

CUSTOMER INTEGRATION IN THE PRE-DEVELOPMENT STAGE OF NEW PRODUCTS: MANAGEMENT PROCESS PROPOSAL

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ABSTRACT

The aim of this paper is present a process management support to customer integration in the pre-development of new products. The proposal was conceived from a literature review and case studies in five Brazilian companies of the capital goods sector. The process consists of three stages: prospecting customers and their needs, selection of customers and customer integration in pre-development. Each phase involves specific activities and tasks. Decisions and operationalization of this management must occur in Managers level, responsible for the functional areas of Marketing, Sales and Engineering. The main focus of the customer integration en the pre-development of new products is to obtain information more accurate on market needs current and future, thus enabling: 1) translating those needs into opportunities to generate new products and / or new businesses with low risk of failure, 2) improve the attributes and its perception in the market of products offered by the company.

Keywords: user centred design, early design phases, collaborative design, customer integration, capital goods

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1 INTRODUCTION

The literature in Marketing and Product Engineering highlights the importance of Customer Integration (CI) in the Product Development Process (PDP) to improve the efficiency and effectiveness of this process. Meanwhile, the literature review about the practice of customer integration in the PDP (Kaulio, 1999; Prahalad and Ramaswamy, 2000; Dhalsten, 2004; Lagrosen, 2005; Enkel et al., 2005; Gassmann et al., 2006; Lettl, 2007; Hemetsberge and Godula, 2007; Griffin et al., 2009) shows that this integration was studied only in specific situations and without a vision of management of their activities.

In PDP management (Clark and Wheelwright, 1993, Cooper, 2001; Creveling et al., 2003; Kahn, 2005; Pahl et al., 2005; Rozenfeld et al., 2006; Morgan and Liker, 2006), there is a lack of customer integration management studies, either through its role in the management PDP or in PDP specific activities.

These precedents show that there is a gap between what is recognized that customer integration improves the efficiency and effectiveness of the PDP, and what actually there is in literature about characteristics of this integration.

A premise of this paper is how the customer integration with market information, knowledge and ideas, in the pre-development of new products, can influence the PDP performance, for a better fit of the new product to the customer needs.

Moreover, customer needs vary according to industry and market segment, and change over time. In some sectors, the priorities of needs are more than aesthetics and appearance of the product, such as in the fashion industry. In other sectors, the needs are of technological content, such as in the computer industry, or with greater expectation of benefit in the use of the product, such as capital goods.

In the capital goods industry there is a greater expectation to the technical and economic performance of the product, once machines and equipment will be used in production processes of customers. In this sense, it is relevant for machinery and equipment manufacturers to understand the real needs of customers in order to design, develop, manufacture and deliver to the customer what the production process requires. The quality of the machine or equipment will define the costs of the production process for the customer.

The capital goods industry, and specifically its PDP, is the object of study in this paper. This sector is important, once the product innovations occur with high influence and participation of customers. The customers of this sector are the main source of ideas for development of new products.

The research question that motivated this study was: which phases and activities should compose a structure for managing the customer integration in pre-development of new products in the company's capital goods sector? This paper aims to present a proposal for management process of the customer integration in pre-development of new products. The customers, considered in the research, refer to employees of client companies.

2 CUSTOMER INTEGRATION IN PRE-DEVELOPMENT OF NEW PRODUCTS

The product development process, which is one of the main business processes of the company, is situated in the interface between the company and the market, is aimed at identifying and anticipating market needs and propose solutions through new product projects that meet those needs.

In this study, it is adopted the structure of Rozenfeld et al. (2006), in which the PDP is divided into three macro phases (pre-development, development and post-development). The macro phases of pre and post-development are generic and can be applied with small changes in all types of business. And the development macro phase emphasizes the technological aspects of the definition of the product itself, its characteristics and means of production and that it should be adapted to the reality of each project and industrial sector.

