets. Therefore, product development is considered as crucial process for the success of companies (Woodside and Biemans, 2005). Three external elements: intense worldwide competition, fragmented markets and diverse shifting technologies persuade companies towards the new product development (Wheelwright and Clark, 1992, cited in Munksgaard and Freytag, 2011).

For the product development, various models are available that companies can adopt to escalate the efficiency of their product development process. The product development process includes the idea generation, design and launching of the product in the market (Ulrich and Eppinger, 1995). The new product development is resource intensive and risky job. Therefore, firms need to find the ways for reducing risks and costs involved in the product development. The collaboration among organizations have been identified as one of the ways for reducing the product development cost and lowering the risk of failure.

Further, technological firms understand that the successful commercialization of innovation often depends on the availability of compatible products that work together in a seamless fashion. Small number of the technology products work in isolation. However, most of the products deliver high customer value in conjunction with other hardware or software upon which they are dependent. For the success of innovation, companies must be good at innovation management practices.

According to the Rothwell (1992), successful innovation management is not only about being good at R&D, buying in technology and recognizing the customer needs. However, innovation is required to be viewed as a system and needs to be managed in an integrated way. The situation in every firm is different and each firm needs to develop its own subsets and ways, and implement them in a system for managing innovations (Mooge, 1993).

The organizations can deliver more value to their customers through collaboration (working in network) despite functioning in isolation. Chesbrough (2003) introduced the concept of open innovation which is considered as sixth generation model of innovation. The open innovation is a network model that not only takes into account the internal ideas and development efforts, but also focuses on the external resources equally in the innovation process. Through open innovation, organizations have large base of ideas, resources and technologies to drive their internal growth. Further, leading firms utilize open innovation as a strategic tool to explore the new opportunities at lower risk. The innovation struggle of a firm can be capitalized with the enough development from the complimentary technology providers and component suppliers.

This thesis proposes that customer value approach can be applied to the whole innovation process from the product definition to the launching of a product. This determines what technologies and resources are needed throughout the innovation process. Figure 59 illustrates the thesis framework for fostering a systemic innovations.

