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ORGANIZATION AND MANAGEMENT OF THE EXPANDED INNOVATION  
VALUE CHAIN

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Abstract

Based on literature review and ten case studies of innovation projects in Brazil and France, the paper proposes a set of parameters or contingencies that distinguish projects and influence organization and management of innovation in the company. The innovation value chain is treated broadly, neither limited to product development (which is one link in the chain) nor restricted to the company (given practices such as open innovation, co-design etc.) – a network instead of a chain. It begins with a discussion of conceptual and practical limitations of current models (as innovation funnel and stage-gates), taking the concept of innovation value chain proposed by Hansen and Birkinshaw (2007) as a starting point. It proposes eight project parameters: product lifecycle, degree of knowledge formalization, kind of market, technological path, total expenditure,

kind of product, position in the value chain, product concept. It ends by proposing a new topology of the chain / network.

### **1. Statement of problem**

The paper discusses situations that structurally affect the management of innovation in companies. It takes primarily as unity of analysis the projects of innovation; they are treated broadly, that is, from idea generation and before to commercialization and beyond. There are various established concepts, models, methods, and techniques for managing product development, such as the "development funnel" (Clark and Wheelwright, 1993); the stage gates model (decision points on the continuity of the project); Cooper, Edgett and Kleinschmidt's (1997, 2002) framework for portfolio managing; Meyer's product platforms (1997).

These models fundamentally concern the management of product development. Despite its elegance and consistency, they are procedural, treating the process of development but have almost nothing to say on the organizational side of the company: the structure for innovation, the relationship of product development areas with the rest of the organization, people's incentives and incitation to innovate, organization and incentives to generate ideas within the company and network with those outside (or even with other units of the company), and the consistency of the whole system. Organizational aspects are usually approached superficially by the traditional typology organization by function, by project or by matrix. Rozenfeld (1997) points out the need to teach the company via transmission of information to other areas not directly involved in the product development process (PDP); Rozenfeld et al. (2006) introduce the phases before and after development, incorporating the logic of gates.

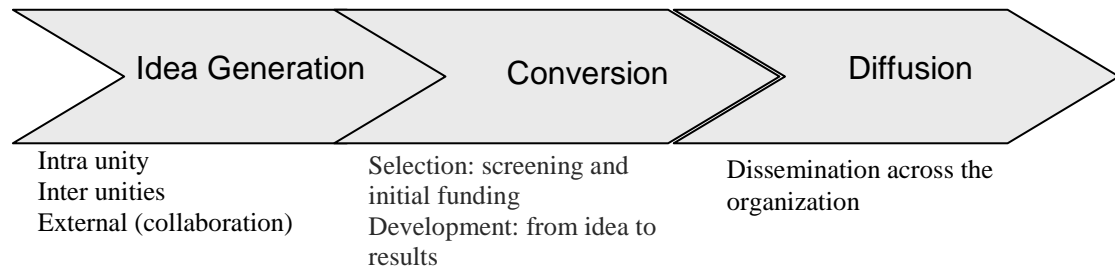
Again, fundamental aspects of organizational dynamics do not receive much attention. For example, mobilization, incentives, autonomy to generate and test ideas - which often means, the possibility of funding for testing, prototyping, without prior authorization by committees or schemes for network projects intra-company and with third parties (partners).

Implicitly, the models focus on large companies with R & D departments, projects that take long periods of time for development (months or years), typically durable goods, with many resources allocated; such conditions would justify the proposed decision-making and managerial structure. These models show few adherences to radical innovative product development, in which there is much uncertainty, complexity and ambiguity; such situations call for new models, tools and management techniques (Pitch, Loch and Meyer, 2002).

Cooper (2008) tries to answer to a set of criticisms for the stage-gate model, such as linearity, rigidity, bureaucracy. He also proposes some simplification in the model according to the risk of the project. His answers are a bit impressionistic, based mainly on the good sense than in sustainable empirical evidence.

We would prefer to base our development in Hansen and Birkinshaw (2007) innovation value chain. This framework does not antagonize to the development funnel or the stage-gate model. But instead of focusing on a sequential process (“the stages”) and on decision points (“the gates”) that draft a funnel (“the development funnel”) from the bulk of proposed ideas to the final product sent to the market, they highlight organizational and managerial issues of innovation (figure 1).

Figure 1. The innovation value chain by Hansen and Birkinshaw (2007)



In a first moment we will incorporate to the framework the notion of extra-company networks (or open innovation, Chesbrough and Crowter, 2006) in all phases (idea generation, conversion and diffusion) not only in the first one. We must think also of the novelty degree of the product since highly innovative products suffer uncertainties and lack of information from the market.