The Pre-development of products refers to activities generating and evaluating ideas for new products. It must assure that the strategic direction defined in the strategic planning of the company, the ideas of internal and external actors involved with the products, and the opportunities and constraints, are systematically mapped and transformed into a set of projects (Rozenfeld et al. 2006).

Customers are the key external partners in the PDP. Studies conducted by von Hippel (2001), Kujala (2003), Bonner (2005), Lettl (2007), Sandmier (2007), propose the customer integration in PDP activities of companies.

Several definitions are cited for Customer Integration. Considering the purpose of the study and the means used to achieve it, the definitions can be grouped into two perspectives: process and purpose. From the process perspective, involving such definitions: participatory innovation (Buur and Mattheus, 2008), co-development (Neale and Corkindale, 1998) and interaction with customers (Kaulio, 1998; Kujala, 2003; Gassmann et al., 2006). Thus, customer integration can be seen as a process in which the company interacts with its customers in the PDP. From the purpose perspective, related to the creation of value, involving such definitions: increases customer satisfaction (Kristensson et al., 2004), reducing failures in launching new products (Enkelet al., 2005) and generation knowledge (Pals et al., 2008).

3 RESEARCH METHOD

The research method adopted was literature review and case studies in five companies of the Brazilian capital goods industry. The literature review was conducted through a bibliographic systematic review, covering the period from 1980 to 2008 and had as keywords: Product Development, Product Innovation, Customer Integration, Customer Involvement, User Involvement and User Integration. 78 articles were identified.

The case studies were conducted through interviews in each organization with: commercial manager, engineering manager, marketing manager and technical manager or quality coordinator. Interviews were done individually. After finishing one interview, collected data was analysed, and the information was used for the next interview.

Data analysis was performed for each case and subsequently between cases. For analysis of each case it was used triangulation of data: interview data, documents obtained from the interview, and observations and information from the company site. As for the intercases analysis, we used a matrix relationship between the cases. Table 1 describes the main characteristics of companies.

Table 1 – Characteristics of the companies

	Firm A	Firm B	Firm C	Firm D	Firm E
Product	Machinery and equipment for processing of citrus fruits.	Hospital surgical equipment; Hospital laundry equipment; Orthopedic implants.	Machine tools metal cutting; Plastic Injection; foundry machines.	Hospital medical equipments; Equipment and systems for military area; Equipment/ systems to space field.	Perforating systems; Filtration systems industrial; Systems of pumping.
Size (revenue)	Large size	Large size	Large size	Large size	Medium Size
Exportation	South America and U.S.A.	South America, Central America, Portugal, Middle East and Africa.	South America, Central America and North America	South America and U.S.A.	South America and Central America.
Certification	ISO 9001:2000; CE Mark; FDA Mark.	ISO 9001:2000; ISO 13485:2003; RDC-59; CE Mark.	ISO 9001:2000; ISO/TS 16949; ISO 14000; CE Mark.	ISO 9001:2000; ISO 13485:2003; RDC-59; CE Mark; FDA Mark.	ISO 9001:2000; ISO 14000.

The CI management process proposed was obtained by crossing between the bibliographic review and the case studies knowledge. This investigation procedure, according to Eisenhardt and Graebner (2007) and Yin (2003), becomes feasible by allowing the researcher tools for the generation of knowledge.

4 CUSTOMER INTEGRATION PROCESS IN PRE-DEVELOPMENT OF NEW PRODUCTS

The process approach to customer integration in pre-development of new products, with phases and activities is justified, once, with over time, these activities are repeated on multiple projects. It is expected that the management of the activities of customer integration, increases the maturity and supports the improvement of PDP performance, over time.

The structure proposed for the CI process in pre-development is composed of three phases (Figure 1) and it results in a set of ideas for new products and business opportunities for the company. This information is valuable for the strategic planning of the company's products, specifically for setting the objectives and goals for new products and defining areas of operation in terms of product families.

