“Supplier involvement in New Product Development:
A literature review and conceptual model”

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I hereby declare that the work submitted is mine and that where I have made use of another’s work, I have attributed the source(s) according to the Regulations set in the Student’s Handbook.

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ABSTRACT

The main focus of this study is the examination of the role of suppliers in the development of new product and services within a firm, not only as an external or a complementary body, but as a key partner and contributor to the whole process through close collaboration and cooperation. The study is compiled by an extended analysis of the key aspects of such an integration, from the buyer’s perspective mostly, such as timing and extend of supplier involvement and the correlation between them. A deeper insight on what is supplier involvement is also given, regarding the role of suppliers in the new product development stage and how impactful their contribution can be to the performance of the items/services produced, but also on the procedures of the NPD operations.

What derived from this research is a model that best explains the supplier integration procedure from start, explaining the most critical issues that are most commonly faced and how those reflect on the total performance of this buyer-supplier venture. Starting from basic SRM operations such as selecting the best possible partner, we continue to give an insight on the inter-organizational functions among the sides involved and we conclude with potential outputs and outcomes of supplier involvement in NPD. Some real-life examples of the model are also provided through article research and gathering of secondary data.

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Keywords used: New product development, Supplier involvement, Innovation, Procurement, Purchasing, Supply chain management, Supplier relationship management
This dissertation was written as part of the MSc in Strategic Product Design at the International Hellenic University. It follows the completion of the courses and it is the last part of the MSc before graduating. Subject was selected among others based on my interests and my willingness to learn more on this field of product design and manufacturing.

Innovation is always something that fascinates me so I wanted to learn more about the procedure many companies follow to achieve a breakthrough or the optimization of existing services and products. Suppliers play a critical role in this field of production and this is what is highlighted through all this research. Searching through literature, which was harder than I imagined since my background is not very relevant to this subject, I have discovered some of the most important and critical factors that contribute to a successful involvement of suppliers in new product development operations, which will be briefly presented here since the body of literature that exists on this field is massive and still growing.

Deriving from what I have been studying for the last months and more importantly what I have learned, is a model that explains in short, why companies should engage such activities with their suppliers, what they should pay attention to and monitor at any given time and lastly, what should they expect from such collaborations, be it good or bad. Hopefully, this thesis could useful to firms that need to get an idea of what supplier involvement is, providing them with a general guideline that enables them to adjust their operations on the basis of what is being discussed and presented in this work. More specifically, this dissertation could be used as a starting point for companies in the area of Greece, where this particular business function is not yet developed but there is definitely a large amount of companies that could utilize it to expand their operations and their field of expertise.

I hope you enjoy reading this study.

Taktikos Evangelos

Thessaloniki, January 16, 2018
CHAPTER 1: INTRODUCTION

1.1 Problem indication

In today’s markets the competition landscape changes dramatically on a very frequent basis. Companies are striving to adapt to these changes so that they are not left behind by competitors who are doing better in overcoming the obstacles new technologies and breakthroughs put in their way. R&D departments work on new technologies that appear, trying to introduce innovative products on the markets to capture the consumers’ attention, design and manufacturing work on new concepts to present a new touch on items or services that already exist, in order to make things simpler for the customers and in the same time, constant intra-organizational improvement and optimizations are necessary for a firm’s prosperity and successfully moving ahead of the competition.

However, not all business organizations have the know-how or the resources to engage in such advanced activities, some may lack technical knowledge or the appropriate personnel, others may not have the necessary expertise level or the machinery and facilities. What is often witnessed in modern businesses, is the close collaboration between a firm and its suppliers in a not-so-traditional relationship, mainly during the product development stage of a project. Business organizations often address their shortcomings by involving an external partner in their activities so that they can achieve their strategic goals.

Studies have shown that the involvement of a firm’s supplier into new product development operations leads to great results in terms of product performance, time-to-market, product quality but also the development of new competencies and the conservation of resources for the buyer (Sjoerdsma and van Weele, 2015; Wagner and Hoegl, 2006; van Echtelt, Wynstra, van Weele and Duysters, 2008).

On the contrary, there are other empirical studies that have not concluded that supplier involvement leads to positive outcomes. The finds of those studies outline there are issues that not only resolve problems but instead are the cause of deterioration of product performance, delays and longer development times and are also impactful on the total cost of the new product development process (Dale, Leverick and Wilson, 1998).

There are multiple things to consider before deciding to engage in such practices which have a critical effect in the NPD process such as selecting the best possible partner depending on the firm’s needs and expectations, excellent relationship management from both sides in order to avoid misunderstandings and keep the cross-organization operations functioning smoothly, good negotiations so that both sides’ terms are satisfied, thus having a fitting start for the collaboration, but also, a tremendous amount of effort is needed throughout the whole new product development process, ensuring that whatever problem or hindrance may appear is dealt swiftly and effectively.

What is obvious from various researches in the field of new product development is that the involvement of supplier is growing to be a key factor to improve inter-organizational operations, product performance and provide
optimization for many business functions. However this is not a one-way improvement relationship. There are occasions when the buyer is also helping the supplier improve through close collaboration and “mentoring”, helping them overcome technical and operational uncertainties (Lawson, Krause and Potter, 2014).

1.2 Problem statement

With all the research that currently exists in this field of study and the increasing importance of supplier involvement in new product development as it is briefly explained in the problem indication section, an important question emerges:

“What are the reasons that drive companies in involving a supplier in new product development and what are the outcomes of such integration. What actions and operations does a venture like this require to be completed”.

1.3 Research questions

The main question of this research can be broken down to three different questions that will be examined:

1. Which are the reasons that lead firms to involve their suppliers in their development operations?
2. Which is the process of selecting and managing this relationship to achieve the best possible results for both sides?
3. What does this process result in? What are the outputs?

