ANALYSIS OF THE DECISION MAKING PROCESSES IN NPD PROJECTS WITHIN INNOVATIVE COMPANIES.
AN EMPIRICAL STUDY IN THE VALENCIAN REGION (SPAIN)

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Abstract

The decisions made during the design process have a critical impact both on the design solution obtained but also on the design process itself. It can be observed that while the way in which products are developed differs not only across firms but within the same firm over time, what is being decided seems to remain fairly consistent [2].

After a thorough Literature research many references addressing decision processes developed within the NPD have been found. In the paper by Krishnan and Ullrich [4] an extensively list the most common decisions made in each phase of the development process of new products is presented. While rigorous at a bibliographical level, this work has not been empirically verified yet.

Therefore, an empirical study to inquire whether decisions considered usual in the literature were actually common within the framework of innovative companies in the Valencia region (Spain) has been carried out. The empirical study has covered a representative sample of innovative companies in this region. A questionnaire including all decisions identified was prepared and sent by mail to all the companies belonging to the sample, whose aim was to determine the frequency these decisions are usually made. At the same time this study has been used to find out the patterns of decision-making processes in those innovative companies.

The analysis of the results obtained confirmed that the decisions identified in the literature do correspond to the decisions mostly made in innovative companies of the Valencia Region and that they all follow a specific pattern.

1. Introduction

The decisions made during the design process have a critical impact both on the design solution obtained but also on the design process itself. It can be observed that while the way in which products are developed differs not only across firms but within the same firm over time, what is being decided seems to remain fairly consistent.

We will assume that product development is a *deliberate business process involving scores of such generic decisions* [4] and therefore will focus our work in analysing such decisions. Several references found in the Literature address decision processes developed within the NPD. [3], [4], [5].

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The authors of the present work want to highlight the paper by Krishnan and Ullrich in which a revision of a total amount of 200 references related to this topic is presented. They extensively list the most common decisions made in each phase of the development process of new products. While rigorous at a bibliographical level, this work has not been empirically verified. We have therefore decided to do so in our nearest geographical proximity, amongst companies of the Valencia Region (Spain), henceforth VR, from various sectors which are involved in innovation activities.

2. Objectives

The aim of the present work is to carry out an empirical study, which covers a representative sample of companies in the VR, a region characterized by having a great number of Small and Medium Size Enterprises in dispersed industrial sectors [1]. Some of these sectors stand out as pioneers in Spain and Europe: tiles, furniture, shoes. Of all the companies active in the region we have studied those considered as innovative by the Generalitat Valenciana in 2002.

The main objectives are:

- *to compare the decisions they made with the ones identified by Krishnan and Ullrich* in order to demonstrate that the list of decisions proposed in the Literature coincides with the decisions actually made by VR companies

- *to find out the patterns of these decision making processes* in order to inquire if it is possible to establish a common procedure for all of them

- *to find out if the interviewed companies know any Decision Support Systems and if not, whether they would be interested in having one* that would make their decision making processes easier

3. Methodological procedure

This empirical study has been carried out on a representative sample of innovative companies in the Valencia Region.

A questionnaire was prepared including all decisions identified by Krishnan and Ullrich in order to determine the frequency these decisions are usually made.

3.1. Questionnaire design

The documentation was carefully prepared so that the people asked (henceforth *experts*) could devote their time to concentrate on the issue and provide their knowledge and experience and not to administrative or bureaucratic tasks. Each expert was provided with one questionnaire and was given the chance to choose for each question the answer that best suited him.

The questionnaire was divided into two parts:

1. List of the most common decisions made in companies that develop new products, (see Annex 1, part I & II). The objective of this first part was to inquire whether decisions considered usual in the literature were actually common within the framework of innovative companies in the Valencia Region

2. Decision-making patterns in companies. A number of questions were asked to find out the patterns of decision-making processes in those innovative companies and their procedures (structured or non-structured decisions) (See annex 1, part III).

3.2. Sample choice

In order to establish a representative population for the study we had to define:

- *Target population*: all innovative companies in the VR.

- *Sampled population*: 1200 companies in different sectors of the VR catalogued as innovative in the DIRNOVA (Directorio de Empresas Innovadoras de la Comunidad Valenciana) data-base of 2002.

