

DESIGN RESEARCH FOR INNOVATION: INTEGRATING CREATIVITY AND PRODUCT DEVELOPMENT PROCESSES

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Keywords: design, innovation, creativity

1. Objectives

This paper is to validate the innovation process defined by the Product Design Research Unit of the Politecnico di Milano and to show, through two case studies, how this process can be integrated with companies' product development processes in order to increase innovation chances.

Nowadays companies involved in consumer goods production need new competitive values to face market turbulence. The Product Design Research Unit has been trying to find these values in the whole of factors related to new products' creation, and especially in those factors that are nearer to consumer habits and life styles.

2. Definition of an innovation process based on design research

We claim that product innovation can be reached starting from a clear definition and analysis of the context surrounding the product. Thus, context analysis becomes an instrument for managing complex issues and, integrated to product concepts' creation, it is capable of defining a scenario for future products. The following model explains the phases that make up the design research activity conducted by the Research Unit and shows the existence of a linear process in which every step of analysis completes the knowledge heritage necessary to design in complex contexts.

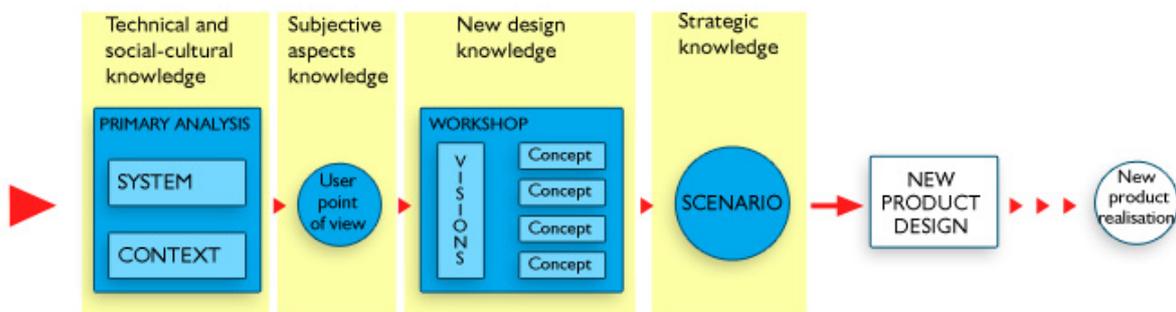


Figure 1. The RU innovation process

The model of our innovation process contains a possible solution to turn a complex context into new design knowledge and then into strategic knowledge that allows products innovation chances. The whole information gained during the primary analysis phase can be analysed creating a sort of filter

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(the user point of view) through which the said information becomes a redefined combination of design issues. Using the user point of view as a filter means to consider all the subjective and objective issues related to the user. In this sense it becomes of primary importance to understand what a product causes to the user and which is its meaning to the user, as well as it is central to define user's reactions to product functions and performances. New design issues can be used then to define new visions of the context in order to enable designers to interpret them with the generation of product concepts during the workshop phase; in this phase designers assume temporarily the double role of artefacts' user and conceiver; this can be considered the most relevant advantage designers can provide to the creation of product's success. This activity, that integrates research to design practice, defines a possible scenario for the product: the key for new knowledge and for innovation.

Thus, the design research actuated by RU manages the complexity of the product context by turning design issues into design tools. To obtain design tools from a multidisciplinary context means to translate every bit of information into visual or technical stimulations for the creativity of the designers involved in the research activity. Therefore, the RU provides designers with visual maps where all the factors that have a strong influence on the product to be conceived are organized. These maps are used by designers in order to deal with the whole issues and the pace at which said issues change. Hereafter every step of the RU innovation process are better described.

2.1 First Step -The primary analysis

To analyze the system and the context of a product means to identify all the elements that can influence the conception and the use of a product: we can distinguish them into actors and factors. Actors are companies' management, designers and the whole of consumers including social and economic institutions. We can define factors: trends about consumption and lifestyles, products, actions, the environments in which said actions take place, the interactions among users, artefacts and spaces, and users' behaviours.