For the purpose of giving an answer to these questions and their context, but also deriving from the findings of the present study, an input-process-output model was developed that outlines, in a general framework, the antecedents and prerequisites that drive companies to cooperate with an external partner, how both sides approach this kind of collaboration and what are the means to its success (things that they should be cautious for and things that they should be looking forward to achieve) and what are the outcomes that could potentially derive from the involvement of the supplier (either positive or negative). This model is a hypothesis of how supplier involvement can be schematically explained without having to delve into much detail, especially since this study covers the basic ideas of supplier involvement.

A schematic depiction of the developed model:
1.4 Research methodology

In order to answer these questions an extensive literature review was conducted, with the main focal point being supplier involvement and ESI (Early Supplier Involvement), innovation management in new product development and various aspects of supplier relationship management (SRM) with more focus on supplier performance management areas. The research is mostly based on literature review of articles found in journals such as the Journal of Purchasing and Supply Management, Industrial Marketing Management, Journal of Product Innovation Management and more, all of which can be found online via online databases such as EBSCO, Elsevier and ScienceDirect but also search engines such as Google Scholar. Furthermore, books found in the International Hellenic University library has contributed a lot in the present research, providing the author with a better with material that enabled a better understanding of the topics discussed.

This research is primarily based on secondary data gathered by examining various articles on the web which contain empirical studies but also case studies of real companies around the world.

No primary data were used, due to the very limited practical implementation of the subject examined in this study, especially in the country it was conducted.

1.5 Research structure

After stating the introductory part of this research, a literature review follows (chapter 2), presenting in short some of the most important factors that have to be discussed, to help the reader acquire some typical information in order to understand better the core of the study, such as describing what is new product development and supplier involvement and its main aspects. In chapter 3 the model that was developed will be extensively discussed, broken down in parts which will be separately analyzed one by one. Chapter 4 will present some cases and examples of real life applications of the model we presented and chapter 5 will be the conclusions and some food for thought for further research and discuss.
CHAPTER 2: LITERATURE REVIEW

To begin with, since this work will be covering aspects of supplier involvement and innovation procurement in new product development, it is essential to explain them in detail and give a better insight to what those terms are referring to. In this context, a theoretical background to each of those aspects follows in order to give the reader a better understanding of what they are and how businesses integrate them into their operations.

2.1 What is new product development

New product development is a business operation that has long been established as an important factor regarding the development and prosperity of a company. Firms that want to stay ahead of the curve and be market leaders, always observe the needs of the market which consequently leads to the creation of new products that serve those needs better than the other similar products that are created for the same purpose. Loch and Kavadias (2008) defined NPD as “the complete body of a firm’s activities that lead to a stream of new or differentiated products in the market over time. This includes not only the development of new products and services but the generation of opportunities which are then transformed into manufactured goods and services”. Furthermore, when talking about the development of a new product, that does not necessarily mean that something new will be created from scratch, but also the rework of something that already exists but with better/ different technology or design, enhancing different aspects of it such as functionality, technical characteristics, performance. A generic NPD process usually consists of the stages given below:

1. Identifying customer needs
2. Establishing target specifications
3. Concept generation
4. Concept selection
5. Concept testing
6. Setting final specifications
7. Project planning
8. Economic analysis
9. Market/Competition analysis
10. Prototyping

Although these are the basic activities during a new product development procedure, there are far more things to consider in each of these steps in order for a project to be fruitful.

In general, some of the reasons that drive more and more companies to engage in such an activity, is the highly competitive landscape, the ever-changing modern trends, technological advancements that are happening in a rapid
pace and many other reasons that can affect today’s markets and compel businesses to improve or alter their products (De Toni and Nassimbeni, 1999). Failure to keep up in this constantly changing environment, where new products appear every day and technological breakthroughs lead to innovations, can lead to the collapse of a business organization, unless it adapts. Although product development is important, the necessary expertise and know-how is rarely found within a single firm. The inter-organizational resources are limited and most of the times firms have to form alliances with other organizations in order to achieve their strategic goals. In this context, alliances refer to supplier involvement and the buyer-supplier relationship that is formed.

2.2 What is supplier involvement

Originating from the Japanese automotive industry, and especially the automotive companies which where the first to integrate their suppliers in their NPD activities (Clark and Fujimoto, 1991), supplier involvement is the act of forming a partnership with a supplier in which both parties share their resources aiming to achieve a strategic goal regarding a product development project. Innovation is usually the outcome of a collaborative work rather than the individual work of a firm, which is why buyers often access external resources with the scope to obtain a competitive advantage, expressed through involving their suppliers in their new product development department (Luzzini, Amann, Caniato, Essig and Ronchi, 2015).

The integration of suppliers will be essential for buyers if they want to remain competitive. Suppliers are an increasingly important resource for buyers and have a huge impact on cost, quality, technology and time-to-market of new products (Handfield, Ragatz, Petersen and Monczka, 1999). Most of the times, this collaboration has the form of a cross-functional team between the buyer and the supplier, with employees from both sides assigned to a specific task so that they can work closely together for a common cause. Depending on the level of collaboration, various communication funnals are formed, spanning from a few meetings per month or year, to the creation of an in-house team that works closely together for a set period of time.

At this point, it is necessary to clarify that supplier involvement is not the same as outsourcing activities to a partner. Supplier involvement means that both parties are working together and share their resources with the aim to develop a product or create something new, whereas outsourcing happens when a business shifts its operations to a third party, and has no involvement in them.

2.3 Timing of supplier involvement

As studies have shown, there is a close connection between the timing and the extent to which a supplier gets involved (Dowlatshahi, 1999). Depending on the buyer’s needs, the appropriate time to involve any suppliers varies. It
is generally agreed that when technological expertise and intense information sharing is needed, the supplier should be involved early but also that the simpler the tasks, the later the supplier needs to get involved (Handfield et al. 1999). However, in the cases of early supplier involvement (ESI) and since most of the time the product undergoing development is something completely new, the uncertainty of the product is much higher than later on so the contingencies are increased, leading to financial risks and performance failures. During a NPD process, a supplier can be integrated in any of the steps of the process depending on the buyer’s needs.

