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PROPOSITION OF A NEW MODEL FOR EARLY PHASES OF INNOVATION PROCESSES

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1. Introduction

Innovation is one of the exciting challenges for industrial companies and research institutes. Indeed, this concept of innovation encompasses complex socio-technical phenomena and processes. Within the economical field, different innovation theories have been proposed in the literature. Among the different works, two main innovation models have commonly been opposed: the "science push" model (innovation pushed by the science), and the "demand pull" model (innovation pulled by the demand). However, these two models are mainly based on the two classical concepts of the economical field: the offer and the demand. Previous works [Mowery and Rosenberg 1979] [Rothwell, 1983] recognize the need to take into account both the offer and the demand to understand and manage the innovation process. But how new ideas of innovative concepts are developed and progressively accepted in industrial companies? What happens at the beginning of this venture: between the moment of the new idea generation and the decision to start a project based on this new initiative? These questions are complex because the first moments of innovative product developments are not well-defined phases of the design activity. Indeed, they are not well-known and combining different aspects such as creativity aspects but also negotiation between different partners (design, marketing, supplier, R&D…).
In this paper, we will propose a new model dedicated to the early design phases (section 2). In section 3 we will discuss about the main concepts used to build our model. Then, we will present how this model can be used according different approach and tools (section 4).

2. A new model for innovation process early phases

2.1 Early phase's charasteristics

During previous works, [Merlo and al 2004] have presented the specificity of design early phases and their hight impact on the innovation process efficiency. The authors highlights the difficulties and the weaknesses of the cooperation processes during the early design phases, especially when a new concept or an idea is proposed for consideration. During these early phases, exploring new alternatives (new technical concepts, technologies…) can prove very difficult and off-putting as the actors find themselves devoid of knowledge in certain areas and tend to remain faithful to traditional solutions that are already proven to be stable and reliable.
The model proposed by [Roozenburg and Eekels 1995] enable a better understanding if the way the ideas emanating from company developed innovations are chosen and formulated. As well, the way they are more or less oriented by a product politic. To be effective, the product politics must be supported by both a technological strategy that can lead to the reinforcerment of the company's

experience, and a commercial one that would permit the market and user information to be fed into the design process [Wheelwright and Clark, 1992].

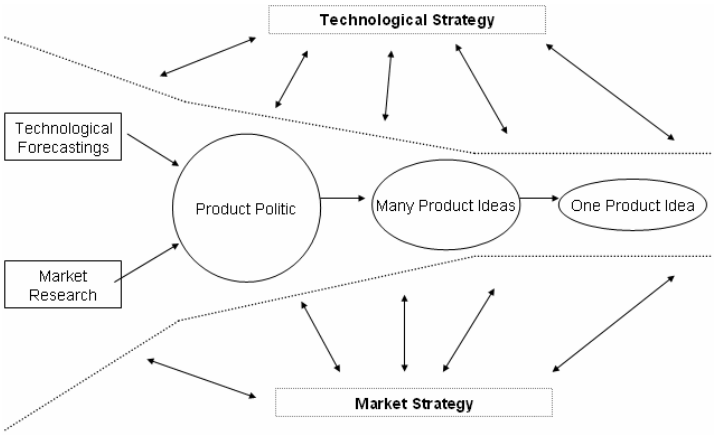

Figure 1. Product development strategy [Wheelwright and Clark, 1992]

Lauche [Lauche 2003] has made field studies concerning the innovation process preliminary phases for six Swiss innovative companies. From these, the author proposes adding the following subtasks to the creavitity phase:

1. Formulation of an innovation strategie
2. Identification of potential technical potential and technology strategy for the key competencies of the company.
3. Analysis of the market demands and opportunities to develop a product/market strategy.
4. Understanding usage and user needs to translate them into usability criteria and appeal.

We must notice that the results integrate components coming from both the "science push" and "demand pull" model. The author concludes that it crucial to allow for enough overlapping R&D, marketing and management.

