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# LEARNING FROM INNOVATION ECHOES IN MATURE ORGANIZATIONS
# THE CASE OF THE AUTOMOTIVE INDUSTRY

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## ABSTRACT
*In competitive industries, intensive and repeated innovation is a recognized necessity (Wheelwright and Clark, 1992; Le Masson et al., 2010). Literature on innovation (Utterback, 1994; Henderson & Clark, 1990) distinguishes Dominant Design revisions (radical innovations) from local improvements (incremental innovations). Regarding the innovation process management, one success factor lies in the knowledge articulation between front end and new product development (NPD) stages (Koen et al, 2002; Cooper et al, 2001). Then, central issue becomes NPD stakeholders' management (Elias et al., 2002) and their ability to establish perennial learning dynamics across the two parts of the organization (O'Connor, 2008). Our paper fits into this research field for local innovations on the dominant design. We discuss the role of technical expertise level of NDP stakeholders involved in early stages. The research mobilized two longitudinal studies (Yin, 1989) carried out with a global car manufacturer since 2005, one focusing on the innovation management process and organization, while the other was devoted to learning dynamics of engineering development departments. Leading as collaborative management research (Hatchuel and David, 2007), analyses were enhanced through deep interviews with project managers, technical experts and decision-makers.*
*Analyzing local innovation impacts, we find that effect of breakthrough innovation projects on NPD organization was similar to waves: close expertise are quickly and strongly affected while distant expertise are more weakly and later affected. Our research material shows that tracking of key stakeholders is based on functional division of the organization whereas force and temporality of the innovation impact could potentially follow other propagation logic. Stakeholders identified by the organization as key actors could be in reality weakly impacted but we observed they were able to convey useful knowledge to heavily affected actors inside their organization when they had a high level of technical expertise of the dominant design. Expertise robustness plays a screen role that returns, as an amplified echo, the innovation low impact on their technical perimeter toward those heavily impacted.*

## INTRODUCTION: IN SEARCH OF A PROCESS TO IDENTIFY INTERNAL STAKEHOLDERS OF R&D PROJECTS

Industrial expectations to management research on breakthrough innovation project processes has two main dimensions: first, measurement and performance management of activities and second, models of financing innovation projects that disrupt established organizations and business models.

In response to these issues, many studies describe the components of management process to design, deploy and maintain a cross-functional management of innovation projects from the early stages of fuzzy front-end to the commercial phase of a new product (Weelwright and Clark, 1992; Koen et al, 2002). Processes are intended to describe maturity levels and content of decision milestones to ensure the robustness of projects at each stage of design (Cooper et al, 2001), to help achieve an internal consensus on the value of the project and its potential deliverables (Hooge and Hatchuel, 2008), to secure and stabilize the allocation of resources (Hall, 2000), and to introduce flexibility in projects' funding in accordance with decisions taken at milestones (Akroyd et al, 2006).

Compared to conventional forms of management of new product development, breakthrough innovation project is characterized by uncertainties surrounding each characteristics of a project (objectives, constraints, management and organizational structure); an "evolutive" planning progress and its associated managerial decisions (validation, redirection or stop), and the complex network of stakeholders within the company who influence the advancement of the project and its guidelines (Le Masson et al, 2010).

To establish proposals on the monitoring process, it is therefore necessary to identify actors and decision makers of innovation projects and their expectations towards the management process. This dimension of project management then concentrates on the construction and the gradual consolidation of the commitment of internal stakeholders to activities of innovative design of the company. If one considers that the financing of breakthrough innovation is a consequence of the involvement of internal stakeholders, identification and commitment of internal stakeholders to breakthrough innovation projects are leading issues of R&D management process. This paper fits into this research field by studying the conditions of identification of internal stakeholders of breakthrough innovation project and the skills needed by these players network to allow that type of divergent activity in companies with a strong dominant design (Utterback, 1994; Henderson and Clark, 1990).