For each of the stages we mentioned in the previous chapter, there is the possibility that different suppliers will be needed, meaning that a buyer could potentially partner with more than one supplier during the NPD process. The contribution of the supplier to the project is the definitive factor that sets the appropriate time that the involvement should start but that does not mean that a larger contribution is directly linked with an early-stage involvement (Wynstra and Sie, 1996). Factors such as the undertaken risk, when developing a completely new item, or using new methodologies by the R&D department in any of the above stages, are indicators of the right time to partner with an external firm.

Handfield et al, 1999 has provided a diagram that best explains the possible timing for supplier integration:

![Figure 1: New product development process and supplier integration points (Handfield et.al, 1999)](image)

In the same study, the appropriate time to integrate a supplier is closely connected with the life cycle of a product. A new product development process can last long, meaning that it is critical to ensure that by the end of such a process, the developed product is not obsolete in terms of design or technology. More specifically, it is argued that since technology is changing at a very fast pace, it should be the key factor that decides the right timing for the involvement of a supplier. As it is stated in Handfield et al, (1999) research: “there are two major factors that should be considered in deciding when to integrate the supplier into the new product development process: the rate of change in the
technology and the level of supplier expertise in the given technology.” In other words, if the subject of the collaboration is a product or service of a fast-developing technology, then the supplier should be integrated in an earlier stage in the product development stage, in order to have the full responsibility of the project but also establish the technical targets, since they have a better knowledge on the specific technology. For simpler tasks and necessities, it is common that the supplier is involved later on, as their contribution is not critical for the outcome of the project or it is just that they are not needed during an earlier point in the development of the project.

Consequently, it is obvious that timing is closely related to the amount of freedom and jurisdiction that is given to the supplier to manage the whole project and the degree of expertise they possess on the matter they have been appointed for. In general, timing is a dimension of new product development that is closely related to the nature of the product which is under development. There are other elements that should be prioritized and which affect the timing of the integration which, evidently have more impact on the success of the project, such as the selection of the proper supplier that is to be involved based on the expertise they have and their culture which has to fit the one of the buyer’s (Petersen, Handfield and Ragatz, 2005).

Figure 2: Integration of suppliers at different stages (Handfield et al. 1999)
2.4 Extent of supplier involvement

The extent of the supplier involvement varies depending on the amount of information, the technological know-how and the complexity of the project (Clark and Fujimoto, 1991). The more information sharing and transfer of expertise a development project needs, the deeper involvement is required.

Others argue that greater involvement derives from the familiarity the buyer has with the supplier or the experience they have from a collaboration that has happened in the past, which means that they do not need time to build a relationship from scratch, since the relationship has already been established from prior partnerships and can now focus on substantial issues such as aligning the buyer’s needs and the supplier capabilities from both a scientific viewpoint but also from an organizational and cultural viewpoint. In addition to that, the degree of responsibility the supplier has in decision making (mostly with the form of an engineer / designer from the purchasing department being transferred to work with the project development team on a regular basis) but also the technological risks that arise from the attempt to implement technologies with the aim to achieve strategic goals that the company is not familiar with and in some cases not even the supplier. This means in other words that both parties are facing uncertainties not only regarding the cost of the project but also the performance of the product being developed and the potential impact these risks might have on the product performance measures such as the development time (Petersen, Handfield and Ragatz, 2003).

Through their research, Wynstra and ten Pierick, (2000) identified many correlations between supplier involvement and the type of the product that is being developed. Their study was based on the Kraljic Purchase Portfolio matrix which categorizes items based on their impact on total profits and the potential risk they could pose if there is not sufficient supply.

![The Kraljic Matrix](image)

Figure 3: *Kraljic’ Purchasing Portfolio matrix (Kraljic, 1983)*
The Kraljic matrix depicts four categories of products:

- **Bottleneck products**
  - Products that are necessary for the production phase but hard to find.

- **Strategic products**
  - Key parts/products that a company must ensure their availability at all times.

- **Non-critical products**
  - Every-day, low value products that are easy to find and do not need strong relationship with suppliers in order to obtain them.

- **Leverage products**
  - Many suppliers offer those products yet the careful selection of a supplier is important because they have a strong financial impact on the company.

What Wynstra and Eric ten Pierick have found in their research is that the involvement is a more critical element in the development of the product when the whole project is more complicated. According to their study, Strategic product suppliers are involved early, mostly in the conceptual phase whereas bottleneck and leverage suppliers tend to get involved in the engineering phase. Routine product suppliers are mostly involved later on in the development project. In general, as we move to the right side of the Kraljic matrix, the nature of the products becomes more complex, thus demanding a wider extent of collaboration with the supplier. However, the supplier could be involved in any stage in the development phase but that does not mean that the extent is automatically coupled with the stage of the integration. The buyer could be benefited by a collaboration for trivial issues such as a rework in a spare part’s design but also for more significant projects such as the optimization of a product’s performance through the implementation of a radical breakthrough in the development process.

In addition, there are several studies that examine the connection between the level of responsibility of the supplier in the new product development project and the extent in which they are integrated (Handfield et al. 1999, Monczka, Handfield, Frayer, Ragatz and Scannell, 2000). A new concept of supplier categorization has occurred from the above mentioned research that is based on the level of responsibility of the supplier in the whole project:
According to this concept model, there are four typologies of supplier responsibility level depending on the integration of the supplier in the project. The more complex and formal the relationship of the supplier with the buyer is, the more sophisticated the involvement becomes, with the supplier responsibility increasing from “none” to “white box” which is the situation when the supplier is an external, complementary partner and discussions are happening in regards to technical characteristics and specifications to “grey box’ which is when the supplier has bigger influence on the project and in reality cooperates and communicates with the buyer on the same basis and on equal terms and lastly “black box”, when the buyer transfers the responsibility of the development of a product completely to the supplier, trusting their expertise and know-how, providing them with the necessary specifications that have been established by the customers’ needs (Petersen et al. 2005).