2.2 Second Step - The trend analysis and the user point of view

The analysis of trends in the social field and in the consumption field is a fundamental step in the research activity of the RU. In this analysis are involved experts and consultants in many disciplines like psychology, sociology, anthropology, semiology, communication. RU also involves marketing experts coming from the industrial sector under analysis but also from related fields (i.e., in the case of office furnishing, experts in the field of lighting systems and domotics were involved). The RU process goes from more general to more specific issues, starting from social trends in order to analyse their influence on the production of consumer goods and in order to define with trends are more strictly related to the field under analysis. Particular attention is paid to define the "extreme" trends that can pull ahead product innovation. For example, office furnitures can be studied starting from the analysis of not typical office work like the call-center operator or the industrial machinery operator. As said before, RU takes into account also the evolutionary trends related to the artefacts complementary to the studied product (lighting and domotics in the office furniture case); this is done in order to guarantee the functional correspondence of the solutions to the changing context. This kind of analysis asks for an exchange of knowledge among different project researchs. Every trend analysis performed by RU becomes a dowel of the mosaic of the innovation process and can be useful for the completion of the context analysis of specific products in different research projects.

2.2.1 The user point of view and the experience

According to Hanington [2000] if current trends are any indication, the relevant concerns for product use are much more holistic than in the past. While issues of comfort, safety and intuitive use are no less important, the totality of experience is now recognized as the responsibility domain for designers. At the same time, the consequential relationship between performance and preference can be inverted. Colin Burns, leader of the interaction team of Ideo in London, believes that companies have entered the post-disciplinary age of "interaction design": "It is obvious that design activity is finally related to

consumer's experience, that has its environmental context and a system of relations with different technological and functional systems...".

According to Vinyets [2000] and his definition of "prospective design", product design is an ethnographic phase that goes beyond the product itself, as a narration of experience, a story to be explained through observation of the way products are used. Therefore, the product is not the expression of an idea, but the materialization of a potential experience.

Companies often manage product innovation facing technological issues and trying to get an improvement of product performances; sometimes that causes a functional redundancy of the product. Observation and interpretation of the real experience of the actors related to the product can be an effective solution. In this way a level of qualitative knowledge can be created; this knowledge also integrates the quantitative value of the marketing analysis.

The study of the consumer's experience with the product generates the construction of a narration that includes the everyday use of the artefact; this narration can be put into a system in order to obtain "visions" of and for the future.

2.2.2 The subjectivity: a tool for innovation

According to Schianchi [1997] life goes on two levels: "... the first level is the material one, the physical one; the second level is the spiritual one, the psychological one. These two levels are part of a whole: the material structure of life is pushed from the spiritual one, but the spiritual one shows itself in the limits given by the material structure in which it is inserted."

Economic aspects of both the material and the physical level are perhaps able to be known using already consolidated economic theories, but economy, considered in psychological terms, made of subjectivity, interpretations and expectations, is absolutely unable to be known using common approaches. What is worth for the material level cannot be worth for the spiritual one or for the psychological one: according to Schianchi, the individuals' behaviour is not always explicable only in terms of supply and demand because it is situated on another level of knowledge. This knowledge level is one of the research target.

Through the integration with the knowledge heritage of companies, the RU is able to lead managers and entrepreneurs into the complexity of the product system and to enable them to read the innovative visions of their projects as an instrument for market competition.

According to Zurlo [1999], generally the behaviour of a top manager, beyond an ideological-institutional context, refers to a well defined scheme of behavior: gathering information; taking decisions; putting them into practice; checking them in order to verify if they are coherent with their value. The crucial point has always been taking decisions. The entrepreneur-manager must always be able to make a choice, right or wrong. Every choice is however based on a knowledge that managers obtain with organised methods and information abundance. On the base of the thoroughness and impartiality of this information, the manager makes a choice: the problem is that this information is often not complete or excessive and complex, therefore it is necessary to reduce or to interpretate it. This necessity makes the knowledge about the product neither neutral nor univoque. Information can then be redundant, dispersive, or insufficient and misleading. So if in the theory of the decisions we find limits rationality, then to take decisions becomes more complex. It becomes necessary to get a tool to manage information and the whole knowledge levels, including subjective factors: a sort of map in which any factor can be connected to another creating a vision of a new product. More efficacy in managing innovation can be reached if strategic decisions are taken not only by the objective point of view, but also by the subjective one. So designers and managers are consumers and vice versa. Every actor of a new product conceiving process should share the product's meaning and subjective values.