## STATE OF THE ART ON INTERNAL STAKEHOLDERS IDENTIFICATION: PURPOSE AND ISSUES

### State of the Art on Internal Stakeholders of R&D projects

Since the creation of the word "stakeholder" by Ansoff and Stewart in 1963, and particularly since the work of Freeman in 1984, Stakeholder Theory has progressively deployed through several books and numerous scholar articles that describe and improve several approaches of a strategic management of stakeholders (Elias, Cavana and Jackson, 2002). Beyond the scope of analysis the company through its industrial and economics trades, Stakeholder Theory is announced as a theory of the firm that integrates social and political exchanges between actors (Post et al., 2002). The abundance of work in this field has led to the coexistence of many definitions of stakeholder concept and approaches became divergent: descriptive, instrumental or normative approaches (Donaldson and Preston, 1995); strategic or ethical (Jones and Wicks, 1999), etc. This break-up has lead to confusion or ambiguity about Stakeholder Theory content and central definitions (Elias and Cavana, 2000; Cavana and Jackson, 2002). Nevertheless, the various streams agree on the importance of a systematic identification of activity stakeholders: the understanding of expectations and stakes determine the potential progress of the activity as far as achieving targets. As highlighted by Andrioff and Waddock, the identification exercise is a component of organizational control: without the commitment of stakeholders on a project, the entire organization may no longer support the activity (Andriof and Waddock, 2002).

The most popular definition of stakeholders in literature is Freeman's that designate all individuals or groups who affect or are affected by the achievement of corporate goals (Freeman, 1984) but for our study, we rely on the more precise definition of internal stakeholders proposed by Post, Preston and Sachs (2002): *« The stakeholders in a firm are individuals and constituencies that contribute, either voluntarily or involuntarily, to its wealth-creating capacity and activities, and who are therefore its potential beneficiaries and/or risk bearers. ».* Indeed, we are interested here in this particular case of the combination of internal stakeholders with the representatives of

external stakeholders within the company.

Many authors stress the importance of a correct diagnosis of stakeholders in the management of R&D in order to achieve a project (Freeman, 1984; Mitchell, Agle and Wood, 97; Coombs et al., 1998). The approach of Mitchell, Agle and Wood (1997) helps to understand potential dissymmetry between stakeholders through preliminary interactions. Authors divided actors in three attributes:

- Power: the stakeholder has coercive, utilitarian or normative ability to impose its will in the relationship;
- Legitimacy: judgments and acts of the stakeholder are commonly perceived or assumed as desirable, proper and appropriate;
- Urgency: stakeholder's claims are received as critical or highly important by others.

The more players combine attributes, the more they should be considered essential in steering the project and their aims and expectations must be integrated into the process of value building of a breakthrough innovation.

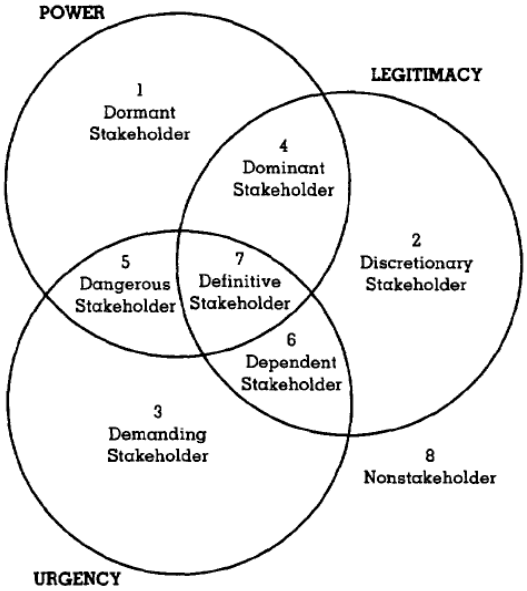


Figure 1 : Qualitative classes of Stakeholders
(Grille de Mitchell, Agle and Wood, 1997)