### 2.5 The correlation between timing and extent.

Wynstra and ten Pierick (2000) in their study developed a matrix called the Supplier Involvement Portfolio which depicts four types of supplier involvement on the basis of two variables:

1. The degree of responsibility for product development that is contracted out to the supplier
2. The development risk
In this matrix, as we move from bottom to top on the vertical axis, the responsibility given to the supplier scales from trivial issues such as changes in simple technical characteristics, up to the complete design and manufacturing of parts and items. On the horizontal axis, the development risk undertaken by the supplier grows as we move to the right side, meaning that the extent of the involvement increases and so does the impact on the performance of the product being developed.

- **STRATEGIC DEVELOPMENT** (*high development risk / high responsibility*)

In this block of the matrix, the supplier is asked to design an item from start, given only some functional specifications from the manufacturer. This early involvement means that there is a high level of uncertainty because the supplier does not know exactly what the contractor wants, making the development risk higher for the buyer too and a closer collaboration is required by both sides.

- **ARM’S LENGTH DEVELOPMENT** (*low development risk / high responsibility*)

In Arm’s development block, the supplier receives again information about the manufacturing of an item which is why there is high responsibility but the development risk is low since the contractor is not very actively involved in the whole process. The supplier is the main contributor in the development in this block.
CRITICAL DEVELOPMENT (High development risk / Low responsibility)

Critical development is the situation when the manufacturer does not have the required knowledge to proceed in their development process and as a result involves a supplier who will transfer their know-how to help them. This is all happening at an early stage of the development because the manufacturing activities can not take place unless technical and functional specifications can be set accordingly. This is why we can see that the development risk is high for the buyer and the responsibility of the supplier limited to just the information that they have to offer.

ROUTINE DEVELOPMENT (Low development risk / Low responsibility)

In this category, the buyer has no responsibility over the development process and the supplier gets all the specifications and information they need in order to begin the work needed. Frequent and extensive communication is not necessary so it is limited to mostly mails, emails and very few face-to-face meetings, hence the degree of involvement is not very extensive. Both parties know from the beginning what they have to do in their in-between collaboration and what to expect from each other.

What is obvious from the study is that the less expertise the buyer has, the bigger the responsibility its partner bears, so it is wiser, in cases of high uncertainty that the supplier is contracted in the early phases of the development, so that they can set their own specifications and have more freedom to work on the project, otherwise, in the circumstance that they are contracted in a later stage, they will be limited to the specifications that are already set by the contractor. It is also best to involve the supplier earlier when the uncertainty level is higher, due to the significantly increased effort that will be required (Wynstra and ten Pierick, 2000).

2.6 The role of Purchasing in new product development and supplier involvement

Purchasing departments have a significant role in the whole new product development process, accountable not only for their traditional roles of bargaining a good price when purchasing materials and parts, but more importantly, acting as the moderator of the relationship between the buyer and the supplier. In particular, since the purchasing department has the better intra-organizational knowledge of the supplier, it should be responsible for selecting the supplier with the appropriate expertise for the completion of a NPD project (Lakemond, van Echtelt and Wynstra, 2001). Many studies argue that a buyer’s purchasing strategies and knowhow, are factors that influence supplier integration to a very high level, even to determine whether the collaboration is successful or not (van Echtelt, Wynstra, van Weele and Duysters, 2008). Luzzini et al. (2015) in their research on innovation, concluded on two separate prerequisites that lead to innovation performance: supplier collaboration and strategic sourcing. What they also prove though their study is that “a higher level of purchasing knowledge positively influences the effort on supplier collaboration and strategic sourcing.”
Figure 6: A theoretical model on innovation (Luzzini, Amann, Caniato, Essig and Ronchi, 2015)

Regarding the NPD process, purchasing department is in many ways and many forms, responsible for supplier relationship management issues. Since every NPD process is different than the other, there are various different configurations of purchasers’ involvement, with two purchasing bodies involved: purchasing specialists and purchasing coordinators (Lakemond, van Echtelt and Wynstra, 2001):

- **Purchasing specialists** who are integrated into the project development team are working closely with engineers either (a) on an impromptu basis or on (b) part time / (c) full time basis regarding material and technologies used.

- **Purchasing coordinators** are integrated into the project development team in order to coordinate the (d) communication with external partners of the project but they can also be added on a (e) full time / (f) part time basis in combination with the purchasing specialists.

A configuration with a specialist is generally preferred in cases when the new product development project demands knowledge and expertise that a single individual can offer, such as the implementation of a specific technology to the project, whereas a purchasing coordinator is preferred when there are many technologies or supplier or other parties involved in a project and a timely and effective coordination is used in order for the procedures to be conducted smoothly. Configurations (a) and (d) are more suitable for smaller projects where the purchasing department only acts as a complementary body and not a core one, while the rest of configurations require a higher level of collaboration of the purchasing department into the project in order to achieve the results the company aims for. Furthermore, a
purchasing specialist is integrated mostly for simpler tasks contrary to the purchasing coordinator who is integrated into more complex ones and for larger projects, a representative of the purchasing department must be committed on a more frequent basis since there are much more partners involved and parts developed. In smaller projects the purchasing department’s resource allocation can happen whenever there is the need to assist the development project activities (Lakemond, van Echtelt and Wynstra, 2001). Project size and complexity are the dimensions used in the matrix developed in the same research, to explain schematically the appropriateness of the purchasing department involvement configurations:

**Figure 7: Purchasing involvement configurations for different contingencies (Lakemond, van Echtelt and Wynstra, 2001)**
CHAPTER 3: Explaining the model

A more elaborate explanation of the model that was developed for the purposes of this study follows next, where we examine each part of it separately and provide information about what each block in our model consists of and the capacity of those elements on the final performance of the new product development project.