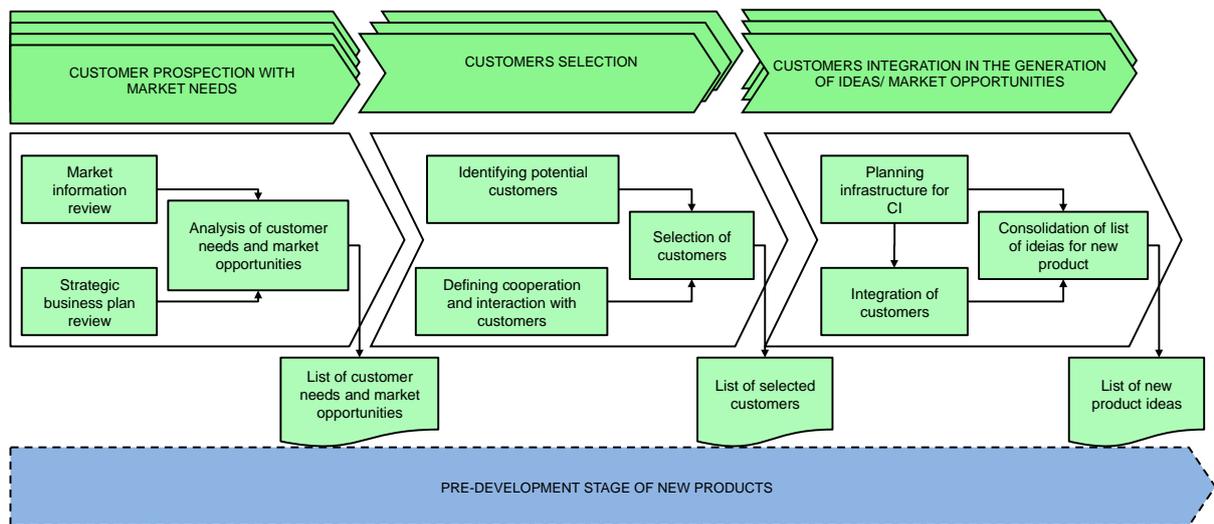


Figure 1. Customer integration process in pre-development of new product development

The operationalization of the CI process requires roles and responsibilities to be defined. The proposed process defines roles for actors in the PDP. Each one represents a particular role and responsibility in CI process. The roles are defined for: directors, functional managers, project manager, specialists, strategic planning team, development team, project evaluation team and customer integration team.

4.1 Phase 1 – Customer prospection with market needs

The purpose of this phase is to prospect customer needs and/or market opportunities, in aggregate, open to different market segments. Its activities involve: reviewing market information, reviewing strategic business plan and analysing customer needs.

Activity 1.1 - Market information review

Companies generally have more than one type of source of market information through reports. Reports (Table 2) are documents resulting from the organization of market information.

Table 2: Documents with customer information

Type of report	Previous activity
Report of customer meetings	Formal meetings that the company organizes for its customers
Database of customer demands	Elaboration of reports of customer orders not attended
Report the results of customer survey	Research with customers about their satisfaction with the product and service
Report customer complaints	Archive or historical complaints made by customers and organized by time period
Reports of technical visits to customers	Visits of sales staff and technical assistance to customers
Report of suggestions program	Programs for customer participation with suggestions to improve an existent product or suggest ideas for a new product
Report of observations of customers	Programme of the company in order to know customers' needs in product usage
Report of company members participation at events or conferences	Company participation in events organized by customers or that involve customer participation in these events
Report of dealers and retailers	Report prepared by the distributors of the company's products on customer needs

The tasks, which involve the analysis of market information documents, should be made, filling in the matrix Need-Source, as shown in Table 3.

This matrix crosses the information on market requirements. The result shows the needs identified in the reports and customers demanding these needs.

Activity 1.2 - Strategic business plan review

The purpose of this activity is to update the company strategic information, which will serve as guidelines to define business opportunities and/or new products.