Including the concept of urgency to the attributes of power and legitimacy already presented in the work of Freeman, Mitchell, Agle and Wood feed the views of a dynamic management of stakeholders. Authors emphasize the influence of time on the attributes of stakeholders (Mitchell, Agle and Wood, 1997): « *Static maps of a firm's stakeholder environment are heuristically useful if the intent is to raise consciousness about « Who or What Really Counts »*[1] *to managers or to specify the stakeholder configuration at a particular time point. But even though most theorists might try for static clarity, managers should never forget that stakeholders change in salience, requiring different degrees and types of attention depending on their attributed possession of power, legitimacy, and/or urgency, and that levels of these attributes (and thereby salience) can vary from issue to issue and from time to time.*»

[1] Authors refer to the principle of the same name previously developed by Freeman: « *On such principle, which I will call ''The Principle of Who an d What Really Count'', says that the primary function of the corporation is to enhance the economic well-being, or serve as a vehicle for the free choices of, the owners of the corporation.* » (Freeman, 1994).

Elias, Cavana and Jackson proposed a combination of Freeman's and Mitchell, Agle and Wood's recommendations to establish a process for systematically identified stakeholders and their interests in an R&D project (Elias, Cavana and Jackson, 2002).

1. Develop a stakeholder map of the project
2. Prepare a Chart of specific stakeholders
3. Identify the stakes of stakeholders
4. Prepare a power versus stake grid
5. Conduct a process level stakeholder analysis
6. Conduct a transactional level stakeholder analysis
7. Determine the stakeholder management capability of the R&D project
8. Analyse the dynamics of stakeholders

Figure 2: Eight steps of a systematic stakeholders analysis of an R&D project (Elias, Cavana and Jackson, 2002).

With this process, project leaders are leading to systematize the association of the identification of a new actor with the description of these expectations and its bargaining power with other actors. However, the language of characterization of stakeholders, their expectations and their modes of interaction remains to build. Moreover, this approach provides us with no evidence on the processes of involvement and support of stakeholders in R&D.

**The slack between identification, commitment and expertise of internal stakeholders of R&D projects**

Breakthrough innovation projects differ from other design activities of new product development by their ability to introduce new design rules in NPD process or to make evolve corporate standards (Utterback, 1994; Le Masson, Hatchuel and Weil, 2010).

NPD projects of large industrial firms are the result of multidisciplinary interactions of an actors network, often very large and complex. In the case of breakthrough innovation, as opposed to conventional projects, all relevant actors are rarely identified at the start of project: building the network of stakeholders in the innovation takes place along the way, associated with the definition of business opportunities and description of deliverables. According the indefinite state of objects in the first stages, it is not uncommon that debates on innovation potentials feed exacerbated reactions of supporters and opponent's players inside the stakeholder's network (Akrich and Latour, 2002). Consequently, the success of a breakthrough innovation project depends on the firm's ability to detect and involve internal stakeholders in the process of definition of potential value.

According to L. Meade and A. Presley, internal stakeholders of an innovative project fall into four groups with different interests and expectations: management, marketing, manufacturing and technologists. Understandably, these four types of actors convey needs and desires of innovation, often contradictory, hence the difficulty to integrate and reconcile the wishes of all stakeholders (Meade and Presley, 2002). Therefore, NPD stakeholders are numerous and often stretched in large firms, which impedes the building of a consensual decision, because of the scarcity of debates of different points of view. In response to this predicament, reasons to consider as illegitimate decisions taken within the framework are proliferating. First, all stakeholders are not always represented at decision-making committees. Furthermore, corporate leaders usually chair this type of meetings so players' games

are very powerful during sessions. Also, divergent positions without prior consultation with other actors may be perceived as a desire to get ahead personally and therefore presents a high risk of exposure to conflict whose outcome is highly uncertain, because the debate could lose its rationality. To avoid this situation, project leaders promote a process of negotiation and consultation before committees. JK. Christiansen and C. Varnes studies show that decision-making sessions are actually places of justification and legitimization of decisions that the various stakeholders have taken prior to these meetings: *"Innovation projects actually consist of myriad actions, negotiations, and micro-decisions in the effort to create strong networks, leaving few decisions for the official gate and portfolio meetings."* (Christiansen and Varnes, 2007).

