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Ecodesign...

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Abstract :

As sustainable development practices expand among companies, innovation appears more and more as a required path to progress towards the integration of ecological concerns at the very heart of business activities. Ecodesign not only requires this integration but can also be a concrete tool for its implementation (Le Pochat, 2005). Our results show that while implementing ecodesign practices, companies mobilize existing competences, that they combine with new ones. These new competences originate from exploration-orientated external cooperations. This original combination of competences paves the way for an internal research, made mostly of exploitation but still including some exploration projects. Long-term continuous innovation (Verona, Ravasi, 2003) requires an appropriate balance between exploration and exploitation. The literature refers to this balance as « ambidexterity ». The present paper provides evidence for a competence development process associated to the implementation of ecodesign. By combining contextual and network ambidexterity, this process promotes a continuous stream of innovation.

Key words : competences, exploitation, exploration, ecodesign, innovation

Ecodesign as an innovation-friendly competence-enhancing process

INTRODUCTION

Integration of environmental concerns appears as a major issue for the companies of the XXI century. To address these concerns, companies have to bring changes and to consider new ways of doing business, new ways of producing, new products and services that would generate less environmental damage. As Thompson (1965) states, the generation, acceptance and implementation of new ideas, processes, products or services, for the first time in an organizational setting, constitutes an innovation. Ecodesign processes, being at the source of environment-friendly innovations, are a challenge for a growing number of companies.

Ecodesign can support organizational innovation by introducing new constraints and providing new opportunities. Some authors dealing with innovation (Verona and Ravasi, 2003...) shed light on the necessity to handle simultaneously two types of innovation, in order to ensure sustainable performances : exploitation of the organization's existing competences, and exploration leading to the acquisition of new competences. Following Danneels (2002), we view the organization as a portfolio of competences. These competences are required for the innovation activity, still, they are impacted in return by the innovations generated. We attempt to identify which competences are used during the ecodesign activity, and to describe the associated process of new competences development. Competence enhancement promotes innovation, and the radicality of this innovation tends to increase, in relationship with the degree of novelty of the developed competences (Danneels, 2002). How could ecodesign implementation be a source for stimulation of innovation ? Could competences developed through ecodesign act as a vector for some types of innovation ? In order to provide some elements to address these issues, we conducted a qualitative study. This study consisted mainly of interviews among a sample of fourteen managers within private companies and professional organizations. We investigate the management of ecodesign projects so as to assess to what extent they could fit with innovation.

This paper starts with the identification of ecological innovation as a major challenge for organizations nowadays. This statement leads us to investigate the ecodesign process that crystallizes the integration of the ecological criteria within the productive activity. Then we provide an overview of the ambidexterity concepts, so as to confront them to the field.

The analysis of our interview-based study displays some key points worth further investigation, like the organization of ecodesign practices and their impacts for competences and innovation.

1. ENVIRONMENT, ECO INNOVATIONS, ECODESIGN

The currently emerging environmental concerns appear, at first sight, little compatible with the economic activity as it has been so far. However, compatibility is required since neither economic growth nor the nature could reasonably be left aside today.

1.1 ENVIRONMENTAL INNOVATION : AN ORGANIZATIONAL CHALLENGE

As the actions of the companies regarding the preservation of the natural environment are expanding, there is an upcoming risk of finding a dead end. Indeed, these practices tend to remain very similar across time and across companies. The consecutive results therefore appear to contribute insufficiently to the underlying target : the preservation of the natural environment. As Gladwin, Kennelly and Krause (1995) indicate, business management has to move from « *reducing the bads* » to « *realizing the goods* ». Innovation seems to be the one way to progress towards the integration of the environment within the economic activity. And this, in spite of the fact that innovation may, under certain conditions, increase consumption and ressource needs by accelerating renewal. Innovation brings more and more accurate answers to the diverse issues faced by firms as far as sustainable development is concerned (Mathieu, 2007). Environmental innovation has to take place. Environmental innovations can be defined in two ways : first, by the effects of the focal innovation on the nature, and second, by the intention of the innovator to reduce the environmental damage caused by products and processes. About sustainable development, Hart (1995) states that companies have to implement three broad types of actions : prevention of pollution, ecological design of products and sustainable development itself. We are especially interested in the second point, environment-friendly design of products, i.e. ecodesign.