We will assume the contingency theory, as proposed by Lawrence and Lorsch (1967) and by Thompson (1967), with roots in Woodward (1965), as the basis for sustain our analysis and propositions. It states that the best way to organize depends on the nature of the environment to which the organization must relate. Adapting it for the innovation process, we will propose that organization and management of the innovation value network (instead of chain) has distinct features according to certain contingencies (parameters), such as cycle time and product development, design based on new technological principles and scientific discoveries or on tacit knowledge and experience, projects that opens a new market (such as Walkman or Post It) etc.

Conceivably, the features, tools and range of decisions are different when considering: the development of a car (measured in months/years and hundreds of millions of dollars; very structured development process - APQP etc.); the development of a collection of fashion apparel (the product cycle is less than 6 months and development is measured in weeks); the case of plastics derived from

bioethanol (design based on encoded scientific knowledge); the case of household or tops of cans (based on tacit knowledge, design, metalwork expertise). These contingency factors may result in different degrees of uncertainty and complexity of the project, which may require new forms of organization and management (Pitch, Loch and Meyer, 2002) of the innovation value network.

In that sense, the research aims to provide an incremental contribution to the knowledge and methods in the management of innovation towards an integrated and systemic approach, based on the concept of the expanded innovation value network that will be discussed below. It will be done by identifying and considering contingencies and risks that differentiate projects and their management.

We then state three research propositions.

Proposition 1. The innovation value network takes different forms and tools of organization and management according to certain contingencies (parameters): of the company; its sector of activity; the innovation project itself regarding the desired product (concept, technology), the market the product aims at meet, the hegemonic form of knowledge of a given innovation.

Proposition 2. A model of management of the expanded innovation value network - involving strategic and operational issues and their organizational and decision-making substrates - varies according to the parameters of the innovation project (contingencies) and to the articulation among parameters [configuration, in Mintzberg (1979) terms]. This leads to special topologies of the chain/network, sometimes breaking with the linearity, sometimes parallelizing or even not performing some activities.

### **3. Literature review**

The conceptual delimitation and especially the analytical or prescriptive models for the management of innovation in the company focus on the activities of product development. Developing products would be the conduct of a universe of activities, managing and transforming resources, information and expertise on specifications and products that would meet (or create) a market need (Clark and Wheelwright, 1993).

Cooper, Edgett and Kleinschmidt (2002) consider that the most successful companies in these activities utilize formal processes, with well-defined criteria, with emphasis on preparing the team and on the quality of the execution of activities. In this sense, several models of the process of product development (PDP) are proposed in the literature. Cooper (1993) proposes the idea of well-defined stages and decision points for the conduct of development projects (stage-gates, presented above), improved by Cooper Edgett and Kleinschmidt (2002) and by Cooper (2008). Clark and Wheelwright (1993) proposed the model of development funnel, in which the product is developed from bottlenecks and decision points where choices are made and alternatives discarded.

Clark and Fujimoto (1991) categorize product developed in partnership (co-development) and discuss types of management (heavyweight manager, for instance). Days and Salerno (2004) discuss the automobile development considering assemblers, auto parts, engineering firms and their headquarters and subsidiaries but from the perspective of the latter. Cheng et al (2007) and Gomes and Salerno (2008) discuss initial planning for technology-based companies in which uncertainty is very high, integrating TRM - technology roadmap. Cookie-Davis (2007), among others, discusses critical success factors for projects. Rozenfeld et al. (2006) propose a model for the process of product development, highlighting some points less explored in

other models, such the informational aspects. Hong, Pearson and Carr (2009) discuss coordination in multi-organizational product development emphasizing information-processing structure and locus of control.

Notwithstanding the differences in approach, the focus of all these authors (and of many others) is the process of product development (PDP). The literature is vast: a search in the Scopus database in June 2009 showed 11,053 records for "product development" AND "management" and 193 for "product development management". However, Hansen and Birkinshaw (2007) proposed the idea of the value chain of innovation, in which the PDP is an important activity, but there are other equally important before and after it. The chain would be composed of three links - generation of ideas (intra-unity / department, inter-unity and inter-institutional), conversion (selection - screening and funding; development) and diffusion (figure 1). This representation enables systems view, encompassing the strategic and operational dimensions. According to the authors, priority managerial action should be given the weakest link in the chain (or bottleneck).

