ANALYSING NEW PRODUCT DEVELOPMENT PROCESS IN A CLUTCH MANUFACTURING COMPANY

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ABSTRACT

New product development (NPD) is a very important process of bringing a new product or service to market which involves many steps. NPD involves cooperating with organizations within and outside the primary manufacturing company, consequently, the interaction between NPD activities is a crucial success factor. The aim of this paper is to explore the relationship between NPD and SCM in the specific context of the mechanical industry. Based on analysis of the extant literature on NPD and SCM, an NPD framework was first framed; then, a case study-based research was carried out, with the purpose of investigating whether the company adopt the NPD framework proposed, or at identifying different phases to be included in the framework, as well as phases to be eliminated. Findings from this study provide managers with a preliminary picture of the NPD framework that the companies adopt, as well as with some useful guidelines for companies wishing to perform better in terms of NPD.
Keywords: new product development, supply chain management, mechanical industry, case study.

1. Introduction

In order to contest in today's hyper-competitive marketplace, manufacturing organizations are forced to focus on a series of factors that may influence their profitability. The existing literature identifies the three most important factors as cost, quality and delivery of products and services. Moreover, both practitioners and managers recognize that only few organizations can contend for long without successful new product (or service) development and supply chain management (Patil et al., 2002). Enhanced management of these two processes should allow companies to create greater customer value, achieve higher market share, as well as enjoy good profits.

New product development refers to the process of delivering a new product or service to the market involves several steps, viz. idea generation, product design, product engineering, market research and marketing analysis, etc. Companies generally observe new product development as the first stage in generating and commercializing new products within the global strategic process of product life cycle management. In today's environment, NPD is observed as a key factor, mainly due to three reasons: first, the growing international competition; second, the fragmenting and challenging markets; third the diverse and flourishing technologies (Bigliardi et al., 2010). Therefore, greater focus has been drawn on NPD and organizations have been enforced to embrace new product development as an integral part of their strategy, as well as on offering products that are adapted to the needs of targeted customers in order to establish a sustainable competitive advantage and to stay alive in the competition (Calantone et al., 1995; Damanpour and Gopalakrishnan, 2001; Scarborough, 2010). Dexterity in NPD is thus recognized to contribute to the success of many companies (Sun and Wing, 2004). During the last few decades, companies have been compelled to focus more on product quality than on internal competence, and to quickly identify changing customer needs, to develop more complex products to satisfy those needs, and to give higher level of customer support and services (Sheperd and Ahmed, 2000).

SCM defines the discipline of optimizing the delivery of goods, services and related information from supplier to customer (Gibson et al., 2005). It is related with the effectiveness of dealing with final customer's demand by the parties committed in the provision of the product as a whole (Cooper et al., 1997). An efficient supply chain consists of a firm's internal functions (that is, all transformation processes), but also its upstream suppliers, and its downstream distribution channels encompassing the end customers (that is, distributors and retailers). Thus, since NPD involves collaborating with organization within and outside the primary manufacturing

company at all stages of the process, interaction between NPD and SCM is now considered to be a crucial success factor (Ken et al., 2007).

On the basis of the premises above, the aim of this paper is to explore the relationship between NPD and SCM in the context of the mechanical industry, and especially to develop a model that describes the NPD process in Clutch Company. The choice of this specific industry was inspired by the fact that it is a primary industrial sector of India, as demonstrated by the high level of employment and the turnover generated. India, in fact have started to move in becoming the world's largest producer and exporter of automobile components with "Make In India". The competitiveness of the industry relies, inter alia, on excellent, innovative products, know-how and skills and the ability to adhere to customers' wishes. Mechanical engineering is a very wide and distinct sector, covering machinery and equipment; machinery for the production and use of mechanical power, except aircraft, vehicle and cycle engines; machine tools and special purpose machinery. Moreover, the mechanical industry serve as the second sector for importance in the Asian region.

