**Innovation and decision making: understanding selection and prioritization of development projects**

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**Abstract** - This paper examines the problems decision makers experience when selecting and prioritizing new ideas and development projects. It is based on an explorative study, with interviews carried out in three companies that have new product development as a core competitive factor.

The findings indicate that to deal with all the situations and problems that may arise in the innovation process, various approaches for making decisions and understanding innovation are needed. However, regardless of the appropriateness of these approaches for given circumstances, they receive different levels of acceptance at an organizational plane. This puts decision makers in the conflictive situation of sometimes having to use approaches to work that are appropriate but not accepted, and other times accepted but inappropriate. Furthermore, an organization’s potential to create new products, and consequently its future competitiveness, depends on how its members deal with the organizational acceptance of the approaches used.

We discuss the implications of these findings for designing work procedures for selecting and prioritizing ideas and projects.

**Keywords** – Decision making, innovation, organization, process design, project selection

I. INTRODUCTION

The selection and prioritization of development projects has been studied in several research areas, such as new product development, multi project management, and project portfolio management. Most of the literature has focused on the development of methods and tools, aiming to achieve optimal solutions for the selection of a group of projects [1–3]. In addition, some authors treat selection and prioritization as a decision making process, describing it as complex and dynamic [4], multi-staged, involving groups of decision makers [5], and presenting multiple and often conflicting objectives [6].

The literature mainly asserts that company decision making regarding what ideas and projects to develop is a matter of a priori portfolio composition, planning, and scheduling [7]. Thus, an appropriate set of methods and tools, integrated in a formal and sequential decision making process, should lead to optimal decisions [2,4]. If problems arise, they should be solved through more clearly defined strategies, better product planning, clearer information about customer needs, and more systematic selection procedures [3]. Furthermore, some authors point out that decision makers are expected to display particular behavior: they are supposed to work together towards common organizational goals, despite having different decision objectives [5,8], be willing to compromise [1], and take into account opinions of different people [3].

At the same time, some recurrent problems that arise in decision making are also described in the literature. These are presented as either the consequence of the undesirable behavior of decision makers or the incorrect execution of the proposed models. However, few explanations of the causes of those problems have been presented. The most important of those recurrent problems are as follows:

- Ideas are simply approved and development projects started without considering the available resources, consequences for other projects, or the balance of the whole portfolio of projects [1,7,8]. This results in companies having too many projects for their resources, projects being delayed, and overall project scheduling that fails [3,7]. Strong expressions are used to describe this problem, such as “disastrous result” [8], “resource allocation syndrome” [7], or “crunch in resource allocation” [9].
- Though it appears easy to start a new project, it seems to be difficult to stop one. According to Cooper et al. [4], a project that has been started takes on a life of its own. It is not easy to justify to an organization that an idea must wait or to stop another ongoing project [1,8,10], even though its implementation is no longer justified on a business basis [4]. This decision making pattern is harmful and results in too many ongoing projects, lower morale [10], long development times [3], and a reduction of a company’s future success potential and competitive advantage [4].
- Furthermore, decision makers display even more remarkable patterns of behavior that do not match those assumed in the literature. Managers sometimes consciously promote certain projects to the crisis point, forcing top management to give them high priority [7]. In some cases, influential people arbitrarily select a certain project, called “the pet project of some senior manager” [8]. What is more, it was found that development departments may have “hidden agendas”. That is, some people may not accept decisions officially made by formal decision making forums, while others carry out projects without management knowledge [1].
To summarize, the mainstream literature on selecting and prioritizing development projects has proposed models based on the use of analytical tools and formal processes, and the existence of decision makers willing to compromise and give precedence to overall organizational goals. However, companies experience recurrent problems during the decision making process, problems that are not solved or explained by the proposed models. There is thus a need for a deeper understanding of the whole decision making process, the organizational phenomena it implies, and the causes of the problems identified [1,7].

This paper aims to build an understanding of the problems decision makers experience when selecting and prioritizing new ideas and development projects. It also discusses the implications of this understanding for the design of procedures for selecting and prioritizing new ideas and development projects.