Building a consensus among stakeholders is therefore based on the quality of the debate before decision-making sessions where consensus will ultimately be acted. As the potential of a breakthrough innovation project is intrinsically unclear at the beginning of the project, it appears that this negotiation process between internal stakeholders leads to the collaborative design of the innovation value for the firm. So, identification and commitment process of actors have to be lead by this point: how project leaders could know if actors they involved are able to explicit and built together the value for the firm in order to propose new design rules of product?

## THREE HYPOTHESES ABOUT RELEVANT IDENTIFICATION AND INVOLVMENT OF INTERNAL STAKEHOLDERS

If literature underlines the necessity to identify as early as possible key NPD stakeholders and to involve them, the process is implicitly considered as achievable by front-end actors. Yet in the case of disruptive innovations, the unknown is very important to start the project, both technically and economically and few dimensions are fully unpredictable during the first steps of fuzzy front end. This unknown influences had been described by Pich, Loch and de Meyer as "Unknown unknowns" in contrast to "known unknown" which are uncertain but indentified dimensions (Pich, Loch and de Meyer, 2002). When this "Unk Unks" affect the project progress, new internal stakeholders could appear. So, our first hypothesis assumes that **front-end organizations are not able to distinguish NPD stakeholders primarily affected by a breakthrough innovation until design achievement (Hyp 1).**

Nevertheless, at the beginning of a breakthrough activity, some central actors have to be systematically included in the decision process: the owners of resources for fuzzy front end explorations, R&D portfolio managers and long-term Marketing representatives. Beyond this first round, a macroscopic analysis of the dominant design dimensions that are being questioned – with the existent definition of the project perimeter - allows to identify a preliminary set of NPD actors that must be associated to the value definition process. To identify these stakeholders, front-end actors rely on the organizational segmentation that is usually based on routine development activities. Therefore, **the efficiency of key stakeholders identification depends on the adequacy of the traditional NPD activities segmentation to the perimeter of the innovation project (Hyp.2)**. However, the organizational segmentation seems *a priori* inappropriate to represent the network of internal stakeholders of a breakthrough innovation precisely because it is the transcription of the dominant design of the firm that the project seeks to disturb.

Consequently, we must assume that an organizational identification process does not allow front-end players to effectively identify NPD stakeholders of innovation.

However, breakthrough innovations exist in large firms so inadequate tracking could not impair innovation deployment. One plausible explanation for the ability of firms to overcome a flawed identification is that wrongly identified actors could be able to involve appropriate NPD stakeholders as the innovation project progress. From a design point of view, we assume that **the ability to shift from the dominant design stakeholders network to the breakthrough innovation network is correlated to the technical expertise of the dominant design from the first network members (Hyp.3).**

The validation of these three hypotheses could enable us to support that innovation deployment in NPD process relies more on the robustness of dominant design expertise of key stakeholders than on their identifications by front-end actors.

## RESEARCH MATERIAL AND INVESTIGATION METHODS

The research mobilized two longitudinal studies (Yin, 1989) carried out with a global car manufacturer since 2005, one focusing on the innovation management process and organization (Hooge, 2010), while the other was devoted to learning dynamics of engineering development departments (Dalmasso, 2009). The issue of the involvement of traditional NPD actors in breakthrough innovation activities from the first steps of design to the implementation of the new design rules in engineering development departments has been discussed in the two study and benefits of the crossed perspectives of the knowledge acquired by researchers on stakeholders from the two parts of the organization.

The distinctive features of the studied project portfolio lie in its technological and organizational variety: projects have very different technical and economic challenges or stakeholders' combinations. Leading as collaborative management research (Hatchuel and David, 2007), analyses were enhanced through deep interviews with front-end and NPD project managers, technical experts and decision-makers. Our approach differs also from the majority of studies on projects valuation and selection by a statistical approach of resource commitment on innovation projects. Yet, in addition to interviews, we had access to detailed analysis of projects, budget allocations and supports, as well as project teams' composition and evolution that allow us to detail the involvement of actors from front-end teams and from traditional NPD teams. This statistical analysis has been performed from the beginning of 2007 to the middle of 2009.