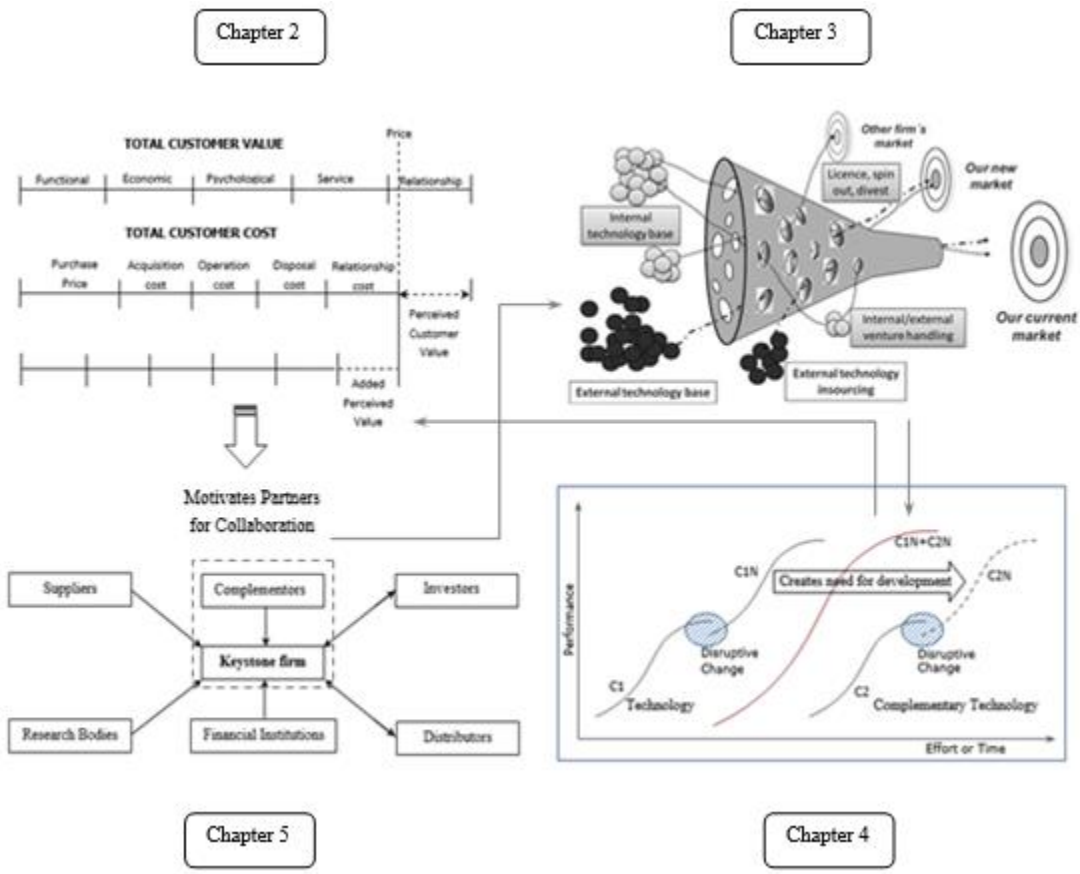

Figure 59. Framework of the thesis.

The customer value analysis helps in finding the cost effective solutions by taking into account the total customer value and total customer costs dimensions. To sum up, this thesis focuses on the cost-reducing innovation therefore, manufacturers need to build a value proposition in a way that product benefits surpass the total customer cost. By calculating the cost savings (Δ), the supplier can claim that their offering can reduce the total customer costs and delivers added customer value. Initially, customer value analysis was merely used for improving the existing products, however, this thesis proposes that it can also be utilized for fostering the systemic innovations.

7.2 Summary of the Results

This section aims to illustrate the empirical findings of the case innovation. This study presented the idea of innovative tractor implement coupling interface. The first step for developing the innovative coupling interface was the problem identification. Therefore, before reaching the idea of developing innovative coupling interface, the existing coupling process was studied in detail to figure out the associated problems. By analyzing the constraints and problems related to the coupling and uncoupling of tractor implements, it was realized that existing coupling process is time consuming, laborious and carry the chances of accidents. It was also observed that to cope with these challenges, farmers buy additional tractors and keep implements connected for ready to use as demonstrated in Figure 57. Thus, they can avoid the frequent coupling and uncoupling of implements, but this solution requires huge capital investment.

The main goal behind the idea of innovative coupling interface was to offer the cost effective solution to the above mentioned problems. It was assumed that the implement can be connected in seconds with little input from the operator without leaving the tractor cabin. To simplify the coupling process, various attempts have already been made by the several manufacturers. One of the solution is provided by the Gangl Docking Systems. The coupling system made by Gangl Docking Systems comprises of two coupling modules, one for the tractor and other for the implement. Coupling modules shape (triangle) is based on the three point linkage system. This coupling system allows the tractor operator to combine the hydraulics and drive shaft with simple push of a button in seconds. During coupling process, tractor’s triangle approaches the implement and adds itself to the opposite triangle. Once both triangles are anchored together, drive shaft and hydraulic system connect automatically.

It was observed that the coupling system provided by the Gangl Docking Systems have made the coupling process simple and easy which until now required the physical effort and time. The operator can conveniently couple and uncouple the working implement without leaving the cabin. Although, Gangl Docking Systems have revolutionized the coupling process, however, still it requires the highly skilled operator to connect the coupling modules (triangles). Therefore, this study anticipated that the coupling process can further be automated by replicating the self-parking car technology in a tractor. The self-parking car technology will guide the tractor automatically to align the hitching points with a minimum input from the tractor operator. Thus, the innovative coupling interface will potentially eliminate the need of highly skilled operator as well as reduce the accidents during the implement coupling process. By acquiring the innovative coupling interface, farmers can save money spent on additional tractors because the work done by four tractors can be managed with two tractors in a stipulated time (Figure 57). As calculated in Chapter 6, farmers can potentially save 3,667 euros in a year. These savings will come from the difference between the total depreciation of machines (Tractor and Coupling Interface) used in old and new coupling systems. The next section explains the application of thesis framework on the case innovation.