3.1 Antecedents that favor the integration of suppliers

In order to understand better the circumstances under which many companies involve a supplier in their operations, we must first understand which are the predecessor conditions that drive firms to ask for the support of an external partner.

Fast-paced technology advancement is one of the most important factors. Although the reasons for gaining access to new technologies may differ from company to company, this source of innovation is the most prominent and can contribute to innovation more than the others. As technology advances, new methods in manufacturing come to the forefront, new materials with unique properties are replacing the older ones, the organizational structure of modern businesses is changing due to the appearance of new fields of micro and macroeconomics (i.e. Digital Marketing departments) and many other changes are happening in a very fast-moving environment. In this context and in combination with the fact that not every company possesses the mandatory know-how, firms are collaborating with suppliers that hold the necessary expertise to help them reshape their operations through the implementation of new ideas and breakthroughs.

A prime example of why technology dictates new product development projects is the shortening of product lifecycles. According to Moore’s law, the power of computers doubles every 18 months which makes technology change in an exponential rate. Technological rate is the main reason for integrating suppliers in many cases, especially in products that have life cycles less than 5 months such as computers and electronic hardware. For example some companies have a certain department that handles issues regarding new technologies that are introduced in the markets but also provides suppliers with the opportunity to propose new ideas to the company with the aim of a potential collaboration (Handfield et al 1999).

Another important reason that favors supplier integration is the constant endeavor of businesses to retain their competitiveness (Yeniyurt and Henke, 2013). Competitiveness can be broken down to many different elements such as product performance, time-to-market, lowering costs or gaining access to new markets and new technologies (van Echtelt, Wynstra, van Weele and Duysters, 2008), which all can improve the place of a firm among the others. Every business has to monitor the activities of their competitors and try to keep up with them or even be the one that surpasses them. This is arguably a crucial reason to seek innovative ideas, which ultimately leads to involving a
supplier who not only can provide its knowledge and expertise that the business is lacking, but present new ideas that through co-innovation and collaboration with other internal departments of the business, can be manifested in the form of innovations and breakthroughs (van Echtelt et al. 2008).

Lastly, there is high pressure coming from the market itself. Consumers are becoming more sophisticated and value more things than just the product. The added value that originates from the distribution channels, the retailers or from other elements of the supply chain, is something that they are looking forward (Mikkola and Larsen, 2003). From that, it is obvious that supply chain partners can provide valuable information to a company about its customers (which otherwise it would not be possible to collect) that can be utilized within the new product development framework.

3.2 Selection of supplier

Selecting the right supplier is probably the most important element of the whole involvement process. Before reaching a consensus, firms have to consider the basis on which they should collaborate with a supplier and this basis is formed by the examination of specific criteria that have to be met in order to proceed. Those criteria are far different than the ordinary criteria which are used when choosing a supplier for the more traditional relationships between buyer and supplier (Handfield et al. 1999). Not every supplier possesses the same expertise or the same philosophy, making this decision the first and most valuable strategic decision that the buyer has to take. Handfield et al (1999) have identified five elements (in the form of strategic questions) that are to be considered before concluding to the final supplier:

- **Targets**: Will the supplier achieve the goals set and within limited budget?
- **Timing**: Will the supplier comply with the product development schedule?
- **Ramp-up**: Will the supplier be able to handle any necessary increase in the production rate?
- **Innovation and Technical**: Has the supplier the expertise and know-how to implement new technologies and designs?
- **Training**: Do the human resources of the supplier have the necessary knowledge to handle the requirements during the new product development process?

Apart from these questions that should definitely be considered before proceeding to more technical SRM operations, it is important to determine whether the supplier and the buyer are aligned both technologically and philosophically. This is the basis on which a good relationship can be built and consequently enable an unobstructed collaboration between the two parts. Furthermore, there is the possibility that the supplier’s capabilities will also be developed as part of the development project, through the knowledge transfer between the participants (Lawson, Krause and Potter, 2015). This is a desirable outcome because it will aid the new product development effort in the long term, but in order to do so, the supplier must present some basic knowledge and expertise which will allow them to show
progress during the new product development procedure. Those attributes that are needed in the first place, are another source of information for the appropriateness of the supplier.

3.3 The process of involving suppliers

The relationship of buyer and supplier are further discussed in this section. An insight on which are the basic elements of a well – established relationship.

3.3.1 Contracting

After selecting the right supplier, it is the right time to manage the relationship both formally and informally. Formal contracting, in the form of legal contracts, is essential in order to diminish the danger for opportunism and lower the level of uncertainty via a higher level of contracting efforts from both sides (Carson, Madhok and Wu, 2006). In the same study, two types of contracting are specified, formal contracting and relational contracting. Formal contracting is situation where two or more sides agree to terms and are safeguarded; in the case of supplier involvement projects, contracts are agreements that regulate the behavior of the partners involved, highlighting the responsibilities and obligations each side has agreed to meet at the negotiations table. Relational contracting on the other hand, is based on the rationale that non-legal sanctions can also have a desirable result through management of qualities such as mutual trust, reputation and history of past partnerships (Carson, Madhok and Wu, 2006).