Brown and Eisenhardt (1995) made a broad review of the literature on organizational issues related to the project development, and there is good literature on concurrent engineering and project management. Nevertheless, as noted by Krishnan and Ulrich (2001), the various approaches to product development management on a theme or focus on a single theme or area (mainly marketing, organization, engineering project and operations management) but do not discuss the relationship among these themes or areas; they also do not treat product design in which there is much uncertainty, complexity or ambiguity (Pitch, Loch, and Meyer, 2002; Sommer and Loch, 2009). The review by Brown and Eisenhardt (1995) is no exception to the rule. Kim and Wilemon (2003) reviewed definitions of complexity

(which by them involve the number of components, their interaction, degree of product innovation, number of disciplines and areas involved in the project etc.). And suggest that the sources of complexity are technology, market, development, marketing, organization – we will use these sources as a starting point for our field investigation.

Hansen and Birkinshaw (2007) seek some integration between traditionally isolated angles, proposing a number of issues and management indicators, going beyond gates without ignoring them. For example, they discuss the organizational forms that enable teams and middle managers to develop ideas, even building prototypes without prior authorization by a board or committee; without that possibility, there would no be products like Post It, previously rejected by 3M's Marketing (IN SEARCH, nd).

The approach breaks with linear models / chain of decision by which ideas need to be approved to be later (preliminary) developed, as suggest funnel and stage-gates models. Hansen and Birkinshaw (2007) also suggest that there are several ways to organize the activity of innovation, whether isolating groups from the rest of the company ("safe harbor"), as also stated by Davilla et al (2006), whether not creating any special or ad hoc structure. However, one important limitation of their paper is that it focuses and takes as paradigmatic the company believes that standard is the large divisionalized multinational, which explains the need to set a phase of spread across the organization, which does not make much sense in smaller or single units companies. This creates the need to expand the type of companies to be studied, not restricted to established large firms.

Two points in the literature will be highlighted for field investigation: 1) the contingencies or parameters for innovation management, as suggested by the authors on uncertainty (Pitch, Loch, and Meyer, 2002; Sommer and Loch, 2009), complexity

Kim and Wilemon, 2003), and also by Davila et al (2006) and Hansen and Birkinshaw (2007) when they compare different types of experiences; 2) the topology of the innovation value chain, from the development funnel to Hansen & Birkinshaw's model, but expanding it as a network. Our field study will search for contingencies and for different topologies of the innovation value chain/network.

We will now shall discuss the research methodology and field study. In the analysis of the field investigation will be further developed some aspects of literature, in order to make the text more fluent.

### **Field research: procedures and results**

The method employed is the traditional in studies of this kind, similar to that applied by Clark and Wheelwright (1993), Cooper, Edgett and Kleinschmidt (1997 and 2002), Clark and Fujimoto (1991) and numerous other studies of organization and management. That is, multiple case studies, which Eisenhardt (1989), Voss, Tsikriktsis and Frohlich (2002), and Miguel (2007) consider one of the best options for research in management. Miguel (2007:223) states that "the case study is a kind of history of a phenomenon, drawn from multiple sources of evidence where any fact relevant to the chain of events that describe the phenomenon is a potential data for analysis," which is highly adherent to our purposes.

We conducted field research in twenty seven innovation projects in eighteen companies, as pointed out in table 1. The basic unit of analysis was innovation projects, not the company itself.

Table 1. Profile of the companies with projects investigated

Company	Size (employees)	Sector	Projects
BK	+5,000	Petrochemical	3, 1 being radical
OX	+5,000	Petrochemical	2, 1 being radical
BR	+5,000	Petrochemical/Oil	1 radical
NT	+1,000	Cosmetics	2, 1 for a new sector
BT	+1,000	Cosmetics	2, 1 radical
BL	+500	Metallic cans	1
AC	+300	Paper packaging	1
FL	+1,000	Auto components	1
DF	+2,000	Auto components	1, radical
FT (France)	+5,000	Telecommunications	2
SO1	+5	Academic spin off/ bio	1, radical
SO2	+5	Academic spin off/ soft	1
OD	+500	Engineering services	1
GEN	+300	Engineering services	1
VT	+20	Garments	2
FC	+2,000	Pharmaceutical	1
FD	+2,000	Truck assembler	1
AR	+2,000	Aeronautical	3

The field research was supported by a structured questionnaire (open form) involving:

a) The company's formal structure for activities of PDP / R & D. Relationship Marketing - Finance - R&D - Production;

b) Origin of the project: how it “happened” to the company; what occurred before its formalization as a project - particularly if there were staff and resource allocated

without necessarily had been approved by a committee (in other words, without gate); compare the origin with the formal structure of product development highlighting what is out of the script;

c) Identification of contingencies / parameters of each project;

d) Criteria for screening/selection of ideas. How they are selected and who selects. Forms of incitation/stimulus for idea generation. In the project in focus, how the idea was generated, by whom, under what circumstances;

e) How the idea progressed to reach the stage of development: how was it chosen, how was it funded (if applicable), what resources it consumed before it was formally transformed into a project, how was it developed. Relationship between the creators and product developers (in the PDP);

f) Forms and methods of organizing and managing the development of the product selected;

g) Business model of the project; how and in which phase it appeared, was improved or modified. It should be noted that the business model of the project is similar or dissimilar to the firm's one, and what contingencies to manage the innovation value network in both cases;

h) How the prospect of commercialization impacted the decisions along the network.