II. METHODOLOGY

A qualitative research study, based on semi-structured interviews as described in [19], was carried out in three companies. Respondents were asked to talk freely about how various organizational processes are carried out, how they consider these processes should be carried out, and what problems arise in these processes. The processes discussed in the interviews were as follows:

- Generating and handling new ideas
- Evaluating ideas and starting projects
- Prioritizing projects
- Developing product development strategies
- Allocating resources among projects

In total, 30 respondents were interviewed, including general managers, business unit managers, product managers, development managers, and project leaders. Interviewees were selected from among those with an active role in decision making regarding the selection and prioritization of ideas and projects.

The studied companies have product development as a core competitive factor, meaning that the business strategy of each company is based on improving existing products and developing new technological platforms.

- Company A develops, produces, and sells high-tech machinery for the electronics industry. Their product development requires highly qualified personnel in several disciplines and technological areas. The company has about 500 employees, including 100 directly involved in development activities.
- Company B develops, produces, and sells machinery for diverse industries, including aerospace and electronics. The products have a medium grade of technological complexity, encompassing mechanical and electronic components and software. The company has about 350 employees, including 90 directly involved in development activities.
- Company C develops, produces, and sells mechanical and electronic solutions for property security. Its products range from a low to a medium level of complexity. The company has about 1000 employees, including 30 directly involved in product development.

Empirical data from the interviews were simultaneously gathered, analyzed, and interpreted. By comparing the data from different interviews, we discovered conceptual categories as well as their properties and inter-relationships. After the analysis, a new literature survey was carried out, guided by the concepts discovered in the analysis. A final discussion was made based on the empirical analysis and the literature survey.

III. EMPIRICAL RESULTS AND ANALYSIS

This section examines how data analysis and interpretation led to the formulation of categories and to the definition of their properties and of the relationships between them; this finally led to the identification of particular decision maker problems. Specifically, we present the information from the empirical data that led to the different interpretations and conceptualizations.

Apparent contradictions

The preliminary reading of the empirical material gave the impression that respondents were giving contradictory descriptions of how the decision making process worked versus how it should work. For example, respondents talked about the importance of planning and forecasting, while concurrently expressing the impossibility of predicting everything. They advocated the use of objective financial figures in evaluating ideas; then some minutes later, they argued for the necessity of subjective judgment. One respondent stated that the existence of written routines was imperative, then immediately explained how ideas are developed informally in coffee breaks. While it was argued that high levels in the hierarchy should make the most important strategic decisions, other stories told of projects started at low levels in the hierarchy without permission. These apparently contradictory statements were coded, in an attempt to discern order. Analysis of the coded material demonstrated that respondents consistently referred to choice in the decision making process. This choice was related to different approaches for making decisions and understanding innovation. We describe the four dimensions of this choice to which respondents referred:

- Understanding of innovation: respondents alternated between two approaches to explaining how innovation occurs or should be managed. We categorized these as the static and dynamic paradigms.
• **Rationality in means**: respondents described a choice when making decisions between using rational analytical procedures or non-rational means, such as intuition and “gut feeling.”

• **Formalization of processes**: respondents spoke of a choice between formal and informal processes.

• **Exercise of power**: respondents referred to the organizational hierarchies that participate in the decision making process and the extent to which they influence it. We categorized the alternatives as hierarchical and non-hierarchical.

The apparent contradictions arise because the alternative choices in each dimension appeared to be opposed, as shown in Table 1.