2.2 A new model proposal

In line with the previous works, our model for the innovation process early phases intergrates the technological and market dimensions. The PTC model (Potential-Technology-Concept) proposed in this work is represented as a triehedron in the Figure 2.

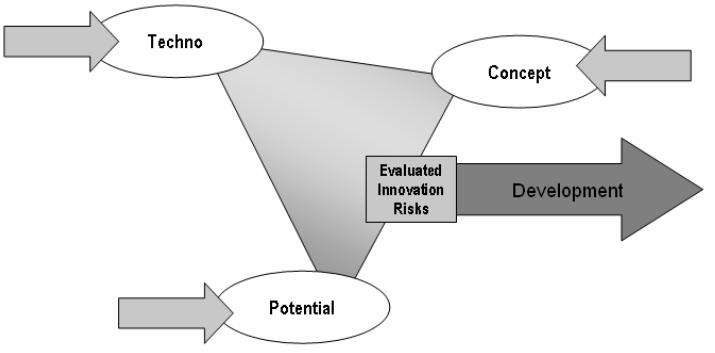

Figure 2. "Potential-Techno-Concept" model

The model characteristic consists in the association of a Concept to Potential of added value and one or more Technologies. This model has the main objective of synthetizing and confronting the data

coming from the technological and markets survey and the different concepts of solution coming from the idea's portfolio of the company. It has also the following expectation:

- Provide a framework in the very early phases for an evaluation of the innovative opportunities and their associated risks.
- Propose a flexible methodology for the innovation management based on a multiple inputs: the market potential identification, the technological opportunities emergence, or the innovative concept generation or collection.

2.3 Definitions: Potential, Technology, Concept

The final products proposed by the companies have the objective of the satisfaction of individual or collective needs. The aim is to sell a product that must fit to the user's demand. In order to have new customers and markets, novelty aspects must be provided in the product. But, this novelty must correspond to a latent or an expressed need of the future customers to be considered as an added value from the consumer's point of view. We proposed here to go futher in the definition of the novelty aspects by the definition of the "Potential" aspects.

Firstly, one customer, one product, and one environment are considered. Then, in a particular date, in the given environment, the customer has a specific need (functional, aesthetic…).

- If the existing products on the market do not correspond perfectly to his/her need, a problem exists concerning an unstatisfied need. By solving this problem with a new product, it is possible to provide a strong added value to the customer. In this case, the added value potential exists within the not yet resolved problem present in the existing products.
- If the existing products correspond perfectly to the customer needs, it is almost harder to provide a strong added value. Nevertheless, this point is valid only at a specific moment. As time passes, changes occur as well in the environment, products usage, consumer's way of life… In that case, there exists an added value potential, linked to the change not yet taken in account in the existing products.

The "Added Value Potential" dimension models the existing gap between the product and the existing or future client expectation. However, the term of potential allows taking into account approaches concerning the analysis of the customer's need but also its change dimension. Therefore the clear identification of the product added values induced by the potential is not only integrated in the analysis of the need but also in the analysis of the changes (usage, way of life…).

The others dimensions of our model (figure 2) are commonly used in previous approach:

The "Technology" dimension encompasses the technologies (material, physical principle…) and the production (process) techniques for new product development. The aim is to identify the opportunities offered by the technology (mechanical, electronical, magnetical…) that can open the domain of "the possible".

The "Concept" dimension is related to the different ideas of new concept of solution issued from any creativity method and tools or ideas' box and portfolios of the company. It is assumed that each idea could be developed and materialized by means of sketches and usage scenarios, and for which the benefits have been formalized.