Our field research showed that some companies are considering the model of the funnel / gates as costly as it would require a lot of management and rule out many good ideas; the model would be more suitable to large companies, to time-consuming projects of complex products (months or years, such as automobiles, aircraft, petrochemical resins etc.). Above all, it is aimed at incremental or routine innovation.

In the continuous process companies (petrochemical) we found two structures and two different management systems according to the type of innovation. There is a structure for routine innovation and other for disruptive/radical innovation. The structure for routine innovation, as those linked to customer demands for adaptation of products is structured in company BK by business units; specific software accessible via the intranet organizes the process since the introduction of the idea to pre-industrial development. This structure was also found in the company of non-metallic packaging that employs software that registers the idea and allocates evaluators, formalizing the whole process.

In BK and BR continuous processes companies there is a corporate structure, governance, much less rigid and without explicit criteria for passing the gates, focused on disruptive/radical innovation that technological or market trajectories (paths).

In BK there are no formal indicators to evaluate radical projects. The decision to stop or continues depends on the Board, and ultimately on the CEO and Director of Innovation, not necessarily supported by traditional analysis such as ROI, PV or the like. Actually, as Hamel (2006) has pointed out, such kind of analysis is not suitable for radical innovation - we would say, it is not suitable for innovations that open a new market path as we will discuss in the next item).

This structure is not exactly the one for a new independent business as proposed by Tidd et al (2008); it is closer to the structure of "safe harbor" proposed by Davila et al (2006).

Meyer (1997) and Davila et al (2006) favor the notion of platforms. They can be defined as a set of subsystems in a particular product or product family (Meyer, 1997). The importance of the platform is the leverage of product strategy and market using the basis of technological resources the company already has (Meyer, 1997,

Meyer and Lehnerd, 1997). A cosmetics company researched (BT) uses the idea of “technological silos”, that is, stocks of dominated technologies that are combined to product development. The other cosmetics company also uses it, but in combination with the funnel model.

The business model also has a strong influence on the innovation value network. The spin off SO1 has changed form product for service: instead of selling the product, now it sells the service that the product enables. That meant changing the business planning, adaptation in technology and product specifications, changes in marketing strategy etc.

But innovation does not happen only in companies with structured R&D or PDP departments. Jensen et al (2007) consider two distinct types of knowledge that relate to two forms of innovation. Explicit knowledge of a scientific nature would be linked to systematic R&D innovation-based, through constant, formalized processes. Tacit knowledge would be linked to flexible organizational forms that enable the use of knowledge and ideas from employees, independent of structured R&D. The authors employed a probabilistic model (probit) to show that Danish companies with systematic R&D have superior innovation performance comparing to those companies without systematic R&D. The companies with flexible organization outperform against those without. However, the companies that combine systematic R&D and flexible organization have the best performance among all. Tajar and Tether (2008) come to similar conclusions analyzing service European firms.

In the companies of packaging studied there is no formal R&D but there are innovations, including patents internationally commercialized, like in BL. This patent was born throughout the internal suggestion system, supported by a very consistent process of internal mobilization of personnel: the company does not fire workers,

keeping them stable at the job, do not use turn over. The idea to have a metallic can used for chemical products (ink for construction etc.) with a top that the user can easily open and close – yes, traditionally to open such kind of cans damages the top and it hardly closes well again – was brought to the company by a HR employee. She talked to a tool and die maker that developed the prototype and afterwards they formalized the idea, generating the product and the patent.

One important parameter is the position in the chain/network the company occupies. Innovation management parameters change if a company is directly linked to the final individual client or if it produces for another company. A company that is in the first stages of the productive flow typically produces patronized products (raw materials, intermediary goods) and has few productive clients, what simplifies market analysis. By the opposite, a company in the end of the flow, selling directly to the final consumer, tends to have a higher need for innovation and product differentiation. Most of the innovation activities are primarily negotiate with clients – as PVC with new density for a specific application, a project we investigated. This project took two years, but it was only started after a client's demand.