7.3 Application of Framework on the Case Innovation

It is learned that implements are the necessary elements that work together with the tractor while operating in a field. Implements must be compatible and best fit to the tractor to perform the field operations. Since this thesis presents the idea of innovative coupling interface to revolutionize the implement coupling process in terms of safety and cost savings. It is realized that the development of a new coupling interface requires modifications both in tractor and implements at the same pace. The inclusion of self-parking car technology in a tractor creates need for development in the implement. The equal development both in tractor and implements will exploit the success of coupling interface. Hence, it must be treated as a systemic innovation. Figure 60 illustrates the coupling interface as a systemic innovation.

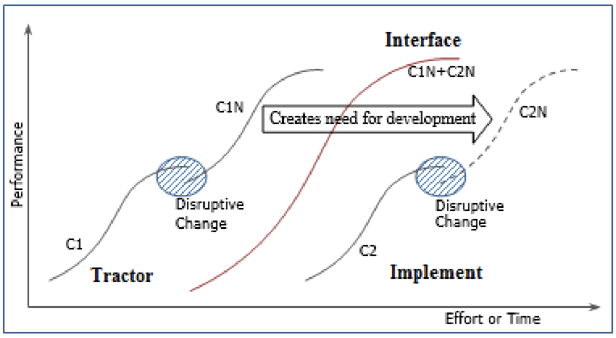

Figure 60. The innovative coupling interface as a systemic innovation.

The theoretical framework proposed in this thesis provides guidelines for developing the systemic innovations. The framework suggests that different technology providers and component suppliers must collaborate in the developing process of innovations. The collaboration among partners reduces the development cost and minimizes the risk of failure through better understanding and control of technology products. Thus, tractor and implement manufacturers must collaborate for innovating the coupling interface. The tractor company may act as a keystone firm in the development process of interface by combining the related technologies and providing the guidelines to the complementary technology providers. Figure 61 exhibits the collaboration among partners (particularly tractor and implement manufacturers) for developing the innovative coupling interface.

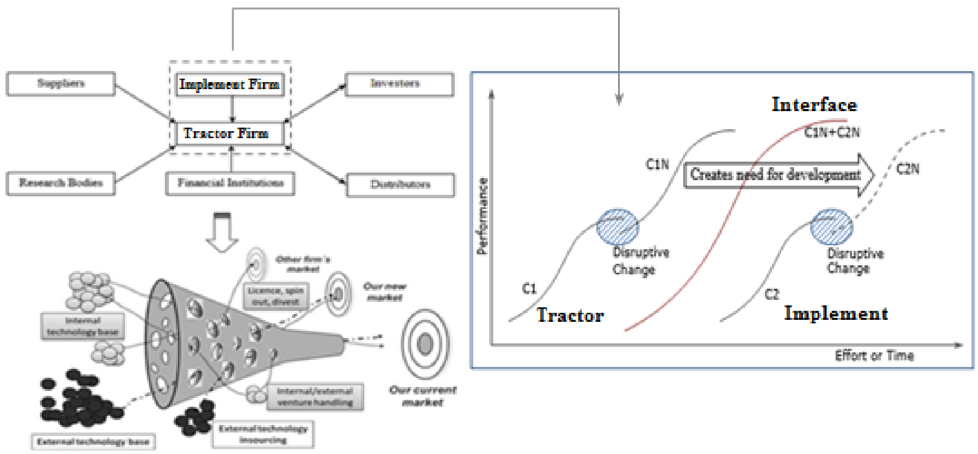

Figure 61. Collaboration between firms in developing the coupling interface.

Next, Figure 62 demonstrates the cost analysis of old and new coupling system described in Chapter 6. The customer value of innovative coupling interface is calculated on the basis of major cost elements. This innovation is beneficial for customers, only if it brings more benefits as compared to the total customer cost. The total customer value remains unchanged, however, the innovative coupling interface delivers the added perceived value by reducing the total customer cost.