- *Sample size*: calculated by arbitrary sampling of finite populations. This calculation indicated that the minimum sample size needed was 124 responses.

- Sa*mple frame*: the support used to deliver the questionnaire was a mailing to the attention of the General Manager of each company. That way we wanted to make sure that the questionnaire would be handed in to people with decision capacity and a global view of the company.

3.3. Data collection

After collating all the reports, the obtained data were analysed. Once the lost values had been removed (reports from companies that did not answer the whole questionnaire) the sample used consisted in all the answers obtained from the companies, which allowed us to include the proper aleatory factor and not include any selection bias. The number of answers received was 136, which was considered a representative sample according to the sample size already calculated.

3.4. Results analysis

The results of the questionnaire have been studied the following way:

3.4.1. Results parts I & II

The first study carried out consisted in a descriptive statistical data analysis. The average and the standard deviation values were calculated for all the answers obtained for each question of the questionnaire.

The possible answers for each question referred to the frequency with which the specified decisions were made (see annex 1). The proposed answers were assigned the following marks: *Never* = 1, O*ccasionally* = 2, *Often* = 3, *Always* = 4

The descriptive statistical results obtained for each question stated in the questionnaire are presented in the following:

Table 1.Descriptive statistics of questionnaire part I. Variables NPD

question nr.	average	std. dev.
NPD1	3,2	0,89
NPD2	3,03	0,87

NPD3	3,05	0,97
NPD4	2,98	0,92
NPD5	3,04	0,93
NPD6	3,37	0,87
NPD7	3,17	0,82
NPD8	2,96	1,01
NPD9	3,25	0,96
NPD10	2,78	1,04
NPD11	2,78	1,02
NPD12	3,02	0,94
NPD13	3,05	0,98
NPD14	2,7	0,98
NPD15	3,2	0,89
NPD16	3,05	0,92
NPD17	2,52	1,04
NPD18	2,82	0,98

Table 2.Descriptive statistics of questionnaire part II. Variables PM

question nr.	average	std. dev.
PM1	2,77	0,89
PM2	2,74	0,87
PM3	2,74	0,87
PM4	2,72	0,93
PM5	2,92	0,87
PM6	2,35	1,04
PM7	2,52	1,07
PM8	2,53	0,99
PM9	2,62	1,11
PM10	2,88	0,98
PM11	2,28	1,08
PM12	2,89	0,94
PM13	2,81	0,98
PM14	2,7	0,91
PM15	2,76	0,95
PM16	2,93	0,98

The results in table 1 show us that in the case of NPD variables the average mark obtained by the answers is very close to 3 in all the cases. Actually the global average of this marks is 2,99, which means that *the proposed decisions are **often** made by the VR innovative companies*. The value of their standard deviation (0,94 global average) indicates us that not all the companies make these decisions with the same frequency. In our opinion, this values dispersion is probably due to the different sizes and the different degrees of maturity of the companies analysed. This statement would need some more empirical work to be proved, therefore, another survey focused on the degree of maturity of the same companies will be carried out in the next future.

The results in table 2 show us that in the case of PM variables the average mark obtained by the answers is 2,69 which means that *the proposed decisions are **occasionally/often** made by the VR innovative companies*. The value of their standard deviation (0,96 global average) indicates us, as in table 1, that not all the companies make these type of decisions with the same frequency, being, in our opinion, the reason for that the same as in the previous case.

The differences observed in global average values between decisions related to New Product Development (2,99) and Project Management (2,69) can be on account of the level of corporate culture of the companies. Some organizations do not have a established corporative culture, that allows them to develop methodologies and standards in their management processes. The foundation for achieving excellence in project management can best be described as a project management maturity model (PMMM). (Kerzner, 2003), which is one field of study that has not been addressed in this empirical study and is left for future works.

After these conclusions, we can affirm that the rigorous bibliographical work by Krisham and Ullrich has been empirically verified in the Valencia Region (Spain).

3.4.2. Results part III

Since the questions stated in the last part of the questionnaire offered different types of answers to choose from, and it was also possible to choose more than one answer for each question, a different way of analysis has been chosen for each part.

Part III.1.

These questions were studied with a descriptive statistical data analysis. The average and the standard deviation values were calculated for all the answers obtained for each question stated in the questionnaire.