In that sense, we could say that such a project has no phase of idea generation in the sense of ideas for a new product; the idea comes directly for the client. The same happens with the service engineering companies investigated: they typically start projects according to a client's demand. Similar is the case of some autoparts manufacturer, that designs or co-designs due to an assembler's specific demand.

### **Contingencies / parameters for innovation management**

We can consider eight contingencies that structurally conforms innovation organization and management. Figure 2, at the end of the section, summarizes the proposal.

1) **Innovation cycle time.** To differentiate projects according to project life time, in order to distinguish between of automotive and garments projects: the first one is measured in years, the second one in months. It is clear that the organization and the management are structurally different according to the innovation cycle, and innovation cycle is linked to the economic life time of the product. We emphasized economic life time because the product can have a long life with the costumer but not being produced/adapted/improved by the producer – for instance, a fashion dress typically occupies few months of design, production and sales of the clothing company even if the client can keep it for years. The relevant point to characterize the parameter is that, for instance, a fashion clothing company must have great agility and flexibility to design, produce and sale. The innovation cycle must be short, and that means no sophisticated and time consuming models and tools for the management. But this not necessarily applies to an auto assembler, for an aircraft producer or for a petrochemical company. In our research, the cases of VT (clothing) and AC (paper packaging) are opposite of AR (aircraft), FD (trucks) and others: VT launches four collections/year, AC have few days to design and produces a prototype to get contracts but AR, FD,BK, OX, FT have projects with 2 years duration and more.

2) **Type of hegemonic knowledge and degree of its codification.** Projects based on codified/formalized versus projects based on tacit knowledge. Actually, there is always a mix of the two but the parameter is important because the organization and the management of the innovation process are radically different in the two

situations. We could also apply the parameter only to the idea generation phase: ideas from R&D (codified) x ideas from blue collars, employees in general. Innovation projects of companies BX, OX, BR, NT, FT are based on codified knowledge – R&D departments, contracts with universities etc. Innovation projects of BL, AC, and VT are based mostly on tacit knowledge, on permanent incitation and mobilization of the workers; most of new products were originated outside technical department.

**3) Technological trajectory.** To differentiate between: a) mature technologies; b) adaptation of known technologies; c) integration of young technologies; d) development or integration of technologies inexistent in the beginning of the project. There are two important considerations. First, there is high uncertainty in the development of a new technology, or in technologies with no consolidated path; uncertainty on the results, on the investment, on the total period of development; on the competences and capabilities necessary for the development. It is the case of company BK, whose corporative R&D is trying to develop a 3-carbon plastic from bioethanol (2 C): there are several initial technological paths and nobody knows which one – if any, will succeed. The company tries the development in several associations with Brazilian universities, outsourcing most of the initial phases closed to basic science; it will retain only scale up and final production. Second, new or radical technologies do not necessarily open or create new markets or new consumer needs; some products with radical technologies are substitute ones. For instance, CD opens a technological trajectory but does not open a new market since it replaces the LP (or the CD-ROM replaces the floppy disk). When that happens, there are data for market analysis, pricing etc.

4) **Characteristics of the market.** We propose the following typology: a) mature; b) in expansion; c) in formation; d) inexistent – the last, towards products that creates new markets, new demands, new consumer needs, even if with known technologies (like the didactic cases of Walkman and Post It). Projects that create market are difficult to evaluate by the usual methods of return, sales projection etc., since there is no historical data to perform the analysis. There is as autonomy between the parameters technological trajectory and characteristics of the market. If a product opens a new technological trajectory and creates a new market, we have the extreme case of uncertainty. This is an improvement in the proposition by Hamel (2006).

We found some companies with problems to justify to the board of directors the expenditures in some breakthrough projects (whether opening technological or market path). They were experimenting tools as real options (cases of BK and BR) but in BK R&D corporative director and staff had clear in mind that such tools have only the effect to calm down the board, they are not effective to help select portfolio projects highly innovative.

5) **Total expenditures for the project,** considering the whole network or chain. Innovation projects with high budget usually have tighter managerial control and higher formalization – gates, committees etc. Expenditures are correlated with development time and product life cycle. For instance, project at VT, SO1 and SO2 have much lower controls (formalized tools, evaluation tools etc.) than projects at the petrochemical companies, assemblers, components etc.

6) **Characteristics of the product.** We propose the categorization in: a) Improvements in existing products; b) New family (or product alone); c) New platform. Besides these categories there are two possibilities: i) the project is new

to the company, that is it has no experience with such kind of product/technology/business, and innovation process tend to slower, more carefully treated; ii) when the product/service is a client demand, being developed based on a preexisting product / service – there is development but at least idea generation and screening/ selection as proposed by Hansen & Birkinshaw (2007) and others do not apply as if the product was new. Improvements in products usually are less demanding than the creation of a new platform. In the auto sector we found most improvement projects that have a predefined path. One project that involved the creation of a new innovative family of cars had a time-consuming decision process because of problems in the relation headquarters-subsidiaries, as pointed out by Dias & Salerno (2004).