During the 70's, reactions to the first major pollution accidents have essentially consisted in searching for curative processes. The aim was to treat pollution at the end of the production process. In the 80's, some industrials have moved from curative to preventive measures and clean technologies. Therefore, they turned from a reactive attitude to a proactive one, but still focused on the production step. During the following decade, consideration of environmental impacts all over the product's life cycle, starting with the design step, has emerged. This approach called ecodesign will be presented in the next section.

1.2. ECODESIGN-BASED ENVIRONMENTAL INNOVATION

It is estimated that an average 9 T of inputs are being used in order to produce 1 T of the final product. It is estimated that the production of a manufactured product emits from one to double of the product's weight as greenhouse gases (Le Pochat, 2005). Thinking about the environment from the very beginning of the business activity, i.e. from the product creation project, is required. Integrating environmental criteria all along the economic process, from design to end of life, through production, transportation, distribution and utilization can be a means to balance environmental concerns and business activity. The very design of the product is the most coherent response, since most opportunities for action are at this level. Ecodesign is therefore to be seen as an efficient tool, not only to help addressing the issue of environmental damage, but also to explore new ways for innovation.

Ecodesign is a preventive approach that consists in taking into account the environmental dimension while designing a product or a service (Roux, Patingre, 2005). The international norm ISO 14062 defines ecodesign as the integration of environmental constraints in the products' design and development process. The ecodesign approach consists in identifying the main environmental impacts throughout the product's life cycle, from the production of the inputs until the disposal (Vignerou, Patingre, 2001). The aim is to minimize the product's overall environmental impact during its life cycle, while maintaining the expected usage standards. The process builds on the usual steps of the design, while adding the ecological criterion. Therefore, it is historically seen as restrictive for innovation. By adding one more criterion, ecodesign induces a decrease in liberty degrees.

According to Hart (1995), for a product to get a low-cost environmental life cycle, the designers have to : minimize non-renewable inputs requirements, avoid the use of toxic

materials, use renewable resources according to their renewal rate. The use of the product also has to be done at low impact and moreover, it has to be easily composted, reused or recycled at the end of its life. Looking for the best compromise, the designer proceeds by selecting and combining solutions throughout the whole life cycle, while integrating all categories of environmental impact. This work of assessment and reflexion about organizational activity and products drives process optimization but also exploration of innovative solutions. Life cycle analysis or LCA is the main tool used for eco-designing. It is a tool for decision-making that identifies and quantifies, all over the product's life cycle, physical flows of material and energy associated with human activities.

Many other tools are available for assessing a process or a product's environmental impact and then help the company identifying solutions. One point underlined by many authors (Le Pochat, 2005 ; Abrassart, 2007) is the necessity of choosing appropriate tools and of adapting them to the organization's context, strategy, competences and values. Besides product innovation, the implementation of ecodesign practices requires technologies, tools, and innovations regarding organization and management. It implies the development of technological competences and of the associated organizational competences.

So far, these practices have only been in an emerging phase. Few companies really know about ecodesign, its challenges, tools, implications, and potentialities. These practices are surrounded by uncertainties. The simplification and normalization of the tools can help their diffusion across business activities. Still, today, for the committed companies, the issue of ecodesign's implications on middle and long-term remains uncertain, due to little experience. However, professionals remain convinced that it is not about any fashion effect. If the largest multinationals can sometimes feel pushed towards ecodesign because of their high visibility, the small companies feel incentives to enter an innovation-based competition. Ecodesign can provide a means of differentiation. Located at the interface of economics and environment, two of the three sustainable development pillars, ecodesign appears as a concrete and effective tool in order to integrate environment into the business (Le Pochat, 2005). Today, ecodesign, alias the product-orientated approach to the environment, is a crucial issue of companies' sustainable development policies (Abrassard, 2007). Therefore we focus here on the study of organizational ecodesign practices.

A literature review of ecodesign issues shows that it has been so far the focus of little investigation in business administration science. Besides, we notice that research is mostly technical, engineerical and aims at suggesting and testing directly operational methodologies. More theoretical and strategy-orientated works on the subject remain anecdotic. But successful ecodesign requires a double level activity : strategic, in order to settle the problematic within the organization as a whole, and operational so as to be able to implement decisions concretely. Ecodesigning means developing an environment-friendly product in an environment-friendly manner and so it drives to innovation. Product innovation drives organizational change by exploiting and exploring the firm's competences (Danneels, 2002). It has been recognized as a major means of organizational renewal (Dougherty, 1992). In order to be able to provide a relevant analytical frame for managing ecological innovation, we will consider the different types of innovation and the concept of ambidexterity.