The possible answers for each question referred to the frequency with which they outlined the proposed questions related to the way they made their decisions. The answers were assigned the following marks: *Never* = 1, *Occasionally* = 2, *Often* = 3, *Always* = 4

The descriptive statistical results obtained for each question stated in the questionnaire are presented in the following:

Table 3.- Descriptive statistics of questionnaire part III. Variables DM

question	average	std. dev.
DM1. Do you think that you have time enough to make a decision?	2,8	0,85
DM2. Do you explicitly outline the objective that you want to achieve with the decision process?	3,5	0,7
DM3. Do you outline how the decision is going to affect your company or organization	3,35	0,9
DM4. Do you outline how the decision is going to affect people involved?	3,14	0,95
DM5. Do you outline how are you going to justify your decisions in front of your managers?	2,76	1,15
DM6. The decision is analysed from different points of view	3,47	0,7
DM7. These criteria or points of view are in conflict?	2,51	0,92

The results in table 3 show us that the average mark obtained by the answers is always very close to 3. Actually the global average of this marks is 3,06, which means that *the proposed questions are **often** outlined by the Decision Maker, and therefore we can conclude that they have structured decision procedures.* The value of their standard deviation (0,88 global average) indicates us that not all the Decision Makers have the same level of structure in their decision processes. This is, in our opinion, a consequence of the differences in the

organizational cultures of the companies interviewed due to their differences in size and industrial sector.

Part III.2.

In this case, for each question the percentage of answers of each type has been calculated because it was possible to choose more than one answer for each question,

DM8. How do you obtain these criteria?
    a.   They are imposed   11,76%
    b.   I know them beforehand   64,7%
    c.   I select them ad hoc   29,4%
    d.   No answer   5,88%

DM9. Do you make the decision…?
    a.   On my own   9%
    b.   It depends   50%
    c.   In group   44%

DM11. How do you select the team?
    a.   I am surrounded by my own team   64,7%
    b.   It depends   35,3%
    c.   I look for external advice   5,88%

DM11. Which characteristics do you expect from the experts?
    a.   The experts are imposed by the management   5,86%
    b.   I select them by their technical knowledge   64,7%
    c.   I select them by their experience   58,8%
    d.   Other (indicate) ………………………………………………………

DM12. Under which conditions would you use a Decisión Support System?
    a.   Because it has been successfully used by other companies
        of my industrial sector   26,4%
    b.   Because it has been proposed by a reliable consulter   23,5%
    c.   Because it has an academia-scientific recognition   35,3%
    d.   No answer
    e.   Other (indicate) ………………………………………………………

These results show us that the majority of the Decision Makers consider that they have enough time to make the decisions. Therefore, we can conclude that *decision activities constitute a considerable percentage of the time taken to develop new products*.

At the same time, most of them agree that they state their decision problem considering objectives and the way the decision will affect the organization and the people involved in it. Besides, some of them do outline how to justify decisions before their commands.

Moreover, most of the people interviewed coincide that they always consider different points of view during their decision making process, which means that *they are dealing with multicriteria decision problems.*

They also mainly agree that decisions usually involve several people, which means that *they are dealing with group decision problems*. In this case, Decision Makers are usually surrounded by a company team, whose members are chosen by their experience or technical knowledge. Rarely are these experts imposed by the company management.

According to the majority of the people who answered, *a Decision Support System would be used* if it either had an academic recognition (35,3%), or it had been successfully used by other companies (26,4%) or by a reliable consulter (23,5%).

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5.- Conclusion

An empirical study to inquire whether decisions considered usual in the literature were actually common within the framework of innovative companies in the Valencia Region (Spain) has been carried out. The empirical study has covered a representative sample of innovative companies in this region. A questionnaire including all decisions identified was prepared and sent by mail to all the companies belonging to the sample, whose aim was to determine the frequency these decisions are usually made. The analysis of the results obtained confirmed that the decisions identified in the literature do correspond to the decisions mostly made in innovative companies of the VR

At the same time the empirical study has been used to find out the patterns of decision-making processes in those innovative companies. The results show us that it is possible to establish a common procedure for all of them, since they can be classified as multicriteria decision, group decision and structured decision problems.

Added to that, although almost all the interviewed people admitted not knowing what a Decision Support System is, they would use on if it had been successfully proved before.

6. Future works.

In order to prove the relationship between decision making procedures and the degree of maturity of the companies, another empirical survey is being carried out at present, whose results will be published in the very next future.