The paper is structured as follows: section 2 of the paper reviews the literature on new product development in general and on the interaction of NPD and SCM. Section 3 details the research methodology followed and reports the preliminary NPD framework for the mechanical industry as developed from the literature review. Section 4 presents the results from the case study, while section 5 presents the summary of the results and introduces the final NPD process as emerged from the results from the case studies. Finally, section 6 completes the paper discussing the main results derived from the study as well as the main limitations and future research.

2. Literature review

NPD is a wide field of the management literature dealing with the design, creation, and marketing of new products, mainly focused at developing systematic methods for guiding all the processes involved in getting a new product to market (Cohen et al, 2000). Companies typically see NPD as the first stage in generating and commercializing new products within the overall crucial process of product life cycle management (Cooper et al., 2002).

The design of the NPD process has expanded throughout the years, and various NPD frameworks have been proposed, both normative and descriptive. Especially, identify three main generations of NPD models can be identified. A first generation (up to the 1980s) introduced the sequential models: here, NPD process was seen as a series of phases to be conducted sequentially, in order to facilitate innovation activities. Klompmaker et al. (1976) and Hanan (1970), proposed a 27-steps model of NPD and a 24- activities flow diagram applicable for non-industrial goods respectively, while McGuire (1973) proposed a similar model for industrial goods. Latterly, during the first half of the 1990s, the "concurrent engineering approach" was commended: according to this approach, the NPD steps were carried out in parallel or simultaneously (Clark and Fujimoto, 1991) and Cooper (1990, 1994), proposed a third generation of NPD models, and described this process as a model for developing a new product from idea to launch mainly integrating discipline into a process, thus allowing the advancement of effectiveness and efficiency. The stage-gate process consists of a series of stages, where essential activities are carried out, that are fulfilled by gates, where interim achievements are evaluated and that function as stop or go and prioritization points where decisions for the future of the project are made. As per the previous creation of NPD models, stages are typically cross-functional and each activity is undertaken in parallel with others so as to boost speed to market. A further characteristic of this model is the role of cross-functional groups of senior managers are called gatekeepers, who manage the gates and evaluate projects on the basis of quality of execution, business motive and quality of the action plan. Today, researchers observe the adoption of the so-called "stage-gate NPD process" as a methodology that is known and widely embraced in companies all over the world (Gronlund et al., 2010).

With reference to the phases to be carried out within the NPD, it emerges from the extant literature that not all steps are same for all NPD projects, nor those steps are necessarily undertaken with the same relative emphasis. Booz et al. (1965) suggested a NPD model composed by six steps, namely: exploration, screening, business model analysis, development, testing, and commercialization. Kotler and Armstrong (1991) proposed a sequential eight-phase NPD process, that starts from the idea generation, idea screening, concept development and testing, marketing strategy development, business analysis, product design and development, test marketing, commercialization of the product developed. Graf and Saguy (1991), by doing the analysis of NPD in the food industry, recommended the subdivision of the NPD process in 5 steps and are screening, feasibility, development, commercialization, maintenance. Urban and Hauser (1993) suggested in their study a sequential and proactive NPD process, consists of 5 steps: opportunity identification, design, develop, test, introduction and life-cycle management.

In 1994, MacFie suggested a 7-step NPD process, stressing the value of time as key factor in the NPD. The steps are: concept generation, concept screening, product development, product testing, packaging development

(including advertising material), first production run, and launch. A similar process was suggested by Fuller (1994), including the following 6 steps: getting ideas (based on the company's objectives and consumer needs), screening of ideas (financial review/feasibility), development, production, consumer/customer trials, and test market.
Pitta (2007), emphasized on the importance of the concept screening and economic viability steps in the traditional NPD process: concept generation, concept screening, economic viability, development, test marketing, and commercialization. Recently, Bigliardi et al. (2010), referring to the results obtained from a case study,
propose a 7-step NPD process, including: identification of the market need and creation of the "idea" of the product; development of the technological solution; pre-testing of the product with selected customers; innovation protection through Indian patents; innovation protection through international patents; product manufacturing and launching in the food packaging market; expansion in different markets.As emerged from the literature review mentioned above, a general model of NPD process has not been fully developed yet. However, most of the models proposed in literature accepts the identification of a series of phases. In the earlier stages, activities generally focus on identifying opportunities and generating ideas, while in later stages the focus on concept development, testing, and commercialization.