<table>
<thead>
<tr>
<th></th>
<th>Static</th>
<th>Dynamic</th>
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<tbody>
<tr>
<td>Innovation can be forecasted and planned</td>
<td>Rational</td>
<td>Non-rational</td>
</tr>
<tr>
<td>Analytical procedures that aim to achieve optimal decisions</td>
<td>Intuition and subjective evaluations; particular interests prevail</td>
<td></td>
</tr>
<tr>
<td>Structured and written processes, such as stage-gate models.</td>
<td>Meetings and decisions without any written procedure</td>
<td></td>
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<tr>
<td>Highest organizational levels influence decisions</td>
<td>Hierarchical</td>
<td>Non-hierarchical</td>
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<td></td>
<td>Decisions made by middle managers without higher approval</td>
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**TABLE I**

**Approaches for making decisions and understanding innovation**

Explaining the need for the contradictory ways

Daily reality for people involved in decision making seemed to present a constant choice between contradictory approaches for making decisions and understanding innovation (see Table I). Further analysis of the empirical data was done to ascertain the reason for this. We discovered that, due to the complexity of the innovation process, there is no single approach for making decisions or understanding innovation that is suitable for all situations. In other words, the different approaches are not contradictory but *complementary*, enabling solving all type of problems that may arise in the innovation process. The empirical data indicating the contributions and limitations of these different approaches to understanding information and to making decisions are presented as follows and summarized in Table II.

• Empirical data indicate that understanding innovation in terms of the static paradigm is suitable when information about the environment, ideas, and projects is unambiguous and certain. This allows planning and controlling to be done, at the same time which makes people feel safe. However, it leads to frustration when plans are not fulfilled and does not help people or organizations prepare themselves for change. Instead, the dynamic paradigm helps in preparing for change and reprioritizing in a less traumatic way.

• Rationality of means help decisions become accepted internally, by showing that an optimal decision was made and by communicating the grounds on which it was made. However, rational methods are unable to solve problems or make decisions when the information is uncertain or ambiguous. This situation often arises in the early stages of an idea. In these cases, non-rational means, such as intuition, allow projections and decisions to be made based on the knowledge and experience of a number of people. However, non-rational means have the limitation that they encounter difficulty being accepted because management is unable to demonstrate that they were made impartially and that the best alternative was chosen.

• Formal processes facilitate the control and follow up of decisions, processes, and projects. They also make it possible to ensure that crucial aspects are taken into account when making decisions and prevent strong personalities from making their opinions prevail. Decisions made via formal processes are accepted in organizations, because it is clearly stated who made the decision and what criteria were used. In some cases, for example, in the early stages of an idea, an informal approach is chosen because the available information is not suitable to fulfill the requirements of formal models. Thus, discussions of an idea to gain the support of key actors are carried out informally outside any formal procedure. Informal processes present the difficulty of communicating how decisions were made.

• High levels in hierarchies apply a perspective that goes beyond particular interests, to ensure that decisions are made according to overall organizational goals. Thus, hierarchically made decisions can resolve conflict arising from two business units competing for resources. Non-hierarchical decisions are made when new ideas are considered promising by middle managers. Making decisions lower in a hierarchy allow for more rapid further development, without having to wait for higher-level authorization.
Discovering the real conflict

However, this ongoing alternation between different approaches for making decisions and understanding innovation seemed to be somewhat difficult for decision makers. In interpreting the empirical data, it appeared that decision makers experienced constant conflict. Is it this ongoing choice between paradigms and means that decision makers experience as conflict? Or is it something else? The encoded material was analyzed once again, and decision makers’ real conflict was identified.

Respondent comments present some ways of working as the “right” ones. At the same time, respondents described situations in which these “right” ways were inappropriate. In these cases, they described the use and appropriateness of other approaches, but other approaches are never described as the “right” ways of working. Moreover, they expressed frustration at the lack of success in using accepted work approaches. Thus, the real conflict decision makers experience arises because some approaches for making decisions and understanding innovation are more accepted in the organization than others. Those approaches that receive a high level of organizational acceptance are assumed to be “right” ways of doing things, regardless of how appropriate they may be in particular circumstances. This puts decision makers in the awkward situation of sometimes having to use approaches to work that are appropriate but not accepted, and other times accepted but inappropriate. It is important to note that the different levels of acceptance of the different approaches were identified at an organizational but not an individual plane. That is, we interpret that respondents depicted a collective accepted discourse about the “right” ways of working.