Based on the results of this study, a Decision Support System will be developed focused on Discrete Multicriteria Decision Analysis, with the goal of supporting the decision makers in making right and intelligent decisions and therefore achieve the improvement of the NPD process efficiency.

7. Relevant References

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ANNEX 1. QUESTIONNAIRE

Part I: Product development decisions made within a Project

Have you made the decision?	I have made this particular decisión…			
	Never	Occasionally	Often	Always
About Concept Development				
NPD1. What are the target values of the product attributes, including price?				
NPD2. What is the core product concept?				
NPD3. What is the product architecture?				
NPD4. What variants of the product Hill be offered?				
NPD5. Which components Hill be shared across which variants of the product?				
NPD6. What Hill be the overall physical form and industrial design of the product?				
About Product Design				
NPD7. What are the values of the key design parameters?				
NPD8. What is the configuration of the components and assembly precedent relations?				
NPD9. What is the detailed design of the components, including material and process selection?				
About Performance, Testing and Validation				
NPD10. What is the prototyping plan?				
NPD11. What Technologies should be used for prototyping?				
About Supply Chain Design				
NPD12. Which components will be designed and which will be selected? Who will design the components?				
NPD13. Who will produce the components and assemble the product?				
NPD14. What is the configuration of the physical supply Chain, including the location of the decouple point?				
NPD15. What type of process Hill be used to assemble the product?				
NPD16. Who will develop and supply process technology and equipment?				
About the production ramp up				
NPD17. What is the plan for market testing and launch?				
NPD18.What is the plan for production ramp-up?				

Part II: Decisions in setting up and development project

Have you made the decision?	I have made this decision…			
	Never	Occasionally	Often	Always
About Product Strategy and Planning				
PM1. What is the market and product strategy to maximize probability of economic success?				
PM2. What portfolio of product opportunities will be pursued?				
PM3. What is the timing of product development projects?				
PM4. What, if any, assets (e.g. platforms) will be shared across which products?				
PM5. Which Technologies will be employed in the product(s)?				
About Product Development Organization				
PM6. Will a functional, Project or matrix organization be used?				
PM7. How will the team be staffed?				
About Project Management				
PM8. Hoe will Project performance be measured?				
PM9. What will be the physical arrangement and location of the team?				
PM10. What investments in infrastructure, tools and training will be made?				
PM11. What type of development process will be employed (e.g. stage-gate)?				
PM12. What is the relative priority of development objectives?				
PM13. What is the planned timing and sequence of development activities?				
PM14. What are the major Project milestones and planned prototypes?				
PM15. What will be the communication mechanism among team members?				
PM16. How will the Project be monitored and controlled?				

Part III: Decisión making process characteristics

	Never	Occasionally	Often	Always
About the statement of the problem				
DM1. Do you think that you have time enough to make a decision?				
DM2. Do you explicitly outline the objective that you want to achieve with the decision process?				
DM3. Do you outline how the decision is going to affect your company or organization				
DM4. Do you outline how the decision is going to affect people involved?				
DM5. Do you outline how are you going to justify your decisions in front of your managers?				
About the decision process characteristics				
DM6. The decision is analysed from different points of view				
DM7. These criteria or points of view are in conflict?				

DM8. How do you obtain these criteria?
    a. They are imposed ☐
    b. I know them beforehand ☐
    c. I select them ad hoc ☐

DM9. Do you make the decision…?
    a. On my own ☐
    b. It depends ☐
    c. In group ☐

DM10. In which cases do you look for advice?...

If the decision is made within a group
    DM11. How do you select the team?
        a. I am surrounded by my own team ☐
        b. It depends ☐
        c. I look for external advice ☐

    DM11. Which characteristics do you expect from the experts?
        a. The experts are imposed by the management ☐
        b. I expect technical knowledge ☐
        c. I expect experience ☐
        d. Other (indicate) …………………………………………………

    DM12. Under which conditions would you use a Decision Support System?
        a. Because it has been successfully used by other companies
            from my industrial sector ☐
        b. Because it has been proposed by a reliable consulter ☐
        c. Because it has an academia-scientific recognition ☐
        d. Other (indicate) …………………………………………………

    DM13. What would you ask a Decision Support System for? ……………………….