3.3.2 Managing the supplier relationship in a new product development environment

Contracting is the fundamental ingredient on which good relationships are built and a formal guideline for the activities and tasks each side has to complete. However, in a new product development environment which is dynamic, a bigger effort is needed by those who are involved to maintain a proper relationship status. There are qualities that are essential in order for this buyer-supplier connection to thrive on the long term. The importance of relationship arrangements is highlighted by Walters and Rainbird (2007), who emphasize on the added value that a network of buyer and suppliers can create in an innovation project and give as example the relationship DELL and other companies have achieved with their suppliers that has led to a massive success.

There are many variables that affect the quality of the relationship in an integrated new product development project; others have greater impact and others are secondary. Sjoerdsma and van Weele (2015) have identified seventeen of these factors and have proceeded in categorizing them from the most impactful to the ones that do not appear to affect the relationship so much. According to their study, after examining more than 123 cases of new product development and innovation cases: (i) trust, (ii) communication, (iii) information and knowledge sharing, (ix) cooperation and coordination, (x) commitment are the first and most prominent factors that modulate the quality of the relationship, followed by more trivial ones such as relationship specific adaptations, satisfaction, dependency and
power, flexibility, reputation, loyalty and relationship history (in the specific given order). Although these factors do not exert the same influence as the five mentioned before, there are cases that they should all be taken into consideration because they could contribute more to the well-being of the relationship than any of the most important. This study will be focusing on the five more important elements, which are the ones that are evidently found to be by many researches of outmost importance and also, they are applicable to all the cases of innovation projects examined.

Trust is the first building block of a strategic alliance. It is defined in many researches as a positive attitude and expectation from one group of people that the actions of another group will be satisfactory (Andaleeb, 1992) and it is coupled with all the other elements that a good relationship consists of. Trust can act proactively to prevent situations like opportunism, protection of information in the form alliances, constrain potential losses due to shortcomings e.t.c. (Seppanen, Blomqvist and Sundqvist, 2007). It is also evidenced that it is easier to resolve conflicts and build intra-organizational team synergies to achieve common goals but also decrease the danger of a partner imitating the other partner’s know-how and R&D methodologies for their own advantage (Knudsen, 2007). The level of trust between the participants is positively associated with the performance of a new product development project; it is an indicator of the well-established communication channels between the cross-organization teams, the transparency of both teams’ activities during the project and can also affect the character of the alliance and the contract model that has been formed (Sjoerdsma and van Weele, 2015). There are multiple researches (Barnes et al. 2005, Seppanen et al. 2007) that highlight trust as the prerequisite factor not only for a robust relationship but also as the cornerstone of long term collaborations and partnerships.

Communication, both in formal and informal manner, is also essential in organizations where alliances with suppliers have been formed. It acts as the prerequisite for setting mutual goals and regulates the coordination between the firms as well as the flow of information (Sivadas and Dwyer, 2000). Moreover, a quite common phenomenon that the collaborating firms experience is a gap in communication due to differences in their businesses’ structure which can be an impediment to the process of knowledge sharing, resulting in information being misunderstood, withheld or lost. This can even be intentional in cases where trust issues are present (Cooper, 1986).

Coordination and cooperation is the element of a relationship quality that forces every partner to bind their resources to a specific cause. Coordination is essential in order to align the projects’ roadmap regarding resources, expectations and responsibilities during the new product development process (Sivadas and Dwyer, 2000). The role of purchasing department is critical in the coordination part as we have mentioned previously in this study, having the responsibility to modulate the cross-functional team so that every side involved is familiar with the practices of the other and the ideas and suggestions of any of these sides are put to the table for examination by the collective knowledge of all involved.
Moreover, Sivadas and Dwyer (2000) have created a single variable named *cooperative competency* where all the above mentioned factors are merged as one. Taking into consideration their interdependency, they propose that they could be addressed as one (among others of more trivial nature) single element that impacts the relationship quality. Beginning with trust, they argue that communication and coordination are vital but unachievable without a satisfactory level of trust adding that mutual adjustments, shared responsibility and trusting behaviors of the participants are attributes that are requisite in order the functions of the strategic alliance to be run smoothly. To conclude, the relationship quality of these specific situations of organizational interdependence rest on the ability the involved members have to effectively and efficiently communicate, trust each other and coordinate their joint operations.

*Information and knowledge sharing* is arguably the ‘fuel’ of the new product development project because it facilitates product innovation through the transfer of resources that are essential for a new idea to be developed. Van Wijk, Jansen and Lyles (2008) define organization knowledge transfer to be ‘the process through which organizational actors – teams, units, or organizations – exchange, receive and are influenced by the experience and knowledge of others’. A supplier can bring new knowledge which can be used to generate new products and positively influence the total performance of the project (Knudsen, 2007). Furthermore, external knowledge that a firm acquires can be utilized in reworking and rethinking past projects and products but this time in a different scope, with a partner’s collaboration; this can also result in innovations and breakthroughs (Sjoerdsma and van Weele, 2015). However, there are various issues regarding the implementation of knowledge transfer. Absorptive capacity, as it is referred in literature, is the ability of a firm to assimilate and apply external information and it is one of most compelling components of knowledge transfer. In addition to absorptive capacity, the subject of the character and the nature of the knowledge is addressed in many studies (van Wiik et al. 2008). Tacit and explicit knowledge are significant in moderating the stream of information sharing between the partners. Explicit information is easier to transfer and assimilate whereas tacit is more of an experience – based, hard – to - articulate knowledge and thus, harder to imitate and comprehend by someone who this knowledge is being given to, rather than experientially acquiring it. In general, information and knowledge sharing is highly dependent on trust and communication; more trust and better channels of communication means better relationship overall, resulting in higher quality knowledge transfer and vice versa.