3. The PTC model contribution

3.1 A multi-input model

The innovation process is a complex phenomenon that is difficult to model. In fact, in the hierarchised (also called "step by step") model proposed by [Gomory 1989] the innovation process is considered as a linear progression towards increasingly practical solutions. The Roozenburg and Eckels model [Roozenburg and Eekels 1995] follows the same structure, but integrates many parallel components (production, product, and marketing). In [Kline and Rosenberg 1986] the innovation model presents a central chain of design, which is interconnected with the knowledge sphere, and has iterative loops called "Feedback". We point here the difficulty to characterize and structure the innovation process phases while presenting the complex dynamics of informal exchanges, the

different actors' encounters and the richness but randomness of the creativity methods. Thus, the contribution of this paper lies in our PTC model that aims to highlight the complex character and the need of combinaisons and confrontations of "multi-input" opportunities for innovation.
In fact, in the PTC model, there is a multi-inputs aspect for the innovation. These inputs can be either the « Potential », the « Technology » or the "Concept" dimensions. Their exploration provides many innovation opportunities to the company. This model architecture corresponds to the different opportunity origins existing in reality. Every actor in the company can identify a problem or a change (Potential dimension), identify the use of another material or a different process (Technology dimension) or have an idea of a new solution (Concept dimension).
In the PTC model, the three dimensions are linked and aim to foster the networking between the concepts, the potential as well as to the technology dimensions. The mechanism of this "multi-inputs" model here proposed is firstly explained and will be aided by the proposition of different tools (section 4). In fact, every new input proposition is analysed regarding the three dimensions of the model. The main goal is to foster multi-dimensions analysis in order to foster point of view confrontations in the very early design phases. This model can also be used as a mapping tool in order to manage the innovation strategy of the company.
This model implies different tools with a particular flexibility to manage the exchanged information.

3.2 Innovation risks Evaluation

Today, the notion of risk is indivisible from innovation. The different risks linked to product innovation, from the company's point of view, are the classical « Cost-Lead time-Quality » tryptic. Among the seven risk factors for innovation projects listed by [Halman and al. 2001], we find that for the early phases, there are two factors linked to the notion of potential (Market Uncertainly Risk and Public Acceptance Risk); one risk linked to techno (Technological Uncertainly Risk), and two others linked to strategie (Competitive Positioning Risk and Project Positioning Risk). The authors identify two other factors related to the « co-developpement » and the « Supply and Distribution ».
The association of "potential", "technology", and "concept" along with the developpement of different strategies in the early phases can provide a refined evaluation of the risks associated with the product innovation risks taken by the company.

4. Phases and tools

4.1 Model phases

The innovation process model for the early phases, centered on the trihedron "Potentiel-Techno-Concept", can be modelled as shown in Figure 3.

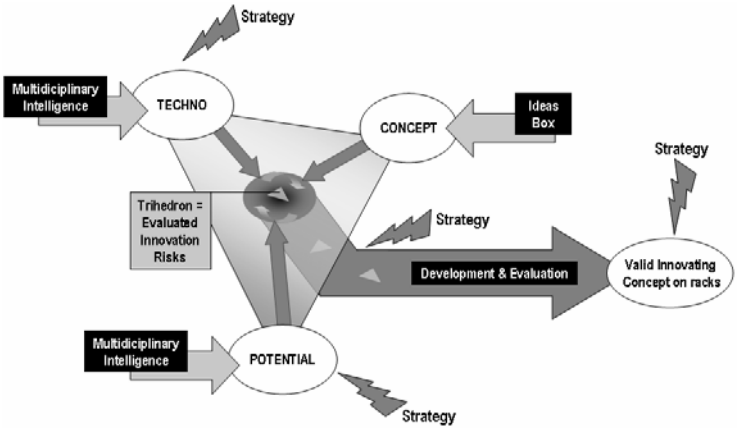

Figure 3. A new model for early phases of innovation process

A more detailed explanation is given here below.

4.2 Some tools

4.2.1 Multidisciplinary Intelligence

According to Rouges, the consumption, just as the notion of an employment, are not life goals but they have become more and more a way for the human being to discover and develop him(her)self. In this way, aesthetics, the "play" aspect, the preferences, the "fun" impose themselves as first order expectations. Because of this, the companies must develop a close relationship with customers by making the effort of identifying the needs, thus the added value potentials. This includes going farther than the limit of just listening to the expectations expressed by the customers.
To accomplish this, a system of multidisciplinary competitive intelligence is proposed. This system rests on the following hypothesis:
« Each trade is more effective to « watch » in the finest possible way the evolutions and problems linked to its domain of expertise ».
The competitive intelligence will be then not only attributed to a dedicated service, but will also become a regular task for each actor inside the innovation processus. As shown in Figure 4, this new organization allows the increase of the quantity of "sensors" of the company about its environment.