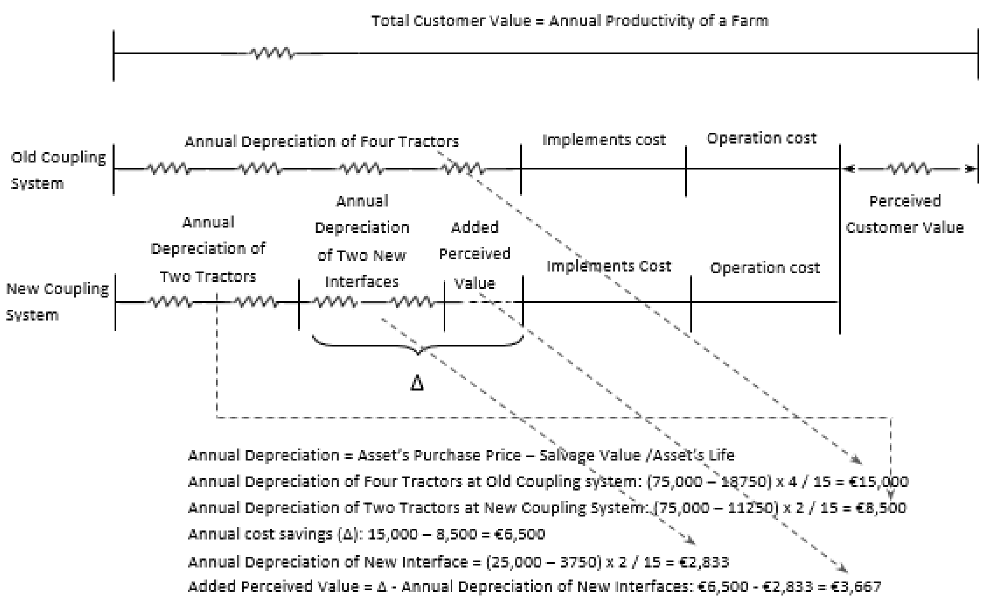

Figure 62. Cost analysis of innovative coupling interface by using the customer value model.

It is evident from the figure above that by acquiring the interface, a farmer can save €3,667 per year. The annual cost saving from tractors' depreciation is €6,500, and the annual depreciation of two coupling interfaces is 2,833 euros. Figure 63 shows the application of thesis framework for the development of innovative coupling interface in a system.

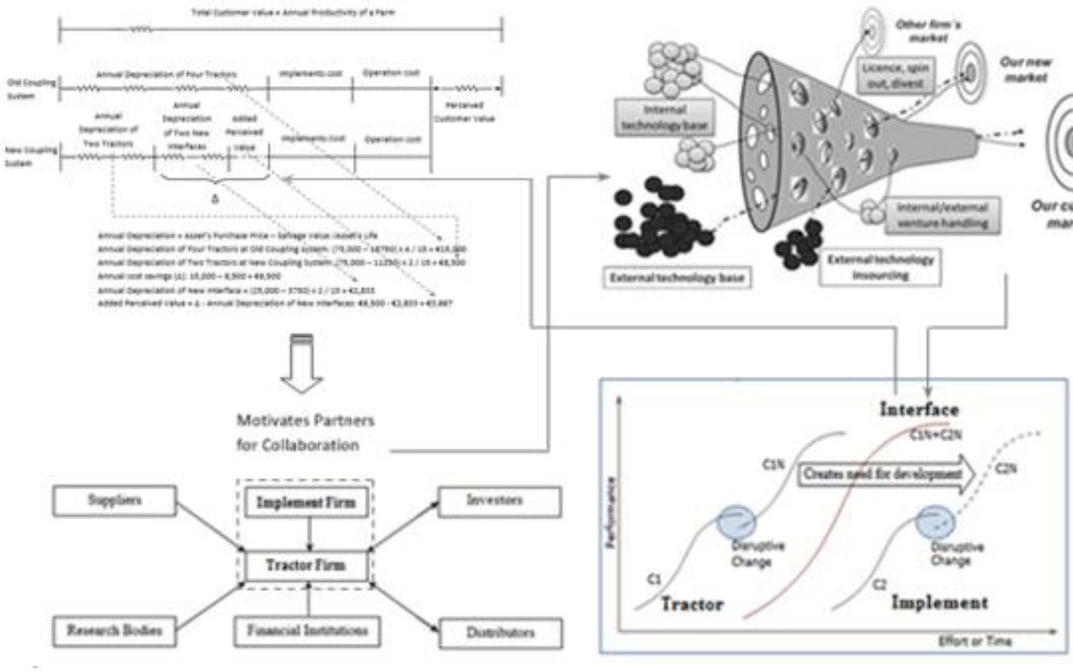

Figure 63. Application of framework for the development of innovative coupling interface.

