The development of industrial products in SMEs: paths for technological innovation in the metal-mechanical industry in São Paulo, Brazil

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Abstract: The research reported in this work is related to technological innovation and, more specifically, to the development of products and their management in small and medium enterprises (SMEs) of the metal-mechanical sector in the Greater São Paulo area and in Sorocaba and surroundings. The work consisted of an exploratory and descriptive survey conducted in 2004, in a qualitative approach, to gain an overview of the processes of product development and technological innovation in SMEs, on the basis of the data collected from a sample of 32 companies. The information produced from the survey may subsidize organizations of support to small and medium enterprises, and provide an increase of competitiveness in the geographic region considered, in addition to promoting the integration of researchers in the mechanical departments of EPUSP (Polytechnic School of the University of São Paulo) and FATEC – CEETEPS (Paula Souza Center for Technological Education).
Keywords: product development, design methodology, technological innovation, small and medium industrial enterprises (SMEs).

1. Introduction

In the current business environment, the survival of a company may be determined by its competitive advantages, such as the ability to manage effectively the development of new products, either original products or the improvement of existing ones, making innovations available to the market quickly, since it is increasingly frequent the perception that business competitiveness is a direct result of investments in technological development and innovation. Entrepreneurs aim to identify market opportunities and provide technological solutions to modern consumers.

A renewed competitiveness in the Brazilian industry shows signs, as evidenced by ARBIX & NEGRI (2005), of a greater emphasis on corporate technological innovation. The authors cite that one of these relevant signs is the integration between innovation and differentiation of products as a strategic factor for a number of companies that represent a quarter of the Brazilian industry revenue.

VALERIANO (1998), advocates the importance of conceiving technological innovation as a process, mentioning the value of knowledge about this process to a better understanding of the product development activity. Therefore, new product development programs should have a clear strategy that is widely available and aligned with the company's overall strategy, with well-defined targets and allocation of resources.

Many companies attempt to introduce and maintain their operational processes of product innovation, but there are few studies available in the literature concerning specific sectoral strategies, connected to the general strategy of the organization and offering an goal to the efforts of new product development.

In a recent research, "Product Development and Technological Innovation in Small and Medium Enterprises of the State of São Paulo", funded by FAPESP (KAMINSKI, OLIVEIRA, 2004), it was observed that this aspect is not exactly the result of a well-planned course of action of the enterprises. In that survey, conducted by professors of EPUSP in partnership with professors of FATEC - CEETEPS, the goal was to survey the existence of strategies for new product development, both in global corporate level as well as in the product level, that is, in each project done, making explicit the vision of small and medium enterprises (SMEs) regarding technological innovation.

This research, under the perspective of an assessment of the product development methods adopted in SMEs of the metal-mechanical industrial sector, was initially addressed in the paper "Evaluation of the actual use of formal methodologies in the product development process in Brazilian SMEs "(KAMINSKI et al., 2005), which describes in detail the research and its findings concerning the use of formal procedures for product development in this category of company.

This paper aims to consolidate this research with the results and analysis of the responses submitted to the five main questionnaires, along with a statistical evaluation of the correlations between the responses obtained.

1.1. The importance of industrial SMEs

There has lately been a strong resurgence of the importance of small and medium enterprises, recorded on the multiplication of opening records and the generation of jobs and wages (LA ROVERE, 2003). Since then, the interest in companies of this category has increased and expanded around the world.

KAUFMANN & TÖDTLING (2002) conclude that the geographical region of the enterprise is particularly important to the innovation process in SMEs because their external relations are more restricted to the region than in the case of large companies. With the exception of partners in the same business sector, predominantly customers, small and medium enterprises have few external relations in the innovation process. The lack of interaction with providers of knowledge (universities, for example) outside the same industry sector seriously restricts the external influences that enable or encourage innovation.

BAGCHI-SEM (2001) also considers that the regional context is important as a source of competitive advantage for SMEs, in terms of the availability, cost and quality of production factors, as well as the presence and quality of suppliers and service providers.