- 7) **Position in the supply value chain/network.** Roughly speaking, we can think of supplier → industry → wholesale/retailer → final client. The parameter “measures” the proximity with the final client. The idea is that goods for productive consumption, as autoparts, petrochemical goods etc. have a high degree of formalization and control in development and production, sometimes by third parties, as required by BR (Petrobras, the Brazilian oil company), due to clients’ requirements. Innovation in raw materials and components depends on an agreement with the client, many times being co-designed and controlled by formalized systems as APQP in the auto industry , For instance, an autopart (DF) developed and patented a new disk brake system for car with higher performance, low weight, less material, but no assembler adopted it due to commercial disputes and aiming at have the privilege to launch firstly a car with the system. The result was no launch.

8) **Product concept.** Concept could be defined as the description of the objective and of the main functions of the product. New products can be related to: a) the creation of a new concept for an existing product; b) the creation of a new concept by a new product; c) the improvement of the concept of an existing product. Each one of the three cases delimitate different management situations. For instance, to improve the concept of an existing product is less demanding than to create a whole new concept. OS1 and OS2 have changed their business model and their product concept, as seems to be usual to start ups and spin offs. Both have launched a product and both have transformed their products into services. OS1 changed the targeted market from individual consumers to public sector. It produces a trap for specific dangerous mosquitoes; when launched directly to the market the mosquitoes were attracted to the client's home infecting the inhabitants. So, they decided to supply the public administration with a geo-referencing service showing mosquitoes focus in order to direct public action – sprays etc). OS2 changed the way it is paid for the service, now by drug providers instead of the final client.

Figure 2. Contingences to the innovation value network management



### The topology of the innovation value network

The representation of the innovation processes as the funnel and the stage-gates implicitly lead us to consider a linear and fixed-sequenced process. Even if Cooper (2008) states that there are some non linearities, the model induces a linear thinking since its topological representation and its logic are sequential and linear. Linear graphic representations and sequential written presentation of sequential activities that would constitute a chain, as well as the idea of chain itself, induce linear thinking on innovation projects, its organization and management.

We found several cases of non-linearity. Companies supplying intermediate goods, components or professional services normally have an idea generation process very limited if compared to those that produce for the final client. In the service

engineering companies researched (OD, GEN), as well as in many projects of petrochemical product adaptation by BK or OX (new density etc.), of paper packaging (AC), autoparts (FL, DF), most of the idea generation cycle, as stated by the funnel, by the stage-gates and by Hansen and Birkinshaw's (2007) innovation value chain was already done by the client. For instance, Petrobras ask engineering firms to develop a pre-specified project; assemblers like FD have already the concept, the parameters and some definition of the component before negotiating with suppliers its the co-design and, to some extent, the same happens in the aircraft industry (AR).

Although most of the projects in such companies can be characterized as in the previous paragraph, they can also develop completely innovative products based on the idea generation phase as in the traditional models. That was true for the bioplastic developed for BK, the process that mix oil with biodiesel in the oil refinery to get cleaner products developed by BR, or the new brake system developed by DF. But such projects were developed by a different organization unity of this companies, either in a "safe haven" or in a corporate central R&D department, while the previous kind of projects were developed in R&D and engineering teams of the business unities closed linked to clients, specialized in a technological platform (like PVC, tensoactives, detail engineering for plant design, etc.).

That is, if an order to develop a product comes from a client, the idea generation phase is much reduced and has a different characteristic. Of course there is idea generation throughout the whole project but not to define product concept and target market.

Conversion or development phase itself uses to be the more standardized due to project management procedures, PMI style. Many details of the final product are defined in this phase, and many new ideas occur, sometimes changing the concept,

specifications and even business model associated to the product. The most extreme case of these changes is an academic spin off (SO1, SO2), that must develop simultaneously the technology, the product, the production process, and sales/market, as well as most of internal competencies and capabilities.