2. AMBIDEXTROUS INNOVATION

Helfat and Raubitschek (2000) underline the relevancy of the resource/knowledge-based view for studying product development processes. Their argument is that organizational competences and products evolve together over time. Ecodesign practices will be interpreted at the light of the resource/knowledge-based view theoretical frame. The organizational learning theory and its exploitation and exploration concepts, as introduced by March (1991), will also be mobilized.

Continuous innovation (Verona et Ravasi, 2003) can only be achieved on the long run through combination of exploration and exploitation innovations. We define exploration innovations (Danneels, 2002 ; Benner et Tushman, 2003 ; O'Reilly et Tushman, 2004) as innovations requiring technological or marketing competences that are new to the firm.

- Exploration innovation will therefore be referred to as an innovation that goes significantly beyond the firm's core existing competences, on the marketing or technological side.
- Exploitation innovation results from strategies consisting in accelerating innovation processes while building on the firm's existing marketing and technological competences (Chanal et Mothe, 2005).

To synthesize, exploration and exploitation innovations differ from radical and incremental innovations since they focus on the notion of « competence » more than on the innovation's

degree of novelty (Danneels, 2002 and Benner et Tushman, 2003). The simultaneous achievement of exploration and exploitation - « ambidexterity » - is identified throughout the literature as a source for continuous innovation and as a condition for the company's success on the long term. An ambidextrous organization manages at the same time these two types of innovative activities.

The literature identifies three categories of ambidexterity :

- Structural ambidexterity, viewed by Benner and Tushman (2003) as the integration of exploration and exploitation activities in different units. The necessity of a relevant balance between these two activities has been crystallized by Tushman and O'Reilly's model (1996).

They view the ambidextrous organization as being as well able to compete in mature markets, where the crucial issues are costs, efficiency and incremental improvement, as able to be innovative in product development activity for emerging markets, where experimentation and flexibility are key abilities.

According to O'Reilly and Tushman (2004), organizational ambidexterity can be achieved through the establishment of internal structurally independent units. Each unit manages its own processes, structures and cultures. However, these units are fully integrated within the existing managerial hierarchy.

- More recently, Gibson and Birkinshaw (2004) introduce the notion of contextual ambidexterity as the behavioural –and not structural- ability to implement both short-run alignment and long-run adaptation. Adaptation can be defined as the ability to quickly reconfigure activities within a single strategic business unit, in order to address changes in the environment. This ability relies on the individuals.

- Third, network ambidexterity (Mc Namara, Baden-Fuller, 1999) can be defined as the balancing of exploration and exploitation through networking. Typically, large companies focus on exploitation around their core competences whereas small companies or start-ups focus on exploration. We notice that this last type of ambidexterity happens to be far from stable and that many discussions are currently held around the concept.

Furthermore, companies frequently address the implementation difficulties of an innovation policy by setting up cooperative relationships. These cooperations can help generating innovation since they provide access to knowledge and resources otherwise unavailable (Powell, Kogut, Smith-Doerr, 1996). Stuart and Podolny (1996) establish a significant

positive relationship between a company's propensity to initiate external relationships and its degree of innovation in fields not directly linked to those in which it had developed technologies in the past. Call for external partners' competences could then especially facilitate exploratory innovations, i.e. innovations out of the organization's core expertise. Cooperations can therefore be extremely valuable in organizations' quest for ambidexterity. As far as environment is concerned, we observe a strong tendency from companies to enter in relationship with other entities perceived as more competent, or with entities facing similar environmental problems.

We will confront these theoretical assumptions to the concrete reality of companies' ecodesign practices. These practices will be apprehended through a qualitative exploratory study. Can ambidexterity be achieved within ecodesign activities? What categories of ambidexterity could then be relevant?

3. EMPIRICAL STUDY OF ECODESIGN PRACTICES

After explaining our research methodology, we present the main results from the analysis of the data collected.

3. 1. METHODOLOGY

Our approach is empirico-deductive. We aim at describing organizational ecodesign practices, in order to identify regularities, features and key points that will then be confronted to the theoretical frame. This confrontation will lead us to determine which concepts from the literature could apply to ecodesign. Regarding the object of the research, emerging, complex, and still unclear organizational practices, a qualitative methodology allowing detailed study seems appropriate.

We perform a series of fourteen exploratory interviews. The aim is to approach the concrete reality of ecodesign practices and to identify its challenges and difficulties. The interviews' average duration was 1h30. The interviewees are either sustainable development or environment managers, or R&D/innovation managers or ecodesign managers. They belong to large companies or professional organizations. They are identified within their respective organizations as being the best informed persons for everything regarding environment and

ecodesign. The interviewees have been selected through a snowball sampling method, each respondent indicating other potential respondents competent on the subject.