The revised strategic business plan should answer the question about the scope to be reviewed. The structure of the revision proposal is contemplated in Table 4.

Table 3: Matrix Need-Source

Market need	Source				
	Client A	Client B	Client C	Client D	Client E
N1. Machine with higher speed and lower noise	“Report of customer meetings” and confirmed with “Report of observations of customers”	-	-	“Report of suggestions program”	-
N2.					

Table 4: Structure to review the strategic business plan

Item of business plan	Question that must be answered
Market	Which are the main markets of the company? How is the company's participation in those markets?
Products	What are the products offered to the market? What are the performance objectives defined for these products? What is the competitive positioning of products on the market?
Customer Relationship	What types of relationships are maintained with clients? What Relationships types are most effective?

Activity 1.3–Analysis of customer needs and market opportunities

With the information from the Need-Source matrix and having revised the strategic plan, potential market needs are analysed and identified. In this activity, the use of Delphi technique becomes important to classify the degree of importance for each of the prospected needs. At the end, there will be a list of customers whose needs represent potential opportunities for the company.

4.2 Phase 2 – Customer selection

This phase aims to select customers within a market to obtain information about the needs and opportunities obtained in the previous phase and also to serve as a source of information for market needs and new product opportunities.

Activity 2.1 –Identifying potential customers

The customers whose needs represent potential opportunities for the company must be considered in this activity. Furthermore, it needs to consider other customer groups to take part in CI activities. The company must find out which customers have the potential to participate in these activities.

Prahalad and Ramaswamy (2000) and Von Hippel (2005) propose to "Lead users" as a potential source for generating opportunities and/or ideas for new products and businesses. Still, Von Hippel (2005) proposes that identification of "Lead users" depend on the market. In the consumer market, and considering a specific trend, lead users can be identified by appropriate market research, as those who consider most significant attributes value to the product. In the industrial goods market they are identified by their performance and innovative effort on its market.

Since the client, considered in this paper, is a company, the “Lead Users” are employees of the client company, who fit the profile of the criteria in Figure 2, and will use the product. To identify the "Lead users", it may be considered the procedure shown in Figure 2, which is an adaptation from Lettl (2007). It starts from a database of clients that Marketing and Sales team accumulated over the time. The update of database must be conducted by team of sales, engineering and technical assistance.

The first criterion for selection is whether the customer has a problem and what is their interest in resolving it. If the answer is positive, it is passed to the second criterion, related to technological upgrading, for example if the customer is the first to adopt new technologies. For customers who attend these requirements there is a third criterion. For example: customers take time to creative thinking and customers have access to multidisciplinary knowledge (through relationships with research groups).