Currently in Brazil the debate on SMEs revolves around a large number of issues, whose main concern is how these companies can survive in the new economic and technological scenario. These approaches on the subject show the great need to understand the real role of SMEs in the economy. This work is part of this current trend in that it describes a recent study conducted in the state of São Paulo/Brazil, which aims to characterize the behavior observed in small and medium enterprises of the metal mechanical sector, in the area of product development and internal procedures.

2. Technological innovation and new product development in SMEs

The merit of this research lies in the use of product design methodologies, in small and medium enterprises of the metal-mechanical sector in the state of São Paulo, so as to exploit and disseminate their best practices in product innovations.

The research "Product development and technological innovation in small and medium enterprises of the state of São Paulo" is classified as exploratory and descriptive, using the method of survey research and a qualitative approach.

The participating companies were selected from among those in Greater São Paulo and the administrative region of Sorocaba, based on their formal size classification (as small or medium enterprises), considering the criteria used by the Brazilian Service of Support for Micro and Small Business (SEBRAE), or the classification of the National Bank of Economic and Social Development (BNDES).

In this region of interest to the survey, companies were identified by sector of activity (metal-mechanical industry, focus of the proposal) and the product, which was restricted to the profile suggested in the project. The research was applied presentially in a sample of 32 small and medium enterprises in the region considered.

For this activity a questionnaire was designed that would meet, concerning its content, the goal of clarifying the vision of SMEs regarding technological innovation and, more specifically, the product development and their management.

As to the format of the questionnaire, the choice was a document with open questions, and closed dichotomous or multiple-choice questions, identifying facts or actions of the company, to be completed directly in the document.

The general questionnaire basically consists of three blocks: the questions of the first block characterize the company and the interviewee's work area (questionnaires A, B and C); in the second block, the questions address the work method of product development adopted by the company (questionnaires D, E, F, G and H); finally, the third block is for general assessments (questionnaire I). These blocks, composed by the nine questionnaires, are presented in Table 1.

Table 1 - General questionnaire.

Scope of the General Questionnaire	
A	Data about the company
B	Data on the department in charge of product development
C	Characterization of the company's main product
D	Does the development process generate evolutive or innovative products?
E	Is it possible to identify a method in the product development process?
F	Does the company have automated resources to aid development?
G	Is the development carried out only by the company?
H	Is the development department strategic to the company?
I	General observations

The survey yielded a large amount of information, which were evaluated, systematized and classified, enabling the assembly of relevant statistical data and the consolidation of the results in a database.

3. Paths to technological innovation

With the results obtained in the second block of the general questionnaire, composed by questionnaires D, E, F, G and H, the goal is to study the formulation of a number of paths to guide technological innovation and to allow the improvement of the efficiency in the product development process, in industrial SMEs in São Paulo/Brazil.

The characteristics and behavior of these paths may become essential for an SME to be able to achieve the necessary growth in its product development sector.

But in order to benefit from these guidelines, the company should simultaneously implement new technologies and management procedures, along with automation resources for the product development process, represented in the specific questions of the research.

The questions of the research that interact and are correlated must then be perceived as relevant. Thus, the question (qualitative variable) that is strongly associated with another one should gain priority in its implementation; in the same way, the question that is independent from the others must first demonstrate the feasibility of its implementation.

4. The behavior of the selected questions

The survey produced a wide range of data that was categorized to facilitate the analysis in blocks of questionnaires. To characterize relations and interactions among the questions selected from the main five questionnaires, and which act as a guide to technological innovation, a statistical approach was chosen in which all questions were considered together, two at a time, so as to establish the correlation between questions.

One of the major goals of building a joint distribution of two qualitative variables is to describe the association between them, that is, to know the degree of dependency between them, so that we can better predict the outcome of one of them as the achievement of the other is known (BUSSAB & MORETTIN, 2005). The purpose is to infer whether there is an association between management aspects and the economic performance of the company, by identifying parameters in the product development area that involve and/or speed up the technological innovation process.

The degree of association between two variables is generally quantified by means of association or correlation coefficients. The initial statistical approach uses Pearson's chi-square test (MONTGOMERY & RUNGER, 2003). The closed dichotomous questions (yes/no) of the main questionnaires (D, E, F, G and H) were selected for the implementation of the chi-square test.