The gathered material allowed discussing the following hypotheses across two main insights: the discussion of the organization charts from an evolving dominant design model approach and the New Product Development Process analysis from a stakeholder commitment point of view.

## WHAT IS EXPECTED FROM AN INTERNAL STAKEHOLDER COMMITMENT PROCESS FOR BREAKTHROUGH INNOVATION PROJECTS? IMPROVING OUR HYPOTHESIS IN THE AUTOMATIVE INDUSTRY

To test our hypothesis, we started our study by a detailed characterization of the different states of discomfort on the issue of internal stakeholders management that an important firm of the automotive industry met in it breakthrough innovation activities. In 2007 and 2008, we build two different approach of the case to test our hypothesis that we describe below: the first to model the internal stakeholder network from an

organizational approach and the other to quantify the involvement of internal contributors from an accounting approach, monitoring the consumption of resources on breakthrough activities. This analytical phase was to learn and model on three points:

- when the different stakeholders were identified and involved;
- where they were located in the firm from on organizational interpretation;
- how they had been identified and who was the actors that had done the identification, and subsequently how they were involved in breakthrough activities.

**Building a cartography of innovation stakeholders according to organizational chart and the traditional NPD process of the firm**

In order to model R&D stakeholder's interactions within the firm partner, we used the approach of Mitchell, Agle and Wood (1997). This typology facilitates early identification of stakeholders because it is very meaningful for managers. They can easily associate concrete actors in these categories:

- Holders of power are most often resources owners and corporate managers;
- Holders of legitimacy are technical and market experts or experienced leaders;
- Holders of the emergency are those who bear the risks of the project.

With designers and managers, we have mapped the R&D stakeholders by attributes from fuzzy front-end stages to development stages. The exercise had generated a fruitful discussion on the expected role of each stakeholder in fuzzy front-end projects, inside and outside the decision-making process because the mapping underlines the disparity of the origin of rights and duties of different stakeholders and their status differences. Moreover, as part of automotive projects, the internal stakeholder network include few counterparts of the others firms of the automotive industry, but internal representatives of external stakeholders appeared spread in the firm depending to the skate of the external stakeholder they represent. Thus, members of development teams could express the interests of a supplier for technical stakes while a member of the Purchasing Department would be the spokesperson of the financial requirements and supplier contract.

If we analyze stakeholder's interactions from the aspect of industrial deployment decision, three groups of stakeholders had emerged:

- Design partners: holders of design skills from front-end to development and validation within the company and active members of many professional networks, they have individually and collectively the technical ability to implement the project. Their membership is essential to realize the innovative product;
- Product prescribers: representatives of the end customer throughout the design cycle and in charge of the definition of Vehicles Programs, their membership is essential to market effectively the innovative product;
- Decision-makers: owners of the resources of design partners and the final decision of innovation application in a vehicle by prescribers of the product, they have individually and collectively, the "right of life or death" on the project. Their membership is crucial to create the necessary conditions to develop and commercialize an innovative product. Ideally, power allows them to orient and guide the innovation strategies to implement the strategic vision of the company by a consistent deployment of new products in the range and time, through optimum mobilization of resources.

The figure below is the final map we obtain with the superposition of Mitchell, Agle and Wood's representation and the three groups involved in the industrial deployment of an innovation.