Interpretation of the empirical data led to the conclusion that the static paradigm, rational means, formal processes, and hierarchical decision making receive a higher level of organizational acceptance than do the dynamic paradigm, non-rational means, informal processes, and non-hierarchical decision making. The indicators in the empirical data that led to that interpretation are as follows and summarized in Table III.

- Respondents spoke of the static paradigm as the accepted way of understanding innovation. Thus, forecasting and planning are described as ideal ways of working. Reprioritization and changing plans are presented as undesirable and experienced by respondents as somewhat of a failure. At the same time, innovation is explained in terms of the dynamic paradigm, though this is not described as an accepted explanation; rather, it serves to mitigate anxiety and frustration when plans cannot be fulfilled.

- Rational means and behavior were advocated by interviewees as the right way to make decisions. Non-rational means are allowed to contribute, but only if followed by the use of rational means, to facilitate organizational acceptance of the decisions made. For example, some ideas first evaluated by intuition are further developed by avoiding decision gates or by being presented in terms of optimistic projections. Then, when the ideas reach a certain level of development, a formal decision can be made via rational means. Moreover, business units influence decision making to defend their particular interests, though this is never depicted in the empirical material as the “right” way of behaving.

- Decisions made in informal ways are at some point forced to undergo formal processes. Respondents described how most of the actors that participate in a formal decision meeting use to being involved before in informal discussions. As a consequence, many decisions have already been made, and some actions, that imply allocation of resources, have already been done, before they are forced to be considered in formal meetings. In other situations, a formal procedure is not considered the most appropriate way to solve a problem, so some phases of it are bypassed. For example, in early stages of development projects, when ideas are not possible to be defined in a clear way and described by certain information, stage-gate models are largely not put into practice.

- From the empirical material, it appears that it is accepted that higher levels of hierarchies should make strategically important decisions. Despite that apparent acceptance, middle managers complain that they are not allowed to take responsibility for their own decisions. In company A, for example, middle managers resolve this situation by initiating action without waiting for higher-level approval, when they consider that a decision is correct. This is not described in the empirical material as the “right” way of behaving, and in practice, at some point, such decisions tend to be validated by higher level of the hierarchy.
There were two main findings from the analysis of the empirical data. First, due to the complexity of the innovation process, different approaches for making decisions and understanding innovation are needed to deal with all problems and situations that may arise. Second, decision makers experience conflict, because some approaches receive a higher level of organizational acceptance than others do, regardless of their appropriateness for given circumstances.

**Critical analysis of literature**

The prescriptive literature on selecting and prioritizing ideas and projects has mainly proposed formal, sequential, and analytical methods. Besides, it has assumed that the innovation process can be managed through forecasting and planning and that decision makers display rational behavior. According to our findings, those models and assumptions are based on the static paradigm, rational means, formal processes, and hierarchical decision making. Those are the approaches for making decisions and understanding innovation that receive a higher level of acceptance at an organizational level. However, this captures just one side of the means required to explain and deal with the problems that arise in the innovation process, so much of the prescriptive literature is inadequate when it comes to explaining and solving decision makers’ problems.

**Synthesizing the results**

To provide a basis for a more general understanding of decision making in the context of innovation, the previous analysis needed to be further developed. Accordingly, we conducted a literature survey, directed by the above findings, looking into areas not commonly connected with the selection and prioritization of development projects.

Reference [11] presents two ways of explaining how organizations change and are capable of renewal. The first states that activities are organized according to pre-defined long-term outcomes and that organizations tend to reach equilibrium. The second states that long-term outcomes cannot be pre-determined and that organizations work through dialog under conditions of conflict and ambiguity. The former explanation helps us understand organizations operating under conditions of stability and certainty, and that repeat past behavior; the latter describes organizations operating under conditions of change and newness. As well, it is stated that both formal and informal systems coexist in organizations, where they make different contributions. Formal systems contribute to efficiency by establishing well-defined hierarchical structures, rules, and procedures. At the same time, informal systems contribute by allowing room for a plethora of contradictory human needs, such as conformity, excitement, innovation, and individuality [11–13]. Furthermore, organizations use non-rational means when ambiguity and power struggles do not allow for rational decision making [14].