5. Statistical approach for the analysis of results

When there are two qualitative variables of interest, the tabular representation of the observed frequencies can be made through a simple two-way contingency table.

A fairly frequent question is whether the qualitative variables involved are or are not independent of each other. That is, the following hypotheses can be tested:

- H_0: the variables are independent; and
- H_1: the variables are not independent, that is, they have some degree of association between one another.

This can be tested by the Chi-Square X^2. A statistical approach of Pearson's Chi-Square test for the purposes of this research was initially described in KAMINSKI et al. (2005).

This test introduces the concept of significance coefficient α (or p-value), which represents the probability of error when rejecting H_0 and adopting H_1 as true.

The Chi-Square test was applied by pairing the selected questions in the contingency tables.

With the statistical software MINITAB (MINITAB Inc., 2005), the values of the significance coefficient α are obtained for the pairs of questions of the contingency table. Once a level of acceptance for the statements is defined, the significance coefficients can provide either an affirmation (i.e., the two questions are related) or a denial (i.e. the two questions are not related).

For a moderate nature of the evidence, Fischer's scale of significance (BUSSAB & MORETTIN, 2005) recommends a coefficient of 5%, which will be adopted in this work. In other words, a coefficient between 0 and 5% will be accepted as proof of correlation between the two questions, while a coefficient between 95 and 100% will be accepted as proof of independence between the questions (no correlation).

6. Results

The values resulting from the test for the significance coefficient α are listed in Table 2 (Appendix), which enables the visualization of the values of interest to this study, and also presents the frequencies of answers to the questions.

In Table 2, the questions are identified by letters and indices (D7, G2, etc.) corresponding to each questionnaire. A description of the questions relevant to this work is presented in Tables 3, 4, 5, 6, 7, also by questionnaire.

The values of interest ($0 < \alpha < 0.05$) are in bold and highlighted in blue; the values of interest ($0.95 < \alpha < 1.00$) are in bold and highlighted in red. In the black cells in Table 2 it has not been possible to obtain a value α, because the product of the frequencies in some cells of the

Table 2. Significance coefficients α.

	D.7	D.8	D.9	E.5	E.6	E.7	E.9	E.10	E.11	E.12	F.5	F.6	F.7	F.8	F.9
D.7	0.000		0.893	0.349	0.135		0.581		0.739	0.581					0.882
D.8		0.000	0.810	0.538	0.314		0.225	0.583	0.363	0.581	0.732	0.113		0.732	**0.976**
D.9			0.000	0.149	0.169	0.053	0.055	0.272	0.029	0.234	0.461	0.051	0.087	0.461	0.337
E.5				0.000	0.026	0.087	0.314	0.272	0.007	0.082	0.865	0.538	0.053	0.865	0.160
E.6					0.000	0.028	0.163	0.463	0.002	0.000	0.150	0.108	0.132	0.687	0.599
E.7						0.000	0.159			0.159					
E.9							0.000	0.036	0.244	0.706	0.242	0.740	0.019	0.483	0.612
E.10								0.000	0.301	0.740	0.150	0.628		0.150	**0.976**
E.11									0.000	0.001	**0.950**	0.109		**0.950**	0.213
E.12										0.000	0.242	0.036	0.019	0.815	0.612
F.5											0.000	0.732		0.885	0.489
F.6												0.000		0.064	**0.976**
F.7													0.000		
F.8														0.000	0.186
F.9															0.000
G.1															
G.2															
G.3															
G.4															
G.5															
G.7															
G.8															
H.1															
H.3															
H.4															
H.6															
H.7															
H.8															
H.9															
H.10															
SIM	87%	78%	56%	43%	61%	89%	39%	21%	32%	39%	81%	22%	9%	19%	28%
NÃO	13%	22%	44%	57%	39%	11%	61%	79%	68%	61%	19%	78%	91%	81%	72%