The above framework suggests that tractor firm can utilize customer value analysis model as a tool to analyze the customer needs, and to motivate the partners: implement manufacturer, supplier, distributors and research bodies to collaborate in the development of innovative coupling interface. This will reduce the development costs and risk of failure. Consequently, farmers will perceive added value by acquiring the new coupling interface as it has a potential to reduce the total customer costs.

7.4 Case Analysis

This thesis explained the role of customer value analysis in identifying the customer needs. By utilizing the customer value analysis tool, companies can analyze what value drivers are essential in delivering the added value to the customers. Companies who are good at identifying the customer's problems and needs, offer promising solutions to their customers. The same was reflected in the case innovation of coupling interface. Before reaching the idea of coupling interface, the existing coupling system was closely observed to identify the problems. During research, it was found that existing coupling system is time consuming, laborious and carry the chances of accidents. To cope with these problems, farmers buy additional tractors and keep their implements connected for ready to use in peak farming season. Consequently, farmers can save time and avoid accidents, however, it requires huge capital investment. In order to offer the promising solution to the above mentioned problems, the idea of innovative coupling interface was generated. It was anticipated that farmers can connect implements automatically by simple push of button in seconds that will eliminate the need of additional tractors as demonstrated in Figure 64. Hence, by acquiring the coupling interface, farmers can save money spent on additional tractors.

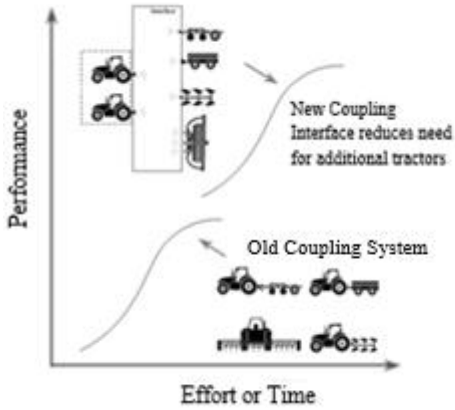

Figure 64. Tractors need with the emergence of new coupling Interface.

To simplify the implement coupling process, Gangl Docking Systems developed a manually controlled coupling interface. However, this study proposed an idea of automatically controlled coupling interface, since it requires minimum input from tractor driver. The use of self-parking car technology in tractors can align the tractor with implement during coupling process as shown in Figure 65. This idea of coupling interface was presented to the director development of the tractor manufacturing company in Finland. He appreciated the idea and showed his willingness to explore it further.

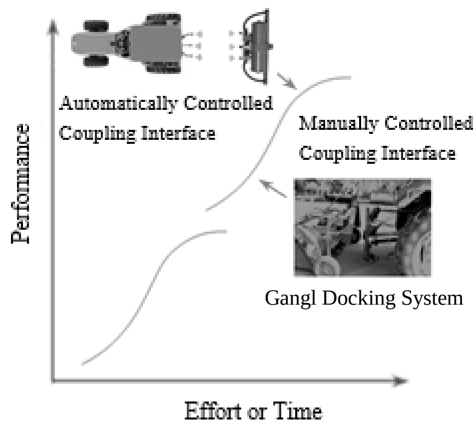

Figure 65. Incremental development of new coupling interface.

Next, the application of framework showed the development process of the case innovation. It was learned, innovative coupling interface is a systemic innovation which can be developed through collaboration among partners. Further, Figure 66 communicates the value proposition of new coupling interface.