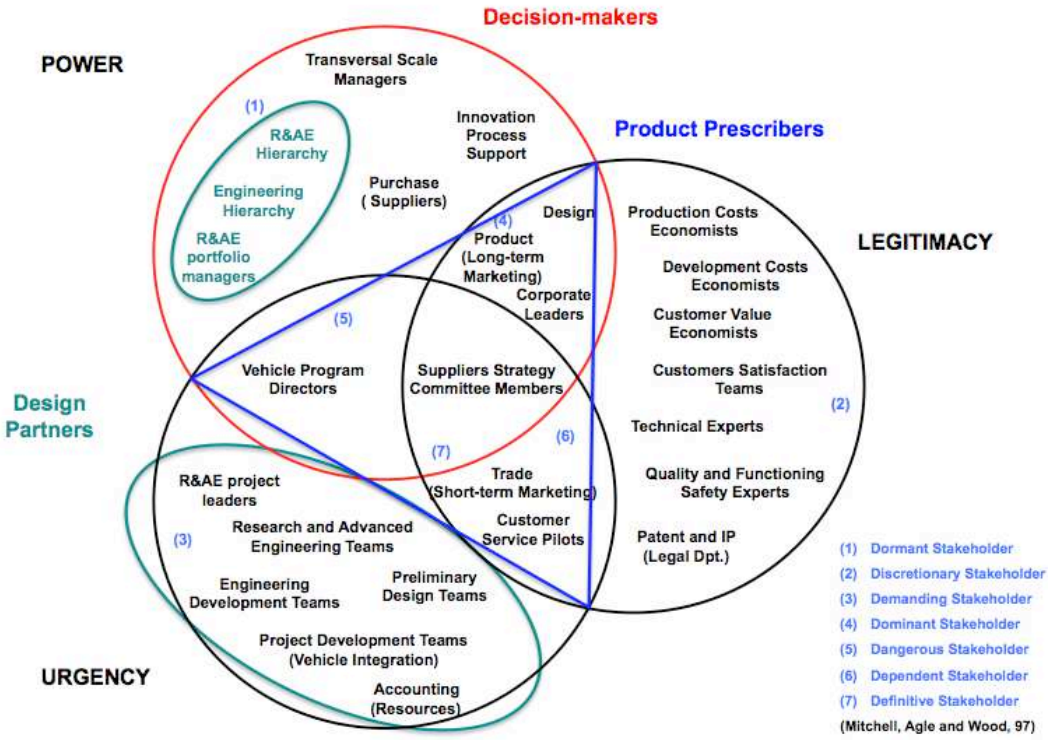


Figure 3: Cartography of internal stakeholders of an automotive firm

The issue of the identification and the commitment of competent resources is a central issue in the management of breakthrough innovation (Bessant, Stamm, Moeslein and Neyer, 2010). In many cases projects are carried out in cooperation with several parts of the organization that knowledge and know-how complete those existing inside the project team. The main barriers concern the expertise held by resources outside the organizational perimeter of the area that controls the activity, and especially development experts who are simultaneously crucial for the success of breakthrough innovation transfer to commercial development programs and so, extremely constrained by short-term needs of on-going development projects. In order to assure the success of the breakthrough innovation activity, design partners have to commit themselves for the duration their expertise is needed by the project and we assume that this commitment have to be managed continuously and as contentiously as if they were outside partners. Nevertheless, to do proposals we needed at this time a better analysis of the resources consumption by design partners on breakthrough innovation activities of the firm.

**Focus on design partners: Statistic analysis of resources involvement of Fuzzy Front-End and NPD actors**

In order to quantify the real involvement of design partners in breakthrough innovation project, we made a detailed analysis of accounting data of the firm. According to project managers of breakthrough innovation, divergences between the forecast scenarios and real resources consumption are strong and repeated across projects portfolios. In interviews, they were likely to attribute these variations to a lack of resources contractualization between the contributory department to

innovation activity that we refer as design partners, while decision makers support the hypothesis of an intrinsic difficulty of innovation activities related to the hazards of innovative design which often lead to re-schedule the most costly actions (tests, prototypes).

Knowing that no major industrial group can empower innovation activities from the rules of management control, as the other activities of the firm, breakthrough innovation activities are subject to management control of the use of human and financial resources. So, all design partners must enter into the accounting system of the company the number of hours they plan to devote to the project during the budget construction and then, month by month and individually, the time they have actually spent for the activity.