	G.1	G.2	G.3	G.4	G.5	G.7	G.8	H.1	H.3	H.4	H.6	H.7	H.8	H.9	H.10
D.7	**1.000**	0.298		0.217	0.496	0.014	0.683			0.581	0.149	0.893	0.496		0.581
D.8	0.805	**0.976**	0.451	0.459	0.314	0.459	0.314		0.732	0.581	0.454	0.020	0.314	0.628	0.151
D.9	0.306	0.538	0.461	0.152	0.430	0.306	0.430	0.893	0.865	0.647	0.599	0.982	0.430	0.538	0.647
E.5	0.066	0.011	0.281	0.008	0.513	0.838	0.946	0.349	0.461	0.784	0.316	0.492	0.946	0.810	0.784
E.6	0.835	0.061	0.604	0.299	0.837	0.835	0.348	0.010	0.150	0.163	0.467	0.467	0.016	0.108	0.515
E.7					0.132		0.787			0.876		0.621	0.787		0.876
E.9	0.092	0.761	0.483	0.399	0.926	0.399	0.020	0.098	0.815	0.258	0.168	0.082	0.114	0.581	0.706
E.10	0.084	**0.976**	0.451	0.459	0.463	0.217	0.314		0.150	0.740	0.863	0.810	0.892	0.628	0.581
E.11	0.713	0.014	0.147	0.109	0.088	0.610	0.919	0.139	0.363	0.373	0.445	0.690	0.353	0.248	0.093
E.12	**1.000**	0.054	0.483	0.399	0.515	0.399	0.403	0.098	0.242	0.059	0.168	0.784	0.403	0.740	0.706
F.5	0.117	0.753	0.192	0.601	0.150	0.117	0.687		0.310	0.815	0.272	0.100	0.025	0.732	0.102
F.6	0.459	0.357	0.451	0.805	0.892	0.459	0.314		0.150	0.740	0.863	0.810	0.060	0.113	0.740
F.7					0.132		0.335			0.273		0.471	0.335		0.273
F.8	0.601	0.489	0.310	0.601	0.604	0.117	0.687		0.885	0.815	0.272	0.100	0.687	0.732	0.483
F.9	0.256	0.181	0.489	0.496	0.003	0.496	0.599	0.181	0.489	0.612	0.314	0.337	0.185	0.357	0.187
G.1	0.000	0.041	0.601	**1.000**	0.146	0.346	0.299	**1.000**	0.601	0.399	0.186	0.152	0.835	0.805	0.399
G.2		0.000	0.489	0.256	0.783	0.112	0.599	0.026	0.020	0.612	0.491	0.160	0.783	0.053	0.761
G.3			0.000	0.601	0.687	0.117	0.687		0.885	0.242	0.903	0.047	0.185	0.150	0.483
G.4				0.000	0.835	**1.000**	0.146	**1.000**	0.601	0.092	0.660	0.838	0.835	0.459	0.399
G.5					0.000	0.299	0.598	0.135	0.604	0.515	0.132	0.946	0.208	0.314	0.515
G.7						0.000	0.533	0.217	0.117	0.092	0.186	0.838	0.533	0.805	0.399
G.8							0.000	0.077	0.185	0.114	0.109	0.169	0.046	0.463	0.163
H.1								0.000		0.098	0.044	0.893	0.077		0.098
H.3									0.000	0.035	0.903	0.281	0.687	0.732	0.102
H.4										0.000	0.168	0.784	0.403	0.740	0.706
H.6											0.000	0.197	0.409	0.454	0.844
H.7												0.000	0.169	0.272	0.234
H.8													0.000	0.314	0.163
H.9														0.000	0.151
H.10															0.000
SIM	75%	72%	22%	25%	41%	54%	41%	87%	81%	38%	69%	47%	41%	78%	38%
NÃO	25%	28%	78%	75%	59%	46%	59%	13%	19%	62%	31%	53%	59%	22%	62%

Table 3. Questionnaire D - correlations.