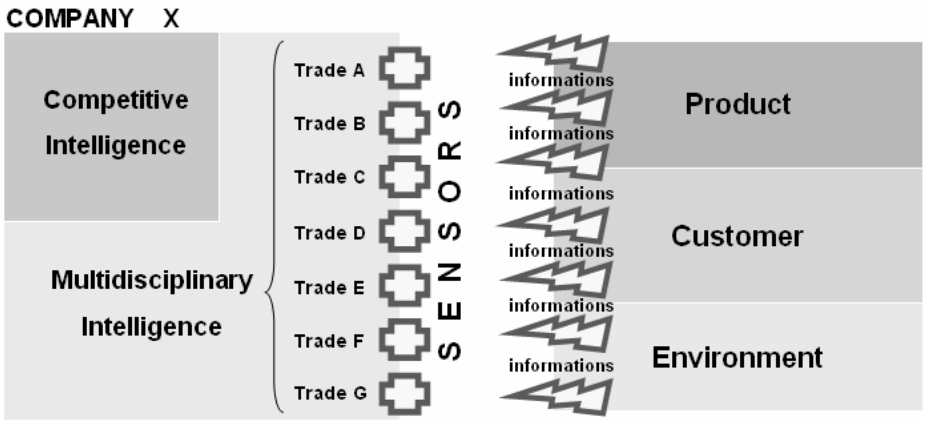

Figure 4. «proximity» watch system

In addition to the identification of the added value potential, a competitive intelligence on ideas that can emerge from domains neighboring those belonging to the company can be also envisioned. In fact, the ideas generated by the company's actors have several origins. They can emerge by chance, generated from casual discussions, multiple observations of several sorts, creativity sessions, from groups working with different methods. And also, they can come from competitive intelligence. Considering the random attribute linked to the birth of an idea, the advantage of a "ideas' box" technique as an indispensable tool is clear.
Regarding the Technos, each trade with develop its own competitive intelligence to analyze needs and new technological opportunities. A service solely dedicated to technologies can be responsable for studying and characterizing them.

4.2.2 Control panel

A recap for data, knowledge and ideas emerging from the three different model inputs by means of a control panel, will be able to improve in a significant way the choice efficiency in terms of the research axis, for companies when working on the early phases of innovation.
A control panel with a « NO-WATCH-GO » characterisation system that can enable the specification of a treatment choice for each reaserach axis is proposed in this paper. This also permits a management that takes in account the company's resources:

- the choice of investing resource in working on the reaearch axis is a (GO)
- the choice of limit the resources by implementing the competitive intelligence results in the (WATCH)
- whereas the choice of judging a non-pertinent situation -at a given moment- results in a (NO).

4.2.3 ID²

From this axes of research, the company's actors will for trihedrons « Potential-Techno-Concept ». When the trihedron is judged to be promising, the following tasks are testing and sketching some principles and/or prototypes in order to validate some of the important points and most importantly acquire knowledge on the most pertinent concepts. These "trial-error-new ideas generation" loops allow a feasibility analysis to be made on the concepts as well as on the new technologies. This phase is enonced in the C-K theory [Hatchuel 2004]. The multidisciplinarity enriches each concept with "know-how" knowledge from each trade, favoring in this way its customer "seduction power" (ergonomy, design, teargeted kinematics, etc.). In order to manage the forward and backward directions the interactions between actors and the multiple advance levels take within the development of a trihedron, [Merlo and al 2004] proposes ID² software. Once the trihedron is developed, racked Innovative Concepts are obtained, which will serve as foundation or as elements for the design of new products.