Analyzing monthly these surveys, the network of expertise sought by a given project could be quantitatively rebuild, given that captures of activity inform about the hierarchical engineering sector of the designer and the intensity of his collaboration, and also gave us the diversity of the organization branches involved. With these data we were able to construct general maps, according to portfolio of project weight in total costs and the investment distribution in the company following the technical maturity of projects (front-end or NPD studies), internal skills involved (technical cross-organizational network) or level of intrusiveness of innovation in the car dominant design. Therefore, from contributing players, we were able to reconstruct the life of the projects we studied: we were particularly interested in differential accounting transactions as they traced the difficulties of budgeting, engagement and disengagement of the players in correlation with the process of identification and commitment of internal stakeholders.

Accounting sources also contain a second data related to purchases associated with projects. Front-end purchases are of several kinds: prototypes, study contracts or subcontracting (simulations, engineering specialized, academic laboratories, etc.). The cost of prototypes give information about the maturity level of the project while contracts spending allow us to reconstruct the network outside the company mobilized by the innovation project team.

Traditionally, this information is delivered through the hierarchical levels of the organization but after a three months screening of these two sources per breakthrough activity, we proposed to consolidate this amount data and to give it monthly to all project leaders and portfolio managers. This new tool of monitoring was discussed with them and management controllers, from January 2007 to January 2009. Then, the tool was automated and is now available on the intranet of the firm.

First of all, accounting data give a concrete picture of who really are the stakeholders of the design of breakthrough innovation, their weight in the investment and where they are in the organization. The deployment of a tool for analysis of resources allocated among the various partners committed to a design project has led to a short loop visibility of the movement of disengagement or over-commitment of the sectors. The table below shows the distribution of accounting transactions analyzed of the design partners according to their membership to an area designated by the Organizational chart as Front-End or as traditional NDP. Area could either be a team of engineering research or engineering development.

| Number of breakthrough activity monitored | Number of accounting movements | Accounting movements repartition from the organization chart segmentation | |
|---|---|---|---|
| | | Front-end Engineering | Traditional NPD Engineering |
| 111 | 414 | 233 | 181 |

Figure 4: From the activity to the consumption of resources: accounting movements repartition by organizational segmentation

Then, each accounting movement on a breakthrough activity had been classified according to the deviance it presented between the budget and the real consumption of resources. When the difference was lower than 50% of the forecasts, we called it limited and when it was bigger to 50%, it is a stronger deviation. We also found movements without links to forecast where resources had not been used or conversely, resources had been consumed without had been planned. Figure 5 synthesizes these evolutions of areas resources involvement between real and forecast scenario in 2007.

| | | Maturity stage of breakthrough activity | |
|---|---|---|---|
| | | Fuzzy Front-end phase | NPD phase |
| % of number of organizational areas involved in **Disengagement** | Limited* | 5,2 | 15,3 |
| | Strong** | 3,4 | 16,7 |
| | Complete | 5,4 | 24,1 |
| | **Total** | **14** | **56,1** |
| % of number of organizational areas involved in **Over-commitment** | Limited* | 2,7 | 7,5 |
| | Strong** | 2,4 | 6,8 |
| | Complete | 3,1 | 7,5 |
| | **Total** | **8,1** | **21,8** |

*Limited = Less than 50 % of the budget
**Strong = More than 50% of the budget

Figure 5: Detailed analysis of the criticality of deviations of accounting transactions

The uncertain nature of the activities could be at the origin of fluctuations between forecast descriptions and the actual need of design teams but this cannot explain that the overall trend is consistently downward. It is clear that movements of disinvestment are only partially offset by the over-commitment on other activities, which inevitably leads to non-consumption of all resources that the company had planned to spend on breakthrough activities. Statistical analysis confirms the intuition of the front-end actors on the gradual and massive withdrawal of resources, but the detailed study also characterizes a movement of recurring and non-negligible over-commitment on some projects.