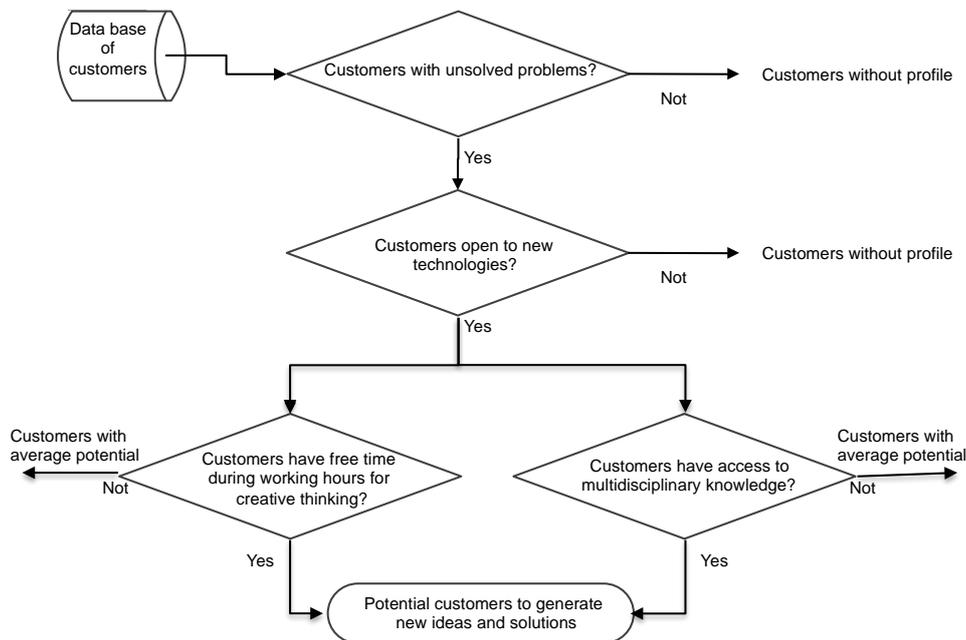


Figure 2 - Selecting clients "Lead users" (adapted from Lettl, 2007)

Customers who meet that profile have high potential to participate in the activities of generation of new ideas or to improve the features of existing products. Besides the two groups of customers (customers with requested demand and Lead Users) it should also be considered customers partners, including distributors and authorized service network.

Activity 2.2 – Defining cooperation and interaction with customers

This activity aims to avoid problems of customer relationships that may come up during or after its integration into Pre-development. There is the need to consider the type of cooperation that customers must have with the company.

The cooperation on PDP activities between customers and manufacturers, in general, has a motivating factor for customers: the consideration of manufacturer to contact the customer and also the materialization of his idea in the project. Studies conducted by Sandén (2007) and von Hippel (2005) suggest that customers with innovative features are motivated by the attention received from the manufacturer to their contributions, in the PDP activities, more than the financial return of their contributions.

On the other hand, for customers named "Lead users", it is this cooperation that will get solutions to their current problems. In these cases, it is necessary to define cooperation agreements.

Three types of interaction are considered in the model structure: Participation in focus group meetings, participation in observation of customers, and interaction online. Some considerations that must be taken into account when using one of the interactions:

Interaction in focus group meetings - the participation of representatives of customers in these meetings should happen with prior notice and approval of their companies:

- a) Contact customers (employees of customer) for participation in the meetings
- b) Send a letter of invitation for the customer to participate in the meetings
- c) Contact the superior head about information meetings.

Interaction in observations of customers - This type of interaction requires the customer to authorize to visit the team with the necessary means for observation:

- a) Letter of solicitation of technical visit to the client company
- b) Approval of the client company
- c) Presentation of observation activities and list of support equipment
- d) Definition of responsible by the client company for the visit
- e) Prepare the program of observation in client.

Interaction online - In this type of interaction the company has an online portal of communication with their customers through incentive programs involving customers with new product ideas and/or ideas for improving existing products and to propose solutions to existing technical difficulties. The

Company E, of the case in study, has implemented with success this interaction type and as a result launched in the past two years, two new products.

Activity 2.3 – Selection of customers

One of the important factors in the selection of customers is associated with customer cooperation with the manufacturer. This cooperation may be affected by: lack of a good communication between the customer and the company, relationship undefined and customer culture organizational.

The customers selection can be carried out using one elimination criterion and two classification criteria: customer with cooperation availability; customer (partner) for activities of observation and; customers "Lead users". Each of these criteria has its virtues. For customer (partner) observation there is an advantage to obtain knowledge about customer needs by observing their work environment. For customers "Lead users", it is through interaction with these customers that the company can acquire not only knowledge about market needs, but also solutions for those needs (Lettl, 2007).

In the case that is defined partner to be observed, it is recommend using the criteria: a) Potential of customer for sales; b) Customer manufacturing process opened for visits; c) Potential of customer that can use the company products.

If the goal is to select customers "lead user", the criteria are: a) The customer is dissatisfied with existing solutions, b) he/she is innovative, c) suggests new solutions, modifying existing products, c) has knowledge about products application d) has technical knowledge about the products.