Planning processes, analytical techniques, and stage-gate models are not applicable in conditions of great uncertainty; despite that, they are used in just such circumstances [11,13]. Furthermore, it becomes difficult to obtain personnel and financing for projects that do not follow structured models [13]. Actors who make decisions in non-rational ways use the formal stage-gate model to justify such decisions already made and to display rational behavior [14]. Even though intuition is considered a highly useful human faculty, it is still somewhat controversial to use intuition as the basis for decision making, because it is seen as opposing analytical forms of thinking [15]. In addition, the static paradigm for understanding innovation leads inevitably to frustration and anxiety, because, according to it, failing to identify innovation in advance indicates incompetence [16].

The above-cited sources indicate that the need for different approaches to dealing with innovation complexity can, indeed, be generalized, though the task is beyond the limits of the present empirical study. They also reveal that the dynamics in which these different approaches interact in dealing with problems in innovation are very complex. As well, this literature offers evidence that the level of organizational acceptance of different ways of understanding innovation and decision making is not related to their appropriateness for use in given circumstances.

Both the literature survey and the empirical study show that the output of the innovation process is strongly determined by the dynamics in which the different identified approaches are used. The empirical study also reveals, however, that these dynamics depend on how decision makers deal with the different levels of organizational acceptance of the different approaches. Thus, to understand and design work procedures for selecting and prioritizing development projects, the different levels of organizational acceptance of these approaches and how decision makers deal with this acceptance should be considered important variables.

<table>
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<th>TABLE III</th>
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<tbody>
<tr>
<td>Dealing with different levels of acceptance of approaches for making decisions and understanding innovation</td>
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<tr>
<td>High level of acceptance</td>
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<tr>
<td>Static</td>
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<tr>
<td>Rational</td>
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<tr>
<td>Formal</td>
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<tr>
<td>Hierarchical</td>
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**IV. DISCUSSION**

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V. CONCLUSION

To deal with all the situations and problems that may arise in the innovation process, different approaches for making decisions and understanding innovation are needed. However, despite how appropriate these approaches may be for given circumstances, organizations display different levels of acceptance of them. This puts decision makers in the conflictive situation of applying approaches that are sometimes appropriate but not accepted, and other times accepted but inappropriate.

The output of the innovation process depends not only on the organization's ability to carry out activities traditionally described as part of the innovation process. They also depend on decision makers' ability to deal with organizational acceptance of the intended means. Thus, how an organization deals with this conflict would have consequences for its ability to deal with complex problems, achieve collective understanding, interpret its environment, and prepare itself to change.

The prescriptive literature on selecting and prioritizing development projects has mainly focused on the approaches for making decisions and understanding innovation that receive a higher level of organizational acceptance. This emphasis means that this literature is inadequate when it comes to solving or explaining recurrent problems that decision makers face. Furthermore, researchers and practitioners must be aware of the potentially negative consequences of using models based on a limited selection of approaches.

The dynamics in which the different approaches are used to deal with innovation complexity are affected by the organizational acceptance of the approaches. Thus, the organizational acceptance of the approaches and how decision makers deal with this acceptance should be considered important variables when seeking to understand the selection and prioritization of development projects and to design work procedures for these processes.

This study does not attempt to explain why different approaches to understanding innovation and decision making vary in acceptance at an organizational level. Some authors argue that these different levels of acceptance are rooted in social factors beyond organizational boundaries [18,17,13]. Empirical studies in different settings than the ones presented in this study and the use of various perspectives, as e.g. institutional theory, can provide new elements for the further development of our findings or the discovery of new concepts. More research is needed if we are to understand organizational acceptance of these approaches and of how they can be used when designing work procedures.

Finally, further research is needed into the dynamics in which the different approaches for making decisions and understanding innovation interrelate in dealing with innovation complexity and how they determine the output of the innovation process.

VI. REFERENCES