4.2.4 Final control panel

Having the trihedron group development management as target, it is herein proposed to rank them in a new control panel. This tool takes the structure of a product organization chart and relates the trihedron group to their architectural level. This chart, shown in Figure 5, constitutes a mapping of future racked Innovating Concepts which can be used of by the company.

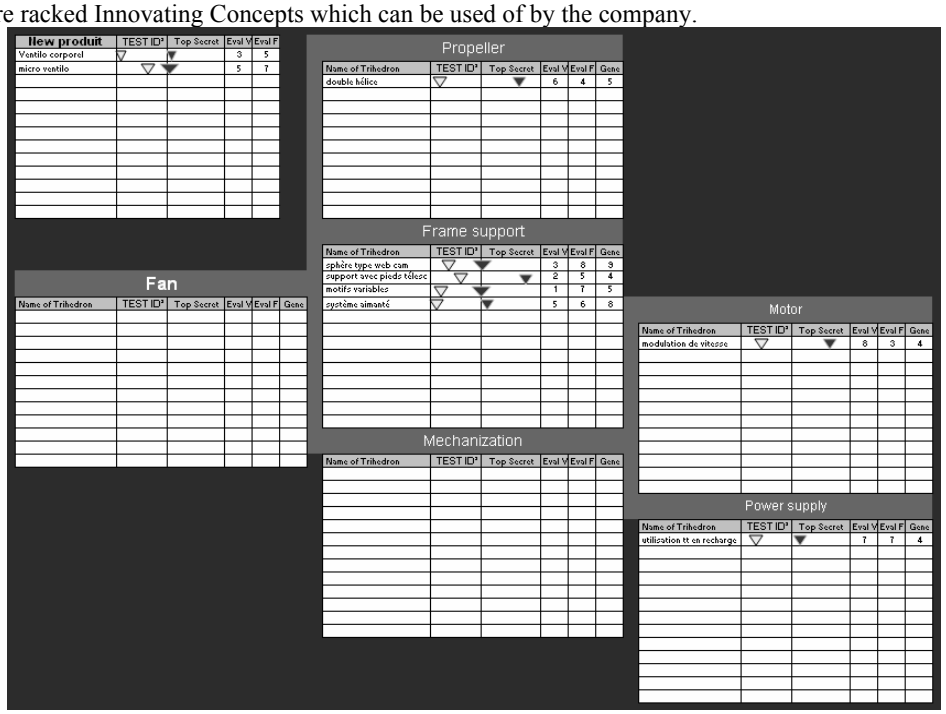

Figure 5. Final control panel

It is as well a tool for additional resources management is terms of the company and its ability to choose among either of the following options:

- the trihedrons it will develop first and the follow up of them by using different criteria,

- the competitive intelligence application
- the judging of a non-pertinance situation –at a given moment-

Also, this tool is useful in terms of the classification of the different types of research axes (potential, techno or concept) which generate the greatest number of "valid triehdrons" possible. As a consequence, the types to be favoured in the future can be of use to increase the company's innovation power.

Once developed, the company can position the innovating concepts by comparing them among each other and considering their market launch date, thus forming "innovation lines" [Hatchuel 2004]. From these "trial-error-new ideas generation" loops linked to the trihedron development, a report that will syntesize the problems found and those envisioned for the future can be given to the design and industrialization teams that lie further.

4.2.5 Strategy

Along the process defined, the efficiency of the tools implies a clear strategic vision of the product, an internal company politics, a guide. The results issued from the field [Lauche 2003] reveal the importance of such internal politics during the early phases.

5. Conclusion

New product/process ideas are thus developed during periods of negotiation and research of solution, which are often informal and unpredictable. At this level the goal of these phases is first of all to be able to bring together a certain amount of data and information in order to justify and consolidate the idea creating a configuration in which it is possible to launch an innovative project. The PTC (Potential –Technology – Concept) model is one way to structure this complex process of emergence of a new innovative solution.

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