Phases intermesh and parallelize. Diffusion in the company can start in previous phases, that is, during product development or even before. Post it is a classical example of it. In our research, a FT project M2M (machine-to-machine communication) through IP was previously negotiated with some subsidiaries before its approval. Actually, the official innovation process at FT depends on the internal sale of the idea not to a committee but rather instead for other subsidiaries that judge the product or service will be profitable for them. There must be theoretically three country subsidiaries (or the matrix + 2) committed to an idea for the project be presented to an evaluation committee. One manager interviewed told us that most of her time was spent on internal negotiations prior to prepare business plans for evaluation. And in some cases there is approval with only one country involved – internal politics weights, but this also means a time consuming period of internal negotiations. The point is that negotiations occur before the approval of the project, before the first gate. Who succeed to negotiate the OK of two other countries normally will be project manager.

The projects at FT highlight the enormous amount of organizational effort that happens before the formalization of a project, efforts that are not considered by the models reviewed in the literature. BK, a very aggressive petrochemical company, has an incitation system for new ideas and projects. The earnings of all employees have a fixed contractual part and a variable part. The later on is negotiated once a year with the boss; for R&D and engineering it usually means that the variable is linked to

approved ideas for product or process innovation. The company is becoming an innovation champion in petrochemical products, at least at regional level. In order to rise the probability of having an idea approved, employees in practice perform the same as the famous HP's and Google's contraband (employees can use a part of their working hours to work on its own projects to further present them to the company): they make lab tests, improve the idea etc. When the idea is registered in the system to dispute the approval in the first gate, it has already consumed several resources.

The key point is not the consumption of resources. Rather instead, if this is important for innovation it should be planned in the organizational system of the company. At BK, although informally admitted, some conflicts arose: disputes for lab tests, people from laboratories complaining against "the others" etc.

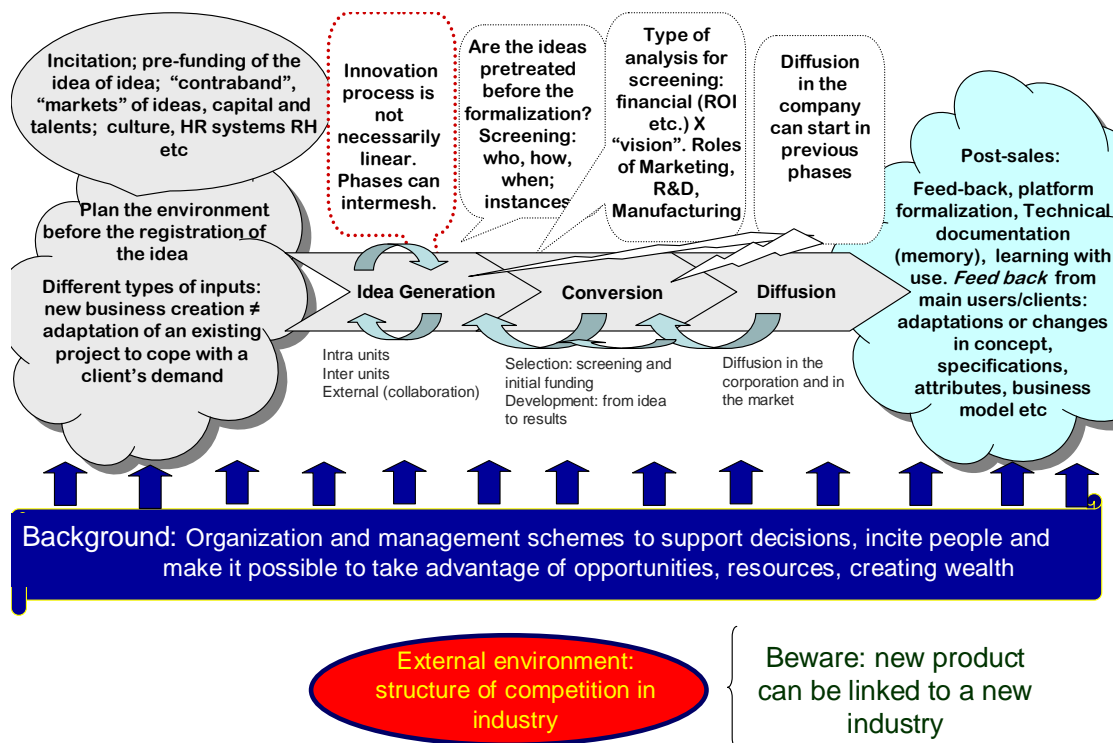
Idea generation process is highly influenced by companies' organization, management and culture. At NT and BL, companies with strong corporate culture, the idea generation is direct by companies' values, and an important part of human resources management is linked to the discussion of the values. At NT there is virtually no proposal outside the professed business of "well being", a value presented even in advertising.

Some companies have a double system for idea selection and project screening. Regular projects, that is, those that do not open new market or technological trajectory are treated as the manual: financial analysis, sales projections, pricing etc. Very innovative projects are treated as special: decisions are taken mostly base on what Hamel (1999) call "vision" due to the impossibility to measure costs and benefits.