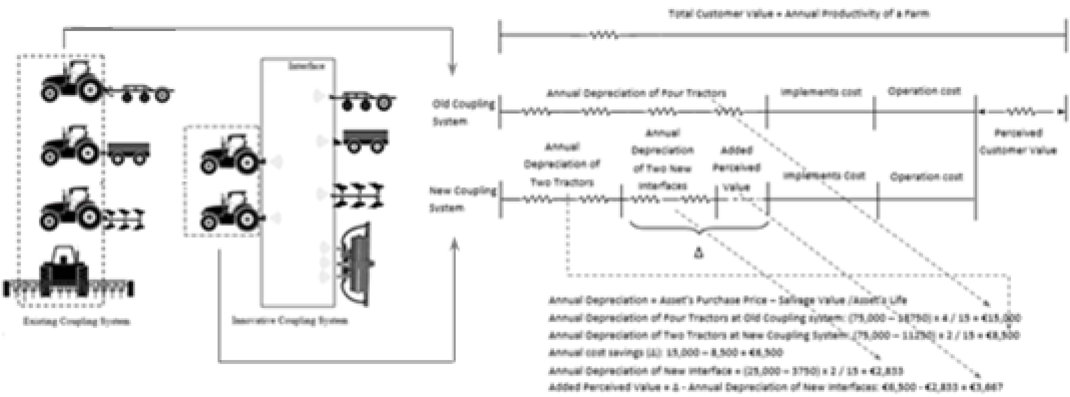

Figure 66. Communicating the value proposition of new coupling interface.

The study conducted in this thesis has the following limitations. First, the study presented the idea of coupling interface on the basis of observation and no prototype was developed. Therefore, understanding the technical complexities, technology requirements and choice of right partners for developing the coupling interface is difficult without building a prototype. Second, the value proposition of coupling interface was based on the assumed values, since it may vary in the real life situation. The framework was only tested with the case innovation. Therefore, it is hard to know the effectiveness and viability of the framework until it is tested with other innovations.

8. CONCLUSIONS

To stay competitive in the market, companies invest resources on the development of products that satisfy customer needs in a better way than the competitors. Clients' preferences change overtime and it is challenging for firms to recognize the customer requirements and keep their product portfolio innovative accordingly. Otherwise, companies find themselves out of business. Organizations who provide promising solutions to the customers likely to win.

The objective of this study was to discuss utilizing the customer value analysis as a tool for fostering a systemic innovation that commit partners to collaborate in a system. This thesis emphasized on various concepts such as customer value, product development, product development models, systemic innovation, tools for managing innovations and business collaborations to realize the systemic innovations. Further, this study proposed a theoretical framework for the development of a systemic innovation. Finally, the case innovation – tractor implement coupling interface was chosen from the tractor industry to depict the implication of theoretical framework, and to show how the convincing value can be delivered to the customers.

It was learned that most of the products deliver value in conjunction with other complementary technologies that work together in a seamless fashion. Therefore, managing innovation is a challenging job, since it requires firms' collaboration and strong market orientation, meaning that companies must jointly concentrate on satisfying the customer needs. The key outcome of this thesis was the establishment of a theoretical framework that helps firms to analyze what "value" means to their clients and motivates technology providers to put their joint efforts in the development of a systemic innovation.

While innovating in a system, companies can take the mutual advantage of technology through collaboration and resource sharing. So, companies better sustain their market position and offer more economical and promising solutions to the customers. This study proposed the idea of innovative coupling interface to simplify the implement coupling process to the simple push of a button that until now requires physical effort and time. This will allow farmers to have flexible way of handling their working equipment and will release them from strictly planned working day. Farmers can conveniently couple and uncouple implement to perform the next job, meaning that less chances of injuries and time waste in the coupling process.

The added perceived value of coupling interface was calculated by applying the framework on case innovation, where all necessary cost elements were considered both for old and new coupling system. It was realized that the innovative coupling interface would deliver the added customer value through cost-savings and safety features. Although, the outcome of this study was found convincing, however, it had some limitations. The added perceived value of a new coupling interface was determined on the basis of supposed values, since it may vary in real situation. No actual prototype was developed to understand the practicalities of the innovation. In future research, the prototype of coupling interface can be developed to comprehend its practical performance, estimate the real costs as well as to know the technical complexities and technology requirements. Thus, it will be easy for a tractor firm to collaborate with right partners. Moreover, the viability of thesis framework can be assessed with other systemic innovations.

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