	D.7 Is the information needed for new projects based on former projects?	D.8 Has the company developed product for new market niches?	D.9 Are new manufacturing processes being use?	Answers - Percentage	
				Yes	No
A.2 Annual invoicing			0.2%	-	-
A.5 Performance market			0.2%	-	-
E.11 Is the FMEA tool used in the project?			2.9%	32%	68%
F.9 Is there any software specially developed for the department?		97.6%		28%	72%
G.1 Do suppliers participate in the development process?				75%	25%
G.2 Do clients participate in the development process?	100.0%			72%	28%
G.7 Are the required tests done internally?		97.6%		55%	45%
H.7 Is people's access to the development area more controlled than to other areas?	1.4%	2.0%	98.2%	47%	53%

Answers - Percentage				
Yes	87%	78%	56%
No	13%	22%	44%

calculation matrix is too small for the sample of companies used. This greatly increases the chi-square value, which means that for these questions the sample is small, and the Chi-Square approach may not be considered valid.

According to the data obtained for the significance coefficient in Table 2, it is possible to determine the correlations between the questions, which are in the defined value range: from 0 to 5% and from 95 to 100%. The correlations and their values are shown in Tables 3, 4, 5, 6, 7 (Appendix), by questionnaire, with their frequencies of responses.

6.1. Analysis of the results

By analyzing the results it is possible to identify some aspects of the product development process, the department responsible for running it, its partnerships and relationships outside the SMEs surveyed. The analysis, discussion and correlations between the results indicate paths to technological innovation. It is important to remember that this approach uses data from industrial SMEs in São Paulo/ Brazil and, therefore, it initially applies only to them.

In relation to the main question of Questionnaire D, "Does the development process generate evolutive or innovative products?", it is observed that new products are developed in a more evolutionary process. This hinders the emergence of innovations (KAMINSKI & OLIVEIRA, 2005b), because the strategy seen in the adoption of new manufacturing processes, identified in 56% of companies, to find new market niches (intention declared by 78% of companies) is not an aid to the development process. This assumption is reinforced when the result shows 87% of companies basing their information for new projects mostly on previous projects.

Concerning the main question of Questionnaire E, "Is it possible to identify a method in the product development process?", in general most companies have a product development pattern that can be characterized as formal (KAMINSKI et al., 2005), since the demand for project methodologies is thus characterized in the companies surveyed: 61% follow methods of internal development, which are formally documented in 50% of them, being mandatory in 32% of the survey sample and recommended in the other 18%. Although formal, the methods employed arise from the SMEs own experiences, but are not mandatory. This prevents the use of current concepts in the approach to new product development (low usage and even ignorance of tools such as Value Analysis, FMEA, etc.).

The main question of Questionnaire F was "Does the company have automated resources to aid development?". The answer is affirmative when the research results bring features such as the use of software to support the product development department, CAD tools, simulation and the management of automated resources of information technology (KAMINSKI & OLIVEIRA, 2005a). Internet access is widespread in all businesses, but its main use is for exchange of e-mails and general research, and the various CAD systems are primarily employed for the implementation of designs. None of the companies researched use simulation tools such as Matlab and few use programs based on the finite element method.

The main question of Questionnaire G was " Is the development carried out only by the company?". The research makes it clear the relevance of the collaboration of suppliers and customers in the product development process in enterprises (KAMINSKI et al., 2007). Their participation (75% of suppliers and 72% of customers) and, in general, their support focus on bridging gaps in this area of the company, from technical questions about materials and components, to specification of trends, aid in assessments and tests, and suggestions for improvement. On the other hand, the participation of other entities, external to the company, is little used, and consultants, specialized companies, research institutes and universities have little interaction in the development process. It is observed that, by adopting this procedure, the management of development activities remains internal to the company itself, revealing a

Table 4. Questionnaire E - correlations.