Numerous studies have investigated the factors that may influence the results of the NPD process. These factors are various, but among others, the involvement of supply chain players in the NPD process starts to attract relevant attention in both NPD and SCM fields. Collaboration between two or more companies has been identified as a way of achieving benefits in the NPD process, in terms of reduced costs and decreased risk of failure (Parker, 2000). In particular, literature on these matters suggests that a company will perform better if it collaborates with suppliers and customers. Hence, the suppliers and customers role and their involvement in the NPD process has been inspected both researchers and practitioners. In literature, various definitions of supplier and customer involvement in the NPD process have been proposed and more recently van Echtelt (2008) defined supplier involvement as the resources (i.e., capabilities, investments, information, knowledge, ideas) that suppliers contribute, the tasks they carry out and the responsibilities they assume regarding the development of a product, process or service for the benefit of a buyer's current or future product development projects. Suppliers, due to their greater expertise and knowledge regarding the specifications, parts and components, may provide companies with different benefits: first, supplier's involvement can help firms incorporate the expertise and their different perspective to improve solutions or create new methods for product development. Second, supplier's engagement also allows firms to identify potential technical problems and speed up the NPD process (Sun et al., 2010). As far as customers' involvement is concerned, its importance is particularly recognized in the early stages of NPD process (Tan and Tracey, 2007). The involvement of customers in the NPD process may lead to better firm performance and new product success (Gruner and Homburg, 2000), as well as to also speed up the process of adoption necessary for success (Johnson and Filippini, 2009).

From the above discussion, it may be argued that the NPD process on the one hand enables management to maintain the flow of new products with good efficiency, on the other hand it allows to assist in the supply processes and other related activities (such as for example marketing and sales), supporting the commercialization of the product developed (Carillo and Franza, 2006). Thus, companies have to coordinate and address these issues in parallel to enhance profitability (Van Hoek and Chapman, 2006; 2007), and this can be done by involving SCM from the beginning of product development (Gerwin and Barrowman, 2002; Morgan et al, 2001). However, the lack of research addressing NPD and SCM coordination is remarkable (Carillo and Franza, 2006; van Hoek and Chapman, 2007). For instance, in recent time, research by van Hoek and Chapman (2006, 2007) analyzed the misalignment between NPD and SCM, and argued that there is a need to improve the alignment between these activities in order to leverage supply chain capabilities and improve product launch effectiveness. They highlighted the lack of research examining how the different NPD and SCM activities influence each other, the way in which they can be coordinated, what benefits that can be obtained by coordinating them, and what are the requirements to succeed with the coordination. This means that there is a need for research aiming to fill this gap in the literature and to increase the understanding of the whys and how's of NPD and SCM coordination.

3. Research methodology

The research methodology followed in this study consists of three steps, namely:
1. A preliminary analysis of the literature related to NPD and SCM, and the development of a draft of NPD process for the mechanical industry, composed by a number of phases (e.g., idea exploration and generation, idea screening, development of the product concept, etc);
2. The design of a questionnaire, including the steps of the NPD process previously obtained from the literature, to be used as a guideline for the following step;

3. The development of a case study on Setco Automotive ltd a clutch manufacturing company from the mechanical industry, aimed at exploring the way the NPD process is carried out in real scenarios, as well as at identifying different phases to be included in the framework or those to be deleted, and at investigating the relationships between NPD and SCM in terms of resource consumption. From the analysis of the case studies, a preliminary picture of the NPD framework that the mechanical companies use to adopt was derived, together with some useful guidelines for companies wishing to perform better in terms of NPD.
A detailed description of the research steps is provided in the subsections below.