*Commitment* is the fifth element and is an assortment of all the other elements described above. It is based on effective communication, mutual trust, efficient collaboration and its results are obvious such as the level of information sharing. Barnes, Naude and Michell, (2005) identify many variables of commitment in a dyadic, inter-organization relationship such as a buyer – supplier one: reliability, reputation, co-manufacturing, contracts joint research and investment stakes being some of them. In their research they found that trust, reliability, quality (brand image), quality (reputation), closeness, friendship, communication extent and affection are the ones that have a strong correlation to supplier involvement, both from the buyers’ perspective but from the suppliers’ too.
3.4 The outcomes of the process of supplier involvement

The last part of the supplier involvement model is comprised by the potential outcomes of such ventures. Researching through literature, most of the cases regarding supplier involvement examined conclude in the same results; product quality, project costs, development and time-to-market times are among the most common outcomes of the integration (van Echtelt et al., 2008). Whether these results are beneficial or not is depending the previous stage of the model, the process of integrating the supplier. Ragatz, Handfield and Petersen (2002) have generalized how separate parts of the process have an impact on the outcome of new product development projects, by fitting individual attributes into more general categories which are then examined to measure their impact on the three major result fields: product quality, development time and cost. More specifically, their research proves that the alignment of the buyer’s needs with the supplier’s skills, integrating suppliers that contribute to the project’s knowledge base and more efficient decision making in the cross-organizational teams have a massive impact on the above mentioned results.

*Time-to-market or concept-to-customer* is a common field where changes occur during collaboration with a supplier. The external knowledge that is brought in-house and the communication that is happening on a regular basis either formally or informally, can lead to shorter development times through a more efficient new product development framework; suppliers are actively involved in every stage of the project by providing information, resources and technical know-how (Clark and Fujimoto, 1991). The tasks and various operations that the project is comprised of are distributed to suppliers, according to their expertise, who are responsible for their execution. As a consequence, inter-organization processes that otherwise would be following a specific sequence, can now be occurring simultaneously, hence decreasing the project’s total time of completion (Clark, Chew and Fujimoto, 1987). Furthermore, firms are constantly assimilating new technologies that contribute to lower development times which postulate that they have both the technical and theoretical background to understand their potential and utilize them; background that in not a few occasions is acquired by involving an external partner to work with them (Restuccia et al., 2016).

*Product quality and performance* is another area that results are obvious. Integrating new technologies, attempting to meet the growing expectations and needs of customers regarding more sophisticated items and services or even the smallest of changes in design can have a substantial impact on the end product of a new product development project. The integration of suppliers implies new methods of production and manufacturing are introduced as well as new materials that can be utilized to increase the functionality of existing products (Clark and Fujimoto, 1991). Moreover, the information that is brought into the endogenous environment of the company by external experts who have deeper knowledge of the market, can contribute to the creation of better quality products, driven by the customers themselves. Lastly, the presence of a supplier in the development process ensures that the project is following the right manner in terms of assembly and technical characteristics. This applies to both early involvement when a supplier can establish their own design and specifications but also during the later stages when prototyping
and testing are taking place and in real-time, meaning that shortcomings such as delays and failures are dealt with immediately as they appear (Ragatz, Handfield and Petersen, 2002).

*Cost efficiency* is a third potential outcome. The fact that companies are distributing tasks and subtasks of a project to their partners greatly reduces the resources they have to allocate hence decreasing their own budget. Clark and Fujimoto found in their research in 1991 that the decrease in delays, the lesser amount of defects and flawed parts, the integration of computer-aided systems and prototyping methods all had a positive reflection on the cost of new product development projects; new technology implementations reduce faults, lead times and enable more sophisticated and realistic testing of new ideas. The on-site presence of external partners and their active involvement helped tackle potential problems before they needed a costly solution. Furthermore, early changes and alterations in the product being developed has been proven to reduce cost of the final product by up to 80% while only requiring less than 8% of the project’s total budget. As we move to the later stages of new product development, design changes are much more costly (Ragatz, Handfield and Petersen, 2002).

### 3.5 Feedback and reverse engineering

After the completion of the project, it is sensible that the parts that where involved in such a collaboration, reflect the outcomes of the project on the processes that took place throughout the whole new product development procedure. Beginning from the outcomes and following a reverse engineering analysis, information can be accumulated about how certain results are linked to specific processes. This knowledge can be used to understand the way problems and issues have emerged (if any), which fields experienced shortcomings which later on impacted the procedure but also examine successful factors that enabled the unobstructed conduction of the project.

This activity, the review of the issues that have appeared by looking back at every step of the new product development project, is the fourth block in the model and not less important than the others mentioned at the start. Van Echtelt et al. (2008) after examining many cases of supplier involvement argue that the level of success of new product development projects can be traced back to managerial and organizational issues from both sides. More specifically, the findings prove that the number of shortcomings in every project is decoupled from the level of success, meaning that quantity of issues faced is not affecting the outcome rather than the nature of those issues.

Breaking down the operations discussed in the “process” block of the model into more elaborate and specified activities, what can be observed is that the initial supplier selection is of outmost important when referring to both the number of problems and their significance. During the development of new products various unexpected technical problems may occur which are related to intra-organizational issues as well as conformity of parts to specifications. Roadmap alignment taking too long to be achieved, discussions about contracting and pricing, setbacks during engineering and design, knowledge transfer and communication disruptions are all issues that can rise during the
procedure, which can ultimately even lead to the formation of doubts about the supplier selection at first place. Depending on the severity of these phenomena the buyers can often find themselves in the position of considering a change in the involved supplier mid-project (van Echtelt et al., 2008) which consequently leads to an increase in costs, organizational re-structure, several procedures beginning from scratch and increased production times.