	E.5 Is any national or international product development standard followed?	E.6 Is an internal development methodology followed?	E.7 Is there any standardized procedure for the filling of drawings, calculus memorials, test results, etc.?	E.9 Is the Design Spiral concept used?	E.10 Is the Value Analysis concept used in product development?	E.11 Is the FMEA tool (Failure Mode Effect Analysis) used in the design?	E.12 Is there any design quality program being used?	Answers - Percentage	
								Yes	No
A.6 Does the company have ISO 9001 certificate?	1.5%	0.1%					0.3%	62%	38%
D.9 Are new manufacturing processes being used?						2.9%		56%	44%
E.5 Is any national or international product development standard followed?		2.6%				0.7%		43%	57%
E.6 Is an internal development methodology followed?			2.8%			0.2%	0.0%	61%	39%
E.9 Is the design spiral concept used?					3.6%			39%	61%
E.11 Is the FMEA tool (failure mode effect analysis) used in the design?							0.1%	32%	68%
F.5 Is any centralized database being used?						95.0%		81%	19%
F.6 Is any design management software being used?							3.6%	22%	78%
F.7 Is there any software for simulation of the finite elements method being used?				1.9%			1.9%	9%	91%
F.8 Is any software for simulation of the manufacturing process being used?						95.0%		19%	81%
F.9 Is there any software specially developed for the department?					97.6%			28%	72%
G.1 Do suppliers participate in the development process?							100.0%	75%	25%
G.2 Do clients participate in the development process?	1.1%				97.6%	1.4%		72%	28%
G.4 Are there any works being made with universities/research Institutes?	0.8%							25%	75%
G.8 Are the products developed being certified by any external organism?				2.0%				41%	59%
H.1 Is there any formal organization chart of the company that includes the PD department?		1.0%						87%	13%
H.8 Are successful designs awarded and/or promoted?		1.6%						41%	59%

Answers - Percentage							
Yes	43%	61%	89%	39%	21%	32%	39%
No	57%	39%	11%	61%	79%	68%	61%

strong trend in the industry, which prevents it from achieving a greater improvement by means of partnerships with universities, foundations, research institutes, etc.

Finally, the main question of Questionnaire H was " Is the development department strategic to the company?". The important position held by the product development department becomes noticeable in its organizational formality because it is in evidence in the organization of most of the companies (87% of companies). The department also has a very low turnover of professionals, receives training paid by the companies, including incentives to the participation in national and international trade fairs, receives investment in equipment and software, and has policies regarding confidential information. However, this important position is not considered strategic to the business as it does not make final decisions regarding the development of new products, which, in most companies, are originated in other areas of the company.

7. Conclusion

The results obtained, their correlations and analysis lead to the conclusion that the identification of knowledge transfer problems concerning methodological aspects of product development can make companies understand its

Table 5. Questionnaire F - correlations.

	F.5 Is any centralized database being used?	F.6 Is any design management software being used?	F.7 Is there any software for simulation of the Finite Elements Method being used?	F.8 Is any software for simulation of the manufacturing process being used?	F.9 Is there any software specially developed for the department?	Answers - Percentage	
						Yes	No
A.2 Annual invoicing.		4.1%				-	-
D.8 Has the company developed products for new market niches?					97.6%	87%	13%
E.9 Is the design spiral concept used?			1.9%			39%	61%
E.10 Is value analysis used in product development?					97.6%	21%	79%
E.11 Is the FMEA tool (failure mode effect analysis) used in the design?	95.0%			95.0%		32%	68%
E.12 Is there any project quality program being used?		3.6%	1.9%			39%	61%
F.9 Is there any software specially developed for the department?		97.6%				28%	72%
G.5 Are external companies hired to do the development or any part of it?					0.3%	41%	59%
H.8 Are successful designs awarded and/or promoted?	2.5%					41%	59%

Answers - Percentage						
	Yes	81%	22%	9%	19%	28%
	No	19%	78%	91%	81%	72%

impact and benefits, as a path for technological innovation, thus effectively increasing their competitiveness.

SMEs base most of their new projects on previous projects. As the business grows and expands to other markets, it also prioritizes the use of new manufacturing processes.

In general only half of the SMEs have a product development area that follows a formalized methodology, although the majority already have procedures for filing project information. Only a third of the companies surveyed use concepts or tools such as Value Analysis, FMEA and project spiral, but those that do use them have formalized procedures for product development.

As for information technology resources, SMEs have a centralized database to store project information. There are few companies that use simulation tools with the finite element method or the simulation of manufacturing processes, but those that apply them also use current project concepts, such as the project spiral, and have a scheme of design quality assurance.