The discussion can be summarized in figures 2 and 3. Figure 2 shows the proposed topology for the innovation value chain in the chain form: there is only one innovation flow represented in the figure, the internal process of the company, although it is

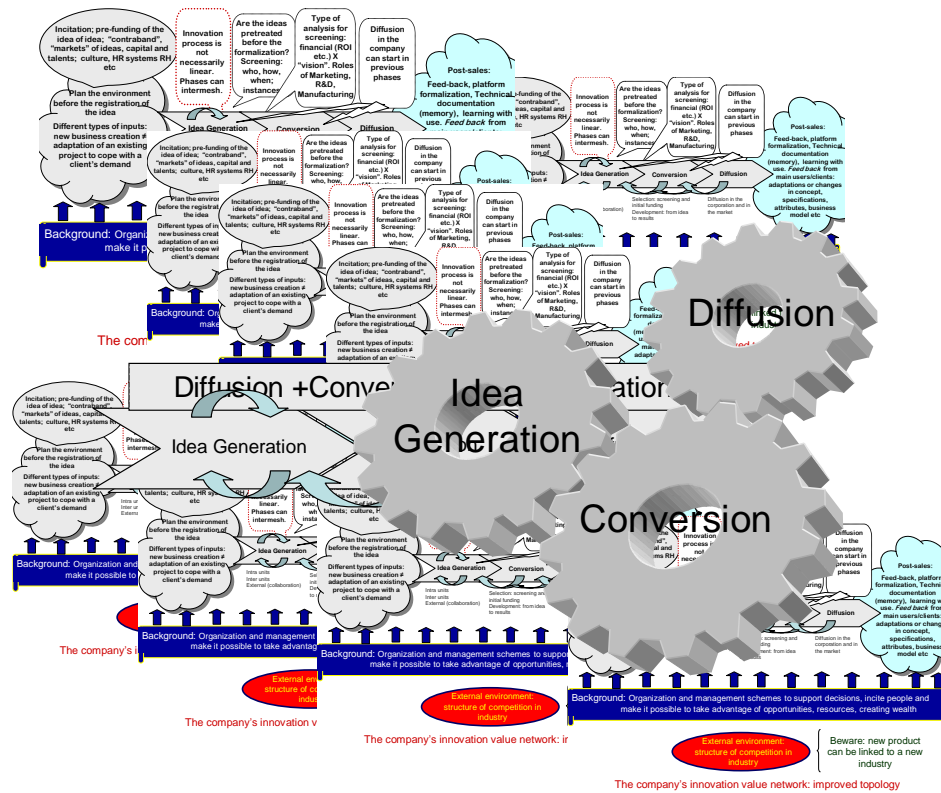
written that there is open innovation, non linearities, feed back etc. Figure 3, although a bit confusing, symbolizes the network: several innovation processes, or part of processes, taking place in several companies, institutes or even other departments or subsidiaries of the same company.

Figure 2. The innovation value chain revisited – new topology



The company's innovation value network: improved topology

Figure 3. Innovation value network – graphic representation



## Conclusions

Based on case studies of innovation projects of different nature in different companies, we propose some contributions to the models to treat the organization and the management of innovation activities in the company.

In a first moment we propose eight contingencies (or parameters) that conforms different processes of innovation, different forms and particularities of organization of innovation activities and their relationship to the overall activities of the company, and different approaches to manage the system. The contingencies that shapes innovation projects are: 1) Innovation cycle time; 2) Type of hegemonic knowledge and degree of its codification; 3) Technological trajectory; 4) Characteristics of the market; 5) Total expenditures for the project; 6) Characteristics of the product; 7) Position in the supply chain/network; 8) Product concept.

Innovation organization and management should assume a particularity according to the combination of these parameters. By expliciting them we aim at contributing for a more effective and efficient innovation process, since the companies could design organization and management systems and tools more adapted to their conditions.

In a second moment we revisited the topology of the classic product development models. We propose the expansion of these models to incorporate important activities that happen before the formalization of any idea to a new product, and after the commercialization. Moreover, we identified several non linearities and discontinuities in the process, as well as several external linkages. We propose to treat the innovation process as a network, not as a chain, and not as a fixed set of sequential operations: there are several entrances that start the process in different points, there are parallelizations of “phases”, and “phases” may not have the same importance according to the type of project.

The company is considered as a part of a network, and innovation activities do happen in other organizations. Instead of treating the external relations alone, as open innovation, we propose the incorporation of such activities in the innovation value network of the company.

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