3.1 Research step 1 – The preliminary NPD process

The first phase of the research was a detailed analysis of the literature related to NPD and SCM, including specific studies in the field of the mechanical industry. The purpose of this research step was to elaborate an NPD framework suitable to be adopted by mechanical companies. From the literature analysis, we built a preliminary NPD process, whose structure is shown in Figure 1. The framework consists of eight steps, ranging from idea exploration and generation to product launch; a brief description of the NPD process steps is proposed below.
Step 1. Idea exploration and generation. This step basically aims at discovering opportunities for NPD, and is a systematic search for useful new product ideas, which have potentials to generate business opportunities. The main activity is thus the collection of detailed pieces of information about potential new products; this can be performed by applying different techniques (e.g., market research, brainstorming, or focus groups). Moreover, the identification of the critical customer's needs is one of the main elements of this phase: it is thus necessary that a company shows good communications skills with their customers during the idea exploration.
Step 2. Idea screening. Many authors suggest that the idea generation should be followed by a phase of "screening" (e.g., Booz et al., 1965; Kotler and Armstrong, 1991; Fuller, 1994; MacFie, 1994). Idea screening consists in evaluating and selecting the best ideas generated in the previous step, i.e. the business ideas which show the highest probability of being successful. As a result, during this phase unsatisfactory ideas will be eliminated. To judge the suitability of an idea, some specific criteria can be applied, such as, for instance (Booz et al., 1965; Graf and Saguy, 1991; Pitta, 2007):
- The feasibility and engineering of the idea into a product design (engineering criterion);
- The suitability of the idea to generate a product which will be required by the targeted market and will meet the business needs (marketing criterion);
- The consistency of the idea with the business objectives and economic feasibility (management criterion).
As a result of this step, the company's top management will be sure that only the appropriate ideas will be chosen for further exploration and elaboration. In fact, the main risk of this step is the possibility of choosing ideas that miss one of the above criteria (e.g., they are technically feasible but unattractive to the market). The role of the company's top management is to identify a balance between what has potential to be desirable by the customer and what is technically feasible. However, at this stage of the NPD process, it is often difficult to get precise information about the potential responses of the market to the new product, as well as on the technical requirements of the product (and thus on its technical feasibility). Hence, the company's managers may also rely on their personal intuition when judging new product ideas. This is why the ideas that do not meet the criteria mentioned above are not properly removed; rather, they are temporarily kept aside: at this time, such ideas will not be explored further, but it would be possible to wait for more favorable conditions to develop them.
Step 3. Conceptual development of the product. Conceptual development consists in the definition of the product structure and its main parameters (Graf and Saguy, 1991; Kotler and Armstrong, 1991). The goal is to convert the business opportunities into a feasible solution that meets the needs of external and internal customers. The product idea is sketched by means of a picture or a verbal description, which should also include some preliminary ideas about materials and technologies that could be used during manufacturing. This phase is supported by marketing research, as well as by engineering, research and development and management business functions, who will work together to develop a preliminary model of the product.
Step 4. Test of the product concept. During this step, the conceptual product is tested on a sample of potential consumers (Urban and Hauser, 1993, Booz et al., 1965). By gathering and interpreting the reactions of the customers to the product, the company will be able to understand whether or not the product concept has a potential market attractiveness, so as to justify the subsequent development of the product.
Step 5. Development of the marketing strategy. During this phase, the company will first perform some detailed analysis of technical solutions, finance and market opportunities. On the basis of the outcomes from such analyses, the company will decide whether or not to continue with the product manufacturing phase. This step involves the

exhaustive evaluation of several aspects of the market opportunities identified, including (Kotler and Armstrong, 1991; Pitta, 2007; Bigliardi et al. 2010):
- The definition of the focused market, market position, market share and distribution channels;
- The available technological and financial solutions (e.g., materials, human resources, technical capabilities and manufacturing plants) and the related cost;
- The analysis of the market risks.

The above criteria aim at determining whether the product will reach the sales volume and profit margin targeted by the company's management. This step is completed by the development of a business plan for the product and manufacturing activities.

Step 6. Product manufacturing. This phase involves the design and manufacturing of the physical prototype of the product, and can be supported by external co-makers (Fuller, 1994; Bigliardi et al., 2010). Prototyping is a main part of the NPD process, and aims at reproducing the real manufacturing process, as well as the final product. The final goal of prototyping is identifying possible design errors and removing them when the product is still in the early stages of manufacturing, meaning that only a limited amount of resources has been exploited. Prototyping activities bring relevant benefits to a company, including lead time reduction, cost reduction and quality improvement.