In SMEs, both suppliers and customers participate in the product development process, but it is mainly the customers who motivate SMEs to employ formalized procedures in product development. This is evidenced in the fact that, when customers are not involved, companies do not follow rules, are not concerned with detecting future flaws (FMEA) and do not involve suppliers in the development process.

Most of the SMEs surveyed have a formal organizational chart and a staff training policy for the product development area. It should be stressed that the involvement of customers in the process accelerates this formalization.

The research also yielded data that will enable a better understanding of the innovation dynamics and the characteristics of small and medium enterprises. These data may be used by a number of institutions involved with the industrial development of the state of São Paulo, for the expansion of their knowledge, and the systemic dissemination and application of the data both for the use in businesses and for the university.

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Table 6. Questionnaire G - correlations.

	G.1 Do suppliers participate in the development process?	G.2 Do clients participate in the development process?	G.3 Are consultants hired to aid product development?	G.4 Are there any works being made with universities/research institutes?	G.5 Are external companies hired to do the development or any part of it?	G.7 Are the required tests done internally?	G.8 Are the products developed being certified by any external organ?	Answers - Percentage	
								Yes	No
A.2 Annual invoicing					97.8%			-	-
D.7 Is the information needed for new projects based on former projects?	100.0%					1.4%		87%	13%
D.8 Has the company developed products for new market niches?		97.6%						78%	22%
E.5 Is any national or international product development standard followed?		1.1%		0.8%				43%	57%
E.9 Is the project spiral concept used?							0.2%	39%	61%
E.10 Is value analysis used in product development?		97.6%						21%	79%
E.11 Is the FMEA tool (failure mode effect analysis) used in the design?		1.4%						32%	68%
E.12 Is there any project quality program being used?	100.0%							39%	61%
F.9 Is there any software specially developed for the department?					0.3%			28%	72%
G.1 Do suppliers participate in the development process?		4.1%		100.0%				75%	25%
G.4 Are there any works being made with universities/research institutes?						100.0%		25%	75%
H.1 Is there any formal organization chart of the company that includes the PD department?	100.0%	2.6%		100.0%				87%	13%
H.3 Is there any training policy for the employees?		2.0%						81%	19%
H.7 Is people's access to the development area more controlled than to other areas?			4.7%					47%	53%
H.8 Are successful designs awarded and/or promoted?							4.6%	41%	59%

Answers - Percentage							
	Yes	75%	72%	22%	25%	41%	54%	41%
	No	25%	28%	78%	75%	59%	46%	59%

believing in the relevance and importance of this project to the current context.

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Table 7. Questionnaire H - correlations.

	H.1 Is there any formal organization chart of the company that includes the PD department?	H.3 Is there any training policy for the employees?	H.7 Is people's access to the development area more controlled than to other areas?	H.8 Are successful designs awarded and/or promoted?	Answers - Percentage	
					Yes	No
A.2 Annual invoicing			95.4%		-	-
A.6 Does the company have ISO 9001 certificate?				96.4%	-	-
D.8 Has the company developed products for new market niches?			2.0%		78%	22%
D.9 Are new manufacturing processes being used?			98.2%		56%	44%
E.6 Is an internal development methodology followed?	1.0%			1.6%	61%	39%
F.5 Is any centralized database being used?				2.5%	81%	19%
G.1 Do suppliers participate in the development process?	100.0%				75%	25%
G.2 Do clients participate in the development process?	2.6%	2.0%			72%	28%
G.3 Are consultants hired to aid product development?			4.7%		22%	78%
G.4 Are there any works being made with universities/research institutes?	100.0%				25%	75%
G.8 Are the products developed being certified by any external organ?				4.6%	41%	59%
H.4 Are the graduate professionals stimulated to make post-graduate educational programs?		3.5%			38%	62%
H.6 Is there any policy to be followed in terms of security of information?	4.4%				69%	31%

Answers - Percentage					
	Yes	87%	81%	47%	41%
	No	13%	19%	53%	59%

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