The sample's structure is the following : Chamber of Commerce and Industry's innovation manager (2), large private company's R&D or innovation manager (2), director of environmental consultancy cabinet (1), environmentally innovative small company's manager (1), large private company's environment manager (3), ecodesign/environment expert in a professional organization (5). This structure is justified by the usually noticed fact that « actor » respondents, directly and personally involved in their company's ecodesign projects, show a tendency to rationalize a posteriori and to adopt a subjective and over-focused point of view. The « external observers » respondents benefit from a more neutral position and more elements for putting the practices they witness into perspective. However, their knowledge regarding the context and implications of a specific ecodesign project may be less accurate. Therefore, these complementary points of view from these two categories of informants enrich each other.

The interviews are divided in two parts. The first one is non directive : the interviewees are asked to talk about their organization's ecodesign practices. The second part is semi-directive. We interview the managers more explicitly and building on their previous speech.

The main points addressed are the determinants of the ecodesign approach, the practices 'organization and the effects of their implementation for the firm. The interview guide is adapted for professional organizations' respondents. They talk about other companies 'practices they had the opportunity to witness. We invite them to identify specificities in an ecodesign project's management, and to look backwards in order to determine to what extent ecodesign could support an environmental or an innovation policy.

Interviews are transcribed and go through a thematic analysis. They are used in the objective of supporting a better understanding of how companies come to implement ecodesign practices and what are for them the impacts. We will present here the most significant results, that is to say the necessity for specific prerequisites, the sequential competence development through external exploration and then internal exploitation and exploration, and finally the role of ecodesign within the ambidexterity challenge.

3.2. MOBILIZATION OF PRE-EXISTING INTERNAL COMPETENCES

There are some prerequisites for the implementation of an ecodesign project. Such a project builds on competences already developed by the organization. These ones support the project's implementation. Ecodesign is then logically a following to approaches like : innovation, design, environment. It builds on the firm's competences and enhances them. Ecodesign implementation relies on the company's leeway regarding design : *« Companies that do ecodesign already do design. They must have a leeway on their products' design, they must master the project itself (Manager, ADEME Lyon) ; « Ecodesign, that's all design steps and we add some tools concerning the environment. In case you don't master the design activity, there's an additionnal risk to get involved in ecodesign. The relevant process is to have first a design activity and then to add ecodesign » (Manager, ADEME Lyon).*

Besides, ecodesign is systematically preceded by an environmental policy. Implementation of ecodesign appears as the next step for on-site environmental, quality, and safety policies : *« We have to integrate ecodesign in addition to an environmental policy at the level of the production site. The approach is global in terms of sustainable development, corporate social responsibility. Ecodesign is then one pillar of the approach. » (Manager, CCI).* Ecodesign policy is supported by an internal normative environmental approach, a preexisting environmental culture, and therefore demonstrates the company's maturity regarding environment : *« That's part of our internal policy, we are ISO 14001 certified. For us, the respect of the environment is part of the company's values shared by the staff. » (Manager, Company V).*

Moreover, ecodesign implementation demonstrates a maturity in terms of innovation : *« An ecodesign approach shows some maturity of the company. People expect then that we already master innovation and design, it's one more step for the vision and the maturity. » (Manager, regional CCI).* *« For rating agencies, if a firm is able to address new issues like sustainable development, it's the proof it is sane and able to produce innovation. » (Expert, ADEME Paris).*

The organization of ecodesign is made by project groups. Here comes the necessity of mastering project management tools. Indeed, these can also be applied in the context of environment : *« Organizing ecodesign by project groups is absolutely necessary. » (Director, environment consultancy cabinet) ; « The project approach is convenient and adaptable for any criterion, including environment. » (Expert, CCI).* Top managers' incentive role is to be underlined : *« Ecodesign have first of all to show top managers' involvement, they have to*

support the project. » (Manager, Regional CCI). Besides, sensitivity to ecodesign depends on the sector of activity, on the position within the productive chain, and on the company's size, since it remains a feature of large organizations : « Ecodesign activity is to be differentiated depending on the size and on the sector. Every large firm does it, still there are different levels of commitment, depending mostly on its leeway.» (Expert, ADEME Paris). The ecodesign approach mobilizes some of the firm's technological and organizational competences. Its implementation draws on them. Still it also requires the acquisition of other specific competences.