Step 7. Product testing on the market. During this step, the company's top management must ensure that the product (or prototype) has been developed according to the defined technical settings (Fuller, 1994). Appropriate criteria that can be adopted for this evaluation refer to product quality and performance. Moreover, the company's top management should assess whether the efforts required for product development is consonant with the resource allocation plan of the whole NPD process. At this stage, the product (or prototype) is evaluated and tested by means of:
- Instrumental tests, to determine whether the product meets the targeted technical and manufacturing requirements;
- Market test of the prototype on a sample of potential customers, with the purpose of assessing their reactions to the new product.

In the case of a positive result of those tests, the company's top management will proceed with the launch of the product on the market, while in the case the product fails one of the above tests, the manufacturing phase will be revisited and modified.

Step 8. Product launch. During this step, the new product is launched on the market (MacFie, 1994; Booz et al., 1965; Pitta, 2007). After the launch, the company's top management will evaluate whether the new product meets the customer's expectations, and will identify potential gaps between product characteristics and market expectations, to remove them. The sales volume of the product is also monitored by collecting direct data.

The NPD process steps described above are often consecutive; nonetheless, some loops can be introduced in the process in the case a step does not return the desired outcomes (Figure 1).

3.2 Research step 2 - Questionnaire design

In the second step of the research, we designed a specific questionnaire, with the purpose of testing the NPD process steps previously described and to collect further details about those steps. It is articulated into 2 sections. The first one includes questions related to the various stages of the NPD process; for each step, some specific questions are elaborated with the purpose of investigating how the NPD process is accomplished in a real scenario. Specifically, the following questions are asked for the different steps:

Step 1. Idea exploration and generation. In the questionnaire we asked employees of Setco Automotive Ltd about the tools and techniques used to gather information about the potential customers, as well as about the opportunity of collecting similar pieces of information about the competitors. For example, we asked them whether they carry out market research, focus groups, brainstorming or exploit other techniques.

Step 2. Idea screening. We asked employees about the involvement of different business functions (e.g., marketing, engineering and design department, research & development, top management, etc.) in this phase of the NPD process.

Step 3. Conceptual development of the product. We investigated the possibility of establishing partnerships with one or more suppliers during the conceptual development of the product, with the purpose of designing and developing specific components of the product.

Step 4. Test of the product concept. Questions related to step 4 were mainly aimed at investigating whether the company uses to involve its potential customers in the phase of product testing.

Step 5. Development of the marketing strategy. During this stage we tried to understand whether company carry out any specific analyses, such as risk analysis or feasibility studies, to evaluate the product and assess its characteristics.

Step 6. Product manufacturing. At this stage of NPD process, during the case study we asked company about the opportunity of manufacturing directly the product prototypes or, alternatively, of exploiting external supplies during manufacturing.
Step 7. Product testing on the market. Company was asked about the implementation of some specific tests on the product, as well as about the involvement of potential customers during those tests.
Step 8. Product launch. During the case study, we tried to investigate whether the company investigated undertake any specific monitoring activities (e.g., on the sales volume) after the launch of the new product.

The second section of the questionnaire includes more general questions, focusing on the way the NPD process is implemented inside the company. Questions included in this section refer to the use of particular NPD techniques, such as cross-functional teams, concurrent engineering techniques, outsourcing of Research and Development (R&D) activities, partnerships with suppliers and patenting. Moreover, this section of the questionnaire also includes specific questions intended to investigate if the NPD steps are undertaken sequentially or in parallel, as well as the use of specific resources (people, business functions, finance, technologies etc.) required to complete the process steps.