In order to guarantee a more objectively selection, the Customer Integration team (staff of Marketing, Sales, Engineering and/or P&D) must choose quantitative criteria for customer selection. Table 5 shows a way to evaluate and score customers. Each of the criteria can be analysed at four different levels: -1 (no pass/bad), 0 (can be/Unknown), 1 (meets/good), 2 (meets the highest degree/very good). The weights for each criterion were obtained from the business model used by Shurter enterprise (cited in Kausch, 2007).

Table 5 – Scoring of customers by criteria

Criterion	Weight	Client A	Client B	Client C	Client D	Client E	Client F	Client G	Client H
1. Availability for cooperation									
a) Possibility of communication	70%	2	1	1	1	1	0	2	2
b) Great relacionamento with the company	30%	2	2	2	2	2	0	1	2
Score	100%	2	1,3	1,3	1,3	1,3	0	1,7	2
2. Partner of observation									
a) Customer significance relative to sales volume	40%	0	1	1	2	0		1	2
b) Manufacturing process open to visitors	40%	0	2	0	1	0		2	2
c) Potential of customer that can use the company products	20%	2	2	2	2	1		2	2
Score	100%	0,4	1,6	0,8	1,6	0,2	0	1,6	2
3. Lead user									
a) Is dissatisfied with existing solutions	20%	0	2	1	2	0		2	2
b) Is innovative	20%	2	2	2	2	1		2	2
c) Suggests new solutions, modifying existing products	20%	0	1	0	1	0		1	2
d) Owns knowledge of product applications	20%	2	2	2	2	1		2	2
e) Owns technical knowledge	20%	1	2	1	2	0		1	2
Score	100%	1	1,8	1,2	1,8	0,4	0	1,6	2

The criterion of cooperation availability is critical. If there is no possibility of communication with the client, concerning language or cultural factors, or if the company does not relate well with customers, there is no possibility of CI. In the example of Table 5 is the case the “client F”.

The groups of criteria "partner for observation" and "lead user" assessment aim to find right customers with that profile. Scores offer a fair selection of candidates and allow getting customers that meet these profiles. In the example of Table 5, the “clients H, B and D ” have a good profile to participate in the CI.

This way, a company interested in IC should organize their portfolio of clients based on the three criteria evaluated. The main information of the portfolio (Table 6) should include: customer, product line, specification of equipment and staff that will support the integration of customers.

Table 6 - Portfolio of Customers

Customer	Product line	Specificity	Team
Company H	Medical equipment	Lighting operator	- Juan (marketing); Adán (engineering); Luis (technical assistance)
Company ...			
Company F			

4.3 Phase 3 – Customer integration in the generation of ideas and market opportunities

For the management structure of CI which focuses in the capital goods industries, it is proposed the following types of customer integration: 1) Participation in virtual environments, as a portal of relationships between the enterprise and customers, 2) Participation in interviews to know their needs or business opportunities, 3) Participation in focus groups meetings, 4) Observing customers in their use environment of the products. For this, the activities of this phase are related to the organization, planning and execution of joint activities between the CI team and selected clients.

Activity 3.1 – Planning infrastructure for customer integration

Depending on the customer integration type, the infrastructure should be planned. In case the company chooses integration through interviews with customers in their work environments, this activity will consist of detailing the logistics of participants dislocation and coordinate date and interview schedules. Planning the interview process is crucial as well as scheduling interviews with company representatives. Kausch (2007) suggest that staff (employees of Client Company) participation in the interviews be: users of the product and also those who decide to purchase the product (purchasing manager of the company).

For the CI in focus group sessions, the activity is focused on the setting of the infrastructure (either external environment or the company's own headquarters), the logistics of dislocation and permanence of customers. It recommends using a checklist to avoid leaving out items or disregarding critical tasks. In the case of the CI through observation, the team of the company will have to dislocate to the client company. Team members should be trained according to principles of empathy. Leonard and Rayport (1997) recommend, also, including in the observation team, members from other areas of knowledge, such as psychologists and anthropologists.