A regression analysis is essential in order to determine what went wrong and at what point during the new product development process. In this context, linkages can be created between low performance in the supplier involvement collaboration and certain actions. Determining which are core operations and which are subsequent, selecting suppliers with criteria that change each time depending on the nature of the project, evaluating them using different parameters but also changing the way the buyer is working with the supplier in terms of communication are dynamic factors and not assumed a priori. For example the cooperation with a supplier without the consent of a specific department or a proper assessment can prove to be disastrous to the outcome of a project; assessing a supplier should be conducted on different basis each time. These cause-and-effect linkages can be used to determine factors that will be used for future collaborations in order to avoid mistakes of the past. All in all, the “feedback” is essentially all the acquired knowledge by a new product development project that a company can use to improve future collaborations, either by building up a more capable supplier base or by changing the organization and management of such ventures; a source of information, both technical and theoretical but most importantly pragmatic. It is extremely hard to know from the beginning how every collaboration with a supplier will progress and what issues will rise every time. What companies can do, however, is accumulate all this knowledge and experience from the previous projects as feedback and use it in order to further evolve and be better prepared for the next.

In order to conclude this chapter, it is wise to present the model in a more elaborate and detailed way. The model presented in the beginning was a simple reflection of an input-process-output model on the supplier involvement in new product development field. After the completion of the research there are more aspects in the whole process that should be depicted in the main model, which from a hypothetical idea can now be depicted as a model which better portrays the reality of the supplier involvement process.
A schematic depiction of the final model:

Antecedents for involving suppliers
- Technology advancements
- Competitive landscape
- Market & Consumer needs

Process of involving suppliers
- Contracting
- SRM activities
- Purchasing & procurement

Outcomes of supplier involvement
- Performance & Quality
- Cost efficiency
- Development times

Reverse engineering & feedback
- Linking processes to outcomes
- Examining the causes of issues and shortcomings
Chapter 4: A pragmatic approach to the conceptual model

In this chapter some findings of various studies will be presented which show some steps of the supplier involvement procedure and their outcomes, all according to the theoretical model.

4.1 The case of ALPHA (Sjoerdsma and van Weele, 2015)

ALPHA company is actively involved in new product development projects. In the specific study, four different cases were presented where ALPHA collaborated with suppliers for the development of new items or the improvement of existing ones. Note that the “antecedents” block of the model is not included because there is not enough information of which force compelled the buyer to collaborate with a supplier at the first place.

4.1.1 Case No. 1

In the first case ALPHA wanted to redesign an existing product to make it more attractive to the consumers and decided to use an internal supplier. Supplier selection was not completed on the right basis so contracting had to be changed in order to proceed. However, the supplier was already familiar with the philosophy of ALPHA which enabled a smooth communication and knowledge sharing procedures; alignment of operations was not hard to accomplish and this was obvious from the outcomes of the project. Time to complete was increased by a little due to the obstructions in the supplier selection process but the positive management of the relationship, the coordination and the level of responsibility have led to a successful product launch within the budget limitations.

A depiction of Case 1 according to the conceptual model:
The second case study of the ALPHA company describes a situation where the new product development project did not go according to the original plan. This time ALPHA wanted to create a totally new product. Beginning with a wrong assessment of the supplier’s capabilities and a wrong allocation of human resources, communication was problematic as well as building trust, since the supplier proved to be underqualified for the task. Knowledge sharing was hindered due to ineffective communication and a lack of physical presence to the supplier’s premises and vice versa. Further allocation of resources from ALPHA, were also necessary for the completion of the project in order to guide the supplier’s operations. In the end, the project performance was satisfactory for both sides, however the whole project took more than estimated and exceeded the initial budget. In this case we could argue that again, supplier selection is of outmost importance and probably the fundamental factor that determines the success or failure of a project. Trust, communication, information and knowledge sharing are proven to be vital along with commitment. Looking back at how ALPHA handled this case, a misjudgment at the selection stage led to their partner underperforming putting ALPHA in a position where it had to increase its efforts to achieve the strategic goals that had been set.

A depiction of Case No 2 according to the theoretical model:
Chapter 5: Conclusions, limitations and further research

The study examines the case of supplier involvement in new product development and tries to encompass the most important aspects in a single model that could potentially be used as a pilot by companies that want to invest in such a business operation. Browsing through literature, the importance of suppliers is highlighted again and again, how they contribute to the new product development projects and what can one expect from a venture like this. The act of reaching out to external partners stems from the realization that the internal resources are limited and that innovation is crucial for the prosperity of a business. After carefully examining several studies, we conclude to a schematic model which, in a very simple fashion, depicts the process of supplier involvement, the dos and don’ts, which parts of an organization are involved and which components of these collaborative projects should every partner be aware of in order this co-innovation environment to thrive.

This study has its limitations too. There is a massive amount of information about supplier involvement and many different aspects to consider. To begin with, this study is based on secondary data which means that the model is not tested in a more practical manner in real-time. Secondly, there are no primary data presented since the both the endogenous and the exogenous environment of firms in the place where the study was completed, is not suitable for businesses to mingle with such operations.

Further research could emphasize more on describing and examining each block of the model individually. Since firms are organizations that change at a very fast pace, the elements of each block are susceptible to change too (i.e. the effect artificial intelligence has on communication and collaboration). Moreover, although the outcomes of the project can be linked to specific setbacks of the process, it is very remotely considered how those setbacks affect the factors of the processes itself, for example how exceeding the time schedule can be traced back to complications in the contracting and negotiations phase and how these complications impacted trust or commitment. In addition to that, there is an open issue in literature (Handfield et al., 1999) that cooperating with a supplier in such a direct manner and for a long time can truly beneficial but at the cost of impairing the ability of the company to work with other suppliers in the same way, since it will be overly-attached to that specific supplier. Lastly, there is the technological uncertainty issue that it is briefly discussed here, but bearing in mind that technology is advancing faster and faster, it is on debate how companies should address situations where implementation of technologies are new for every partner of the collaboration.
BIBLIOGRAPHY


Figure 8: Framework of Integrated Product Development and Sourcing Activities (Wynstra, van Weele and Weggemann, 2001)