3.2. SEQUENCE OF EXTERNAL EXPLORATION AND INTERNAL EXPLOITATION AND EXPLORATION

At the beginning, an ecodesign approach requires competences that the company doesn't master and that it will have to find outside. At the start, companies experience a lack in environmental knowledge. The initial access to environmental knowledge is indispensable. Still the acquisition cost is perceived as high : *«Some must have previously done analyses, firms must have databases available. » (Manager, ADEME Lyon). The ecodesign approach is indeed supposed to start with a diagnosis of the company's activities and products : « We first need a good diagnosis, depending on the stakeholders » (Director, environment consultancy cabinet). Companies don't benefit from experience feedbacks regarding ecodesign yet : « The most blocking factor are the firm's competences and knowledge. We start from zero. There is a knowledge database to create. » (Expert, ADEME Paris).*

Therefore companies find it hard to implement concrete actions : *«We talk a lot about ecodesign but there are few concrete projects » (Manager, ADEME Lyon). Companies look for external expertises at the start of the ecodesign project. Managers underline the necessity to be accompanied by an environment expert. A call for external expertises –consultants- is required to initiate the project : « People who commit themselves to ecodesign can't do it on their own. At the beginning, the company needs an expert, wether external or integrated, it's absolutely necessary.» (Manager, ADEME Lyon) ; « Internally competences are lacking so organizations look for help among consultants, chambers of commerce and industry, engineering schools, technical centers... » (Expert, CCI).*

Companies cooperate then with research institutions, technical centers etc. and also with other companies of their production chain. A company gathers external expertises when it doesn't

have the required competences for developing a new ecodesigned product, and when their acquisition would be too complicated or too expensive : « *Clearly, the laboratory didn't master these competences. Well, it could have got them but then there would also have been a resource problem.* » (Environnement Manager, company L). Ecodesign mobilizes therefore internal environmental competences while requiring an external input : « *Our customers find out the solution by themselves in relationship with universities, engineers, new networks.* » (Director, environment consultancy cabinet).

Then the organization proceeds to the adaptation of external ecodesign tools and methods to its own specificities. In order to be able to ecodesign, companies need appropriate and simple tools : « *A problem regarding ecodesign ? Simplification of tools ! Life cycle analysis is far too complicated.* » (Director, environment consultancy cabinet), « *We would like a label, calculations based on established rules. Ecodesign has to be measurable by third parties and opposable to third parties.* » (Manager, company G) ; « *We look for proper solutions, case by case.* » (Manager, company V). The company then links the new ecodesign skills to its core competences, it associates all internal competences to the policy : « *We have to put together all competences so that everyone can mix the new information relevant to him with his other abilities and his current knowledge.* »

The tools and competences acquired during cooperation phases are adapted and developed inside the company afterwards : « *It started in 96 and little by little, the tool evolved and several ecodesign projects have been launched* » ; « *Progressively we developed internally expertise on our products, I mean tools, abilities for market analysis.* » (Environnement Manager, company L).

Consecutively to an external environmental knowledge input, which is not necessarily specific to its own activity, the company develops competences by itself, competences adapted to its needs. That's why, while implementing the ecodesign policy, the company educates its staff : « *We are training our staff members as part of our sustainable development policy, in order to work as efficiently as possible, with the best available knowledge possible. That's a long-term policy of skills acquisition, a continuous action.* » (Manager, company V).

The company is searching for external competences at the beginning of the project and then it builds competences internally : « *Some external competences are useful for the assessment of*

environmental impacts, the company should be told what criteria to work on » ; «After this environmental assessment the company works on itself to find solutions, design, since only the company has an overall vision of its constraints on product design. » (Expert, CCI). Ecodesign generates a growth in competences : « We also need to be able to implement, to create the culture, to know how to pave the way for improvement. After the first learning loop, there is a competence enhancement process that spans over several years. » (Expert, ADEME Paris). Tools for assessing products and activities change : « Product assessment tools are totally different with ecodesign » (Expert, CCI) ; and including product utilization phase at the design step becomes systematic : « The approach is really new for the firm. It implies opening upstream and downstream in the chain, starting from the production step. It also implies the necessity to research how the customer is actually using the product. And the company's view of its product is to evolve. » (Expert, ADEME Paris).