## HYPOTHESIS DISCUSSION

The both analyses of the organizational study with the internal stakeholders' map (cf. figure 3) and the accounting study (cf. figure 5) gave us a fertile background to discuss, qualitatively and quantitatively, our three hypotheses.

On the first hypothesis on the ability of front-end organization to distinguish NPD stakeholders primarily affected by a breakthrough innovation until the design achievement, the building of a map of the internal stakeholders network (cf. figure 3) has shown how some actors are considered by front-end teams as unnecessary at the

beginning of the design precisely because they did not know what could be the bringing-in of their expertise until the design perimeter will be more clear. Whereas front-end actors identify clearly the need to involve of development teams in the design process, they could not identify precisely what would be the technical need and parts of the organization they are lighting in the map could represent few dozen of engineers. So, it appears impossible to know beyond the identification of a downstream counterpart in engineering development, what are really the skills that will be needed and consequently, who are the expert stakeholders to commit in the design process as design partner.

On the second hypothesis on the effective dependency of key stakeholders identification from the adequacy of the traditional NPD activities segmentation to the perimeter of the innovation project, the analysis of internal stakeholders' map (cf. figure 3) highlights that the only actors systematically involved were top-level managers identified by the organizational chart as responsible of the development of new products. They are unavoidable representatives of the Product prescribers, Decision-makers in charge of the firm's strategy and managers of traditional product development departments, and consequently, they are those who decide what would be the next products but not those who design it.

As the segmentation of the NPD teams are similar to the dominant design of the firm (Henderson & Clark, 1990), the network of design partner thus obtained is in many case inadequate to the breakthrough needs in skills precisely because the aim of the project is to brake some of its structural components. Nevertheless, analyzing resources consumption for innovation activity, we found that effect of the design advancement on NPD organization was similar to waves. Close expertise was quickly identified and strongly involved in resources as their design rules are deeply affected; while distant expertise was more weakly and later affected. The research material of the accounting study shows that tracking of key stakeholders is based on functional division of the organization whereas force and temporality of the innovation impact could potentially follow other propagation logic. Stakeholders identified by the organization as key actors could be in reality weakly impacted but we observed they were able to convey useful knowledge to heavily affected actors inside their organization, when they had a high level of technical expertise of the dominant design. This deferred identification appears clearly on the accounting analysis: some NPD areas leave the design activity and are replaced by others but we could track the efficiency of the wave analyzing the speed of the transfer move.

Moreover, faced with the new information on the involvement of design partners, front-end managers have introduced regular reviews of risk resources with project leaders, thus encouraging interaction and loops renegotiation of resources much more sustained between design partners. In breakthrough activities, stakeholders must make the distinction between resources availability and the "right" resource availability: a project may be under-consumption compared to the budget because its progress is blocked by the unavailability of a particular expert. The availability of individual capture information has enabled project managers to explain the origin of the differences and to alert their hierarchy and the network of stakeholders. This point also leads to a better identification and involvement of who really counts for the design of a breakthrough innovation.

This results leads us to our third hypothesis on the correlation of the ability to shift from the dominant design stakeholders network to the breakthrough innovation network with the technical expertise of the dominant design from the first network members. The network of design partners could evolve in a positive way to the

project only if those involved are able to identify which are those who will be subsequently needed to the innovative design. Thus, expertise robustness plays a screen role that returns, as an amplified echo, the innovation low impact on their technical perimeter toward those heavily impacted. So the project's success depends on the ability of first stakeholders to alert and to make enter new experts in the design innovation network as and when the progress of the design allows identifying them. It appears that this ability depends more on the level of mastery of the dominant design of these players than on their ability to innovate.

Nevertheless, this hypothesis could be discuss as some actors who were not expert of the dominant design appears as determinant in the involvement of some design partners. These players were more similar to internal business angels of breakthrough innovation or architectural manager of the new design rules. So, the mastery of dominant design seems to be one way to build and maintain an efficient network, but not the only one. This result will be investigated and deepen in future research.

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