The infrastructure planning for this type of IC includes the displacement of the company team, the visit procedure, the recording equipment and filming (with prior approval of the customer company). The procedure should include visiting the site and especially the place of use of the company's products.

Activity 3.2 – Integration of customers

The customer integration activity is the "moment of truth" in which the company team interacts with customers according to a defined objective. The company team must have skills in human relations (Jacob, 2006), once this ability can be a facilitator or inhibitor of interaction activities.

In the case of integration through interviews, it is recommended to follow the procedure of interviewing and listening to the customers as much as possible, taking care at the same time, do not get side-tracked interview. When there are several respondents, it is recommended that the interview be conducted one at a time, with a break between an interview and another. After the first interview, the team must perform an analysis of the information. This information is relevant to prepare questions for the next interview.

Customer Integration into focus group sessions should be initiated by the presentation of the company and the objectives that is sought with this event. Then, it must be shown images of market trends, known by the company, in order introduce to all of participants the current and future customer needs. For customer participation, a brainstorming session initially and the Delphi technique in a second time are necessary. The combined use of these techniques involves some tasks: a) Listing of ideas and opportunities cited by the participants, b) Classifying product ideas and business opportunities, c) Listing strengths and weaknesses of the company's current products market, d) Ranking ideas in the order of priority, e) Using the Delphi technique to assess opportunities and ideas generated, e) Finding consensus of needs and ideas raised.

Customer integration through observation of customers must happen at first in a passive way for observers, writing down and recording facts and events that catch their attention. A second moment should be of reflection about the observing and making constructive criticism to the current form of labour and product use (machine and/or equipment). A third moment is to ask questions to the observed ones, taking into account a minimum number of questions.

Activity 3.3 – Consolidation of list of ideas for products and/or business opportunities

After customer integration, the information should be analysed and consolidated by the team in order to use in strategic planning meeting of the company products. Table 7 presents the information necessary for its consolidation.

Table 7 - List of ideas and / or new product opportunities

No.	Idea/opportunity	Source	Need	Target market	Technical feasibility	Economic feasibility	Competitive advantage
1.	Machines/equipment with own cooling system	Client C	Market trend for use of integrated systems.	Automakers	Medium	High	New line of products and will be first in front of their concurrent
...							

The managers of marketing, sales and engineering will be responsible for this consolidation and supervised by the direction of the company. The evaluation of the CI must be made by the direction of the company considering the criteria: a) results achieved - number of ideas and/or business opportunities, number of participating clients, business links generated, b) resources used, c) self-assessment teams, d) IC assessment method for resource invested and outcome.

5 IMPLICATIONS AND FINAL CONSIDERATIONS

The management structure of CI proposed aims at covering the gap between what is recognized (that customer integration improves the efficiency and effectiveness of the PDP) and what actually exists of knowledge available in the literature on management of customer integration in Pre-development. Its configuration by phases, activities and tasks follows a process approach and is a process of support at Product Development Process. This approach enables activities to be improved over time, by repetition in different projects. Accordingly, the proposed process is the construction of a theory, in which the activities of CI can be performed systematically by companies.

Their use focuses on capital goods companies, specifically those companies that conduct transactions Business to Business. However, companies from other sectors can also use as a reference for generating product ideas and/or new business opportunities, and/or to improve the features of existing products.

The proposed structure, while having as antecedent in its construction characteristics identified in five companies, was not applied in practice. In the future, it is intended to evaluate the model with specialists in the area of knowledge and implementation in companies.

The benefits obtained by the CI in the PDP are: ideas of new products and new business; customer contribution with alternative solutions for the project; contribution to tests the new product concept and; contribution to tests of the prototypes. With this background, the proposed management process can also be the basis for future studies that aim to conceive a management structure of the CI in PDP.

Finally, by the characteristics of its activities, with a focus on proactive search about information on customer needs, the management structure proposed represents a contribution to the knowledge area of new product development with a focus on the market, one of the main components of the open innovation.

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