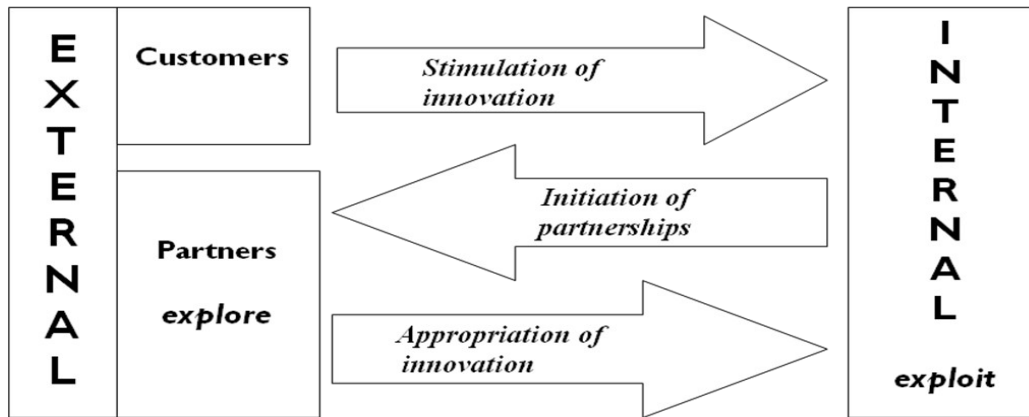
Environment is turning into a major R&D priority, without leading to immediate introductions on the market : « We have many projects regarding treatment, some research on substitutes, filters, material categories and production... » (Manager, company V) ; « Many companies only realize ecodesign in R&D laboratories and they keep on-shelves solutions. This paves the way. » (Expert, ADEME Paris).

Among newly developed competences, some happen to be specific to ecodesign and environment related activities whereas others can be transferred to other applications. Ecodesign therefore stimulates production of versatile competences : « The ecodesign approach leads to the formulation of some things, to the use of other interesting tools. It brings more structuring and transverse abilities. The organization gets used to keep an eye on normative evolutions and to perform technological benchmarking. » (Manager, CRCI). It is an overall and transverse approach : « We can say the approach starts with the feasibility studies, the R&D lab, still it impacts throughout the whole company. » (Manager, CRCI).

This internal competence development allows shifting from an external exploratory phase to a phase of internal exploitation of ecodesign competences : « I was before in an experimentation phase, testing tools and methodologies... And now we truly are in the industrialization phase, we rationalize, we simplify. » (Environnement Manager, company L). Furthermore, we notice that organizations pursue internally their R&D concerning ecodesign projects not expected to end up on the market in a near future. These projects then appear as

exploratory research, which means the company can run internally both exploration and exploitation projects, once ecodesign implementation has been initiated. Cf. Scheme 1.

Scheme 1 : Model for development of ecodesign competences.



3.3. ECODESIGN : BETWEEN EXPLOITATION AND EXPLORATION

Ecodesign operationalizes a balance between diverse existing constraints while implying at the same time high uncertainty and change.

3.3.1. An exploitation-orientated logic

Ecodesign is part of a continuous improvement logic. Breakthrough innovations generated by ecodesign are scarce. It is mostly about incremental innovations : « *Improvements have been brought these last years.* » (Manager, company V). Ecodesign leads to applied research : « *In ecodesign, we're not far from applied research.* » (Manager, company G). Companies tend to follow a policy of continuous environmental improvement : « *Our philosophy is continuous improvement rather than big innovations. We build on users' habits, on experience developed gradually.* » (Manager, company V). They search for process optimization, cost reduction and anticipation : « *We optimize. We master the firm's operation vis-a-vis the environment.* » (Manager, company G).

The environment criterion is included in addition to the others, companies search for performance growth and image enhancement, still at identical cost : « *If we end up with similar costs, the industrial entrepreneur will do it because it provides him with an ecodesign image.* » (Manager, professional organization); « *Environment represents a differentiating element provided there's no doubt about the product. If the quality is*

guaranteed and if the product is no more expensive, the ecological criterion can be decisive. » (Expert, ADEME Paris).

The normative frame, unavoidable as far as environment is concerned, could be counterproductive for innovation. Indeed, the ISO 14062 norm defines product ecodesign. « *We always refer to the norm. The more rules there are the less innovative you get but the better you manage planning, costs etc.* » (Expert, CCI). Ecodesign practices aim at eco-efficiency, which allows for relational and image benefits - among others generated by sustainable development practices. Meanwhile, ecodesign allows cost reductions, thanks to the many improvements resulting from incremental innovations. Exploration innovation seems to be eased by a reflexion with partners and the inclusion of actors located farther from the basic economic activity. In other words, opening appears to promote changes, by enlarging the organization's evolution perspectives, by bringing more diverse values, etc.