3.3 Research step 3 - Case studies

The questionnaire developed was finally exploited during the third phase of the research, as a guideline to carry out a case study on Setco Automotive Ltd's new product development process. Hence, the third phase of the study was based on a case study research, which, according to Voss et al., (2002), is an appropriate methodology to be adopted when trying to describe or explore relatively new phenomena. In the present study, the case study-based research was exploited with the purpose of:
a. investigating whether the companies analyzed adopt (partially or totally) the theoretical NPD framework resulting from the literature analysis;
b. identifying some additional phases to be included in the theoretical NPD framework, or, alternatively, some steps to be removed from the NPD process because they are not implemented in real cases;
c. investigating the relationships between NPD and SCM in terms of resource involvement;
d. validating a general NPD process for the mechanical industry.
The case study carried out can be considered as sufficient to give an account in an empirical research when the purpose is mainly explorative (Rowley, 2002). Questionnaire with open-ended questions are a typical tool to support case study-based research (Barnes, 2001). Interviews mainly involved representatives from the engineering and design department of the company.

4. The case study on new product development process at Setco Automotive Ltd.

4.1 Overview of Setco

Incorporated in May 1982, and listed on the BSE, Setco is the largest manufacturer of Premium Quality Lipe brand clutches for commercial vehicles in India. The company employs more than 1200 people globally. It is a Tier I supplier of clutches to all the prominent Indian commercial vehicle manufacturers such as Tata Motors, Bharat Benz, Ashok Leyland, Man India, Mahindra & Mahindra, Volvo – Eicher Commercial Vehicles and Asia Motor Works amongst others. Setco has all the required global quality certifications such as TS 16949, ISO 14001, OSHAS 18001 and VDA 6.3.
Setco's major manufacturing is in Kalol, Gujarat, it has a fast expanding facility in Sitarganj, Uttarakhand. Setco has set up a state of the art R&D centre at Kalol certified by the Department of Scientific and Industrial Research, Government of India to design, develop and validate full clutch systems. It also has a research and development centre in UK.

4.2 The NPD process

As previously mentioned, in the second part of the interview, we first investigated the way the preliminary NPD process is implemented inside the company, as well as the use of specific NPD techniques (such as cross-functional teams, concurrent engineering techniques, outsourcing of R&D activities, partnerships with suppliers and patenting processes). During the case study we found out that Setco carry out all the phases of the NPD process proposed. The adoption of specific NPD techniques was thus explored.

We investigated the adoption of the main techniques as resulted from the previous phase of literature review, namely market research, focus group, brainstorming, feasibility analysis, as well as product tests, risk or sensorial analysis. Results suggest that almost all the techniques investigated are adopted in the first step of the NPD process proposed (i.e., "Idea exploration and generation"). As regards the analysis of competitors Setco confirm the relevance of this point to the NPD process. A particular attention is paid to the identification of the customer's needs and exploit direct relationships with customers to this purpose. In addition to direct contacts with the customer, it exploit appropriate techniques, such as focus groups, brainstorming and market research, with the purpose of collecting information about customers.

During the second step of the NPD process, it develops a feasibility analysis. Specifically, company's engineering and design department and R&D department, as well as the top management are directly involved in the "Idea screening" phase.

External actors belonging to the supply chain, such as suppliers and customers, are usually involved in the third and fourth phases of the NPD process. As far as the conceptual development of the product phase is concerned, Setco use to involve suppliers in this phase only occasionally. Customers are involved during the step of "Testing of the product concept".

During the "Development of the marketing strategy", Setco carry out risk analysis. Setco manufactures prototypes of the product during the "Product manufacturing" step. From the interview, it emerged that Setco acquire external supplies that mainly include components, standard parts, as well as machines to be integrated in the plant manufactured by the company. In some cases, company also purchase software from external suppliers.

During the "Product testing on the market" phase, Setco involves customers to test the product. Often, customers ask for specific tests to be performed on products or plants before they are purchased. More precisely, the clutch is fitted in vehicles for testing and are operated for some months on the roads; if these tests are satisfactory, the product gets clearance signal from customer and further process proceeds. In the final phase of the NPD process (i.e., "Product launch"), none of the NPD techniques investigated is adopted.

4.3. NPD process and SCM: findings from the case study

We then explored the resources adopted by the company during the NPD process, in terms of human resources, time, technical and technological resources. On the basis of the outcomes, we can elaborate some findings related to the NPD process, as well as to the relationships between NPD and SCM, with a particular attention to the involvement of supply chain players and the resources utilization in the different phases of the NPD process.

Table 1 summarizes the main outcomes obtained from the case studies, in terms of the techniques adopted with a particular attention to the different steps of the NPD process, the techniques adopted and the resources utilization by the company in the different steps.

NPD Process Steps	Techniques used	Time resources utilization(Days)	Human resources utilization (Number of people)	Technical resources utilization (% on the amount of the resources available)
1. Idea Exploration and generation	Techniques for data collection from the customer: -Market research -Focus groups -Brainstorming -Direct contact with customers -Competitor analysis	20-30	10	40
2. Idea screening	Feasibility Study Business functions involved: -Marketing -Engineering and R & D -Top management	10-15	10	70

	-Production engineering team -Sales department			
3. Conceptual Development of the product	Suppliers involvement for product development	60-90	10	50
4. Testing of product concept	Customers involvement for product testing	30-45	5	2
5. Development of marketing strategy	Risk analysis	20-30	5	2
6. Product manufacturing	Prototyping Involvement of external suppliers	30-40	20	10
7. Product testing on market/ Fields	Product testing on a potential group of customers and trail fitments in vehicles	60-90	10	5
8. Product launch	Batch production	10-15	20	4

Table 1 Summary of the results from case study

As a result from the case study, it emerged that, in general, the preliminary NPD process was suitable for implementation in Setco; however, not all the steps proposed in the theoretical NPD process are followed but most of them are followed.

5. Discussion and conclusions

NPD is a focal point of competition, leading to higher product quality and higher company's performance (Sun et al., 2010). The NPD activities, ranging from idea generation to market launch, are recognized to greatly influence the company's innovative performances, thus the interest towards this discipline has growing during the last decades. Contextually, throughout the years various NPD models have gradually emerged. Notwithstanding, a general model of the NPD process has not been developed yet. Moreover, the review of the extant literature highlights that in NPD a company usually acquires external knowledge and resources from the external context, in particular from the involvement of suppliers and customers in the NPD process.

On the basis of these premises, the objective of this paper was to explore the relationship between NPD and SCM in the distinct context of the mechanical industry specifically a clutch company. On the basis of the analysis of the extant literature on NPD and SCM, an NPD framework has been developed, composed by eight phases, namely: (1) idea exploration and generation; (2) idea screening; (3) conceptual development of the product; (4) test of the product concept; (5) development of the marketing strategy; (6) product manufacturing; (7) product testing on the market; (8) product launch. Then, a questionnaire was designed and used as a guideline for case study on Setco Automotive Ltd. From the analysis of the case study, it emerged that the preliminary NPD process was suitable for implementation in all companies examined; however, not all companies precisely follow all the steps proposed in the preliminary NPD Finally, we explored the resources adopted in terms of human resources, time, technical and technological resources in each step of the NPD process. Results show that the third steps of the NPD process is particularly time-consuming, while manufacturing activities are those that require the most relevant human resources. Finally, as regards the technical and technological resources, results show that the step of "Conceptual development" requires a significant effort.

Findings from this study provide managers with a preliminary picture of the NPD framework that the mechanical companies use to adopt, as well as with some useful guidelines for companies wishing to perform better in terms of NPD. Even if we believe that this paper may represent a valuable basis for future research on the NPD issues, we recognize some limitations of the study, mainly due to two aspects: first, the research methodology adopted, second, the restriction of the investigation to a specific sector. Qualitative research approaches based on in-depth interviews and case studies as our research may help to

charter relatively new phenomena as well as to develop theories (Eisenhardt, 1989). Especially, Yin (2009) justifies the use of a case study where a rare or unique event is explored, to probe the how and why questions in great detail. Future research should broaden the scope by studying NPD in a broader sample of companies belonging to the same industry. As for the second limitation, the application of data from just one particular company clearly reduces the number of observations, but has the advantage that firms are relatively homogeneous (Kraft, 1990). A possible future research direction is thus to extend the analysis to different contexts and to compare the resulting outcomes.

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