3.3.2. A logic requiring exploration

Ecodesign is widely recognized as a source of innovation: « *In order to perform ecodesign, one is compelled to perform innovation.* » (Manager, company G) ; « *We can view ecodesign as an innovation since we add a constraint. We know innovation results from a constraint, from a disturbance of a system. The approach is radically new for the firm.* » (Expert, ADEME Paris).

Moreover, ecodesign is a substantially proactive, anticipation-based approach : « *What is at stake is obviously to get a lower-impact product but even more to differentiate, to find a market.* » (Manager, ADEME Lyon). It aims at creating new markets and new activities and therefore at building new competences, regarding technology as well as marketing.

In some cases, definition of the ecodesign project in terms of objectives rather than means can promote more radical innovations : « *For ecodesign, the project's basis has to be defined in terms of objectives instead of means. The objectives must be set so as to free a leeway for ecodesign. Rather than thinking about the floor's thickness, one should think about the space available between floor and ceiling.* » (Manager, company G).

Besides, the uncertainty surrounding practices and the multiplication of initiatives are typical of an exploratory search : « *Currently, we witness label superposition, unlogical and unclear initiatives, etc. this is not rational and then we cannot build on experience.* » (Manager, company G).

Ecodesign practices therefore display features of both exploration and exploitation activities. They require the combination of a daily management and a long term management: « *The objective is first to develop treatment processes, and next to develop clean processes. This means producing in another way, that respects the environment, and finding out non traditional processes* » (Manager, professional organization). The ecodesigned product has to match either the customer's current expectations, which are relevant to exploitation, either the expectations of an estimated potential future market, relevant to exploration : « *If there is a demand from a customer, the relevant indicator will be the fit with his wishes. If the approach is more proactive, the reference will be an assessment of the potential market.* » (Manager, regional CCI). The initial exploratory search is often conducted by research organizations and the applied research for industrialization – exploitation- is conducted by the companies afterwards : « *When a research program is launched, there is a fundamental part, that can today be conducted through partnerships with universities, and on the other side, the industrials have their own basic research center. They start from an idea, that comes from some university, from technological benchmarking, or from a publication, and they assess the feasibility of an implementation of the process.* » (Manager, professional organization).

If ecodesign builds on existing competences and on a will for continuous improvement, it requires nevertheless some exploration, in order to acquire the new necessary competences. These ones will be enhanced and adapted to the organization's specificities later on.

4. DISCUSSION, INPUTS AND LIMITS

The competences mobilized for the implementation of ecodesign are technological but also organizational. Moreover, they come from both exploration and exploitation activities. Cf. Table1. Ecodesign-generated innovations then display characteristics of continuous innovation, which is based as well on existing competences as on the development of new ones, with support from external collaborations. Indeed, the introduction of new technological artefacts requires organizational changes. And these changes will allow a continuous flow of environmental innovations. A process of technological and organizational co-innovation is initiated.

Table 1 : Typology of competences mobilized by ecodesign

| Competences | SPECIFIC | | GENERIC | |
|--|--|---|---|--|
| | Technologies | Organization | Technologies | Organization |
| E X P L O I T A T I O N | Limitation of resources over-consumptions Search for efficiency gains ... | Environmental benchmarking Normative benchmarking Environmental management scheme ... | Production process optimization Ideas for continuous improvement of products and process ... | Product development process structuring Project team management ... |
| E X P L O R A T I O N | Environmental Database construction Environmental assesement of products and processes Life Cycle Analysis software mastery ... | Taking into account utilization phase and end of life Ecodesign methods Someone responsible for ecological products productsproducts » | New R&D ways Alternate technologies Folder defined in terms of objectives instead of means ... | Cooperation with new actors Taking into account new requirements from new stakeholders Upward and downward opening Anticipation abilities |

It appears that companies rely on their existing competences while implementing ecodesign. This result is in accordance with the work from Leonard-Barton (1992) which shows that companies' core competences promote the development of projects using them. Ecodesign is widely perceived as a continuous improvement process, i.e. as exploitation. However, in order to initiate ecodesign, an organization needs resources - and especially competences - it doesn't have and the internal development of them would be too complex and costly. Therefore the organization handles exploration through cooperations with external entities, or calls for experts. The new competences acquired through this one-time exploration are then enhanced and adapted internally.

Furthermore, as states Danneels (2002), newly developed products are vehicles for organizational learning, regarding as well technologies as markets. The company then conducts, as far as ecodesign is concerned, not only an exploitation search, but also an exploration search, by performing R&D without any industrialization objective on the short term. However, it seems that internally, exploitation is preferred to exploration, for several

reasons, including : a will for ongoing optimization, the little radicality of the innovations produced, the weak environmental competences.

Our results drive us to assume that the integration of the environment within organizational productive activity occurs in a cyclical manner, through long periods of internal exploitation, interrupted by brief periods of exploration, managed in cooperation with external partners. This fits with the technological change model developed by Anderson et Tushman (1986). This model describes long periods of incremental innovation, punctuated by radical innovations during very short periods.

This integration process by exploration and exploitation seems to combine a contextual ambidexterity, sequential at the level of the entire organization, since it alternates over time long exploitation periods and short exploration periods, and a network ambidexterity, since exploitation is conducted inside the company and exploration requires cooperation with outside entities. Therefore, we notice here two types of ambidexterity identified by the literature : contextual ambidexterity (Gibson, Birkinshaw, 2004) and network ambidexterity (Mc Namara, Baden-Fuller, 1999). The data collected doesn't allow for recognition of any structural ambidexterity (Tushman, O'Reilly, 2004). Here, ambidexterity seems to be achieved by the option of calling for external expertise or not. In order to attenuate budget tensions that can occur regarding the choice between internal development of either exploration or exploitation innovations (Chesbrough and Appleyard, 2007), companies open themselves so as to innovate more radically. Indeed, as literature states (Koza and Lewin, 1998), alliances for exploration purposes allow the company to build new competences, to adapt to changes in its environment, and to be aware of new opportunities through organizational learning. Moreover, we validate the literature's assumptions (Stuart and Podolny, 1996) regarding cooperations. This literature explains that cooperations, by providing access to new resources, promote the generation of exploration innovations. Combination of exploitation and exploration, typical of the internal pursuit of ecodesign, is appropriate in order to promote continuous innovation, as defined by Verona and Ravasi (2003).

This research draws on the recent works regarding resources and competences developed under the influence of a sustainable development strategy (Mathieu, 2007, Abrassard, 2007, etc.). However, it focuses on a directly productive and necessarily innovative environmental

activity : ecodesign. It sheds light on the usefulness of the resource-based view theoretical frame for the study of firms' ecological strategies.

Still, this work has limits, that invite to further investigation of the subject. The interviewees were not always skilled enough to give accurate answers to all questions.

Besides, all companies investigated don't already have a true ecodesign activity, as defined by the literature. These interviews were meant to collect on the field some information regarding the way private companies handle ecodesign projects. The number of interviews doesn't allow for an exhaustive overview, and small firms are mostly represented by managers from professional organizations, who bring expertise to them. In order to continue this research, it would be relevant to identify more precisely the competences developed during the different phases of ecodesign implementation, and to better distinguish exploration phases from exploitation ones. The different categories of competences identified by Danneels (2002) could be enlightened : first order competences, both technological and marketing, competences for integration, i.e. ability to recombine first order competences, and finally, second order competences, i.e. capability to develop first order competences.

The present research positions itself at the intersection of innovation and sustainable development thematics, which are major issues for organizations today, whatever their size or the business they are in. It focuses more specifically on ecological innovation, approached through ecodesign. Moreover, this paper draws on the emerging flow of studies about organizational ambidexterity. Its main originality resides in the mobilization of the theoretical frame of ambidextrous innovation, in the context of sustainable development's management. But we also approach ecodesign from a managerial instead of a technical perspective, which gives us the opportunity to enlight its more strategic aspects. Last but not least, we identify relevant theoretical concepts to describe the ecodesign process. This work provides a basis for investigation, in order to understand emerging practices aiming at the integration of the environment at the very heart of the business activity, through innovation processes.

CONCLUSION

After identifying ecological innovation and therefore ecodesign as a major issue for the companies of the XXI century, we focus on the modalities of its implementation. We build on

ambidextrous innovation and organizational learning theoretical concepts in order to explain how a company committing to an ecodesign strategy could at the same time promote innovation. We conduct a qualitative study among experts from both private companies and professional organizations. Ecodesign implementation values existing organizational competences, while also requiring collaborative exploration. This exploration allows for acquisition of new competences that will be exploited internally later on.

Therefore, the integration of the environment at the very heart of the productive activity seems to occur through a sequential process of external exploration periods, followed by periods of combined internal exploration and exploitation. In order to deal with ecodesign, organizations combine contextual and network ambidexterity, which is relevant for creating a flow of continuous innovation.

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