2.3 Third and Four Step - Visions for innovation as a design tools: leading product innovation through a design process

As we will see in the two case studies, by reaching a detailed knowledge of context, trends, experience and subjective factors we can create one or more synthetic visions. To each vision will correspond a concept creation. Such creation take place during a design workshop in which a number of designers is involved. At the end of the workshop, every designer presents a product concept that is his/her creative interpretation of the given vison. In this way, the companies that are our partners in the research activity can better understand real product innovation chances. RU leads this creative phase by providing some tools to designers in order to transfer to them in the most effective way all the knowledge gained during the previous two steps of our process. The aim is to allow design creativity to sistematically participate in new product planning process.

At the end of RU process, a scenario can be build by finding the most frequent suggestions within the whole designed concepts. The product scenario, as it is intended by RU, is the "intersection" of several realistic product visions.

To better illustrate our process, two cases of RU design research activity with company partners are hereafter provided.

3. The first research experience: the case of the intellectual work equipment

In recent years market has changed in models of consumption which are becoming increasingly difficult to classify as they become more and more subjective. The office furniture sector reacted to these changes introducing just technological and functional improvements. That can be partially interpreted as a consequence of processes used in new products planning: innovation strategies are usually based on market guidelines and on product incremental evolutionary steps.

The gap between industry and user's complex requirements was fronted by Haworth-Castelli, the company-partner of this reasearch activity, involving RU in its product development process with the aim of gathering new tools for product innovation.

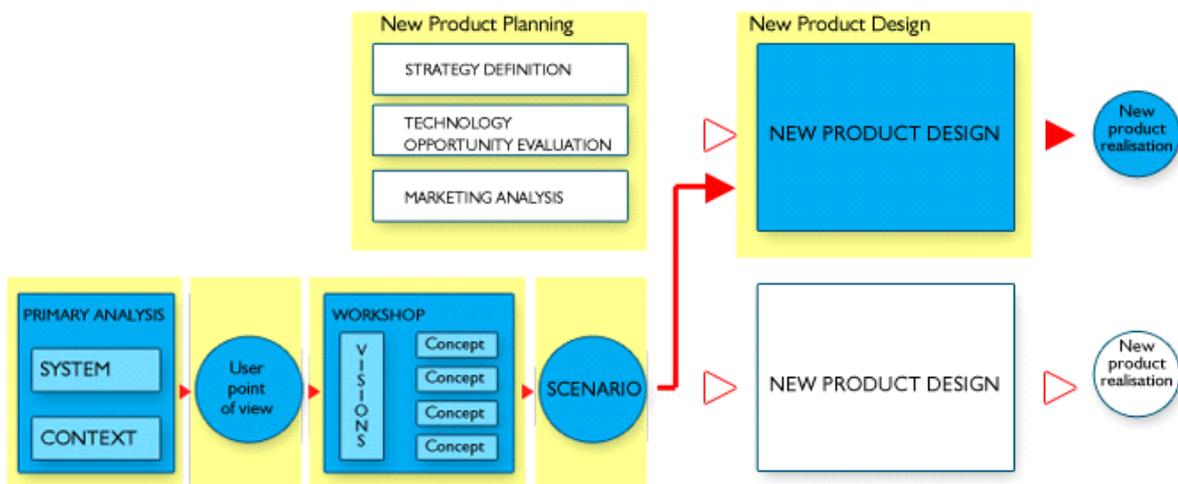


Figure 2. Haworth-Castelli new product development process and its integration with RU process

As showed in the above scheme, RU provided an improvement in the first phase of the new product development process, the Product Planning phase, increasing the cultural references and setting a complete innovation scenario that allowed to substitute innovation chances to evolutionary steps. The research activity started from the analysis of the office furniture system, that is the analysis of the products already available on the market, in order to define current production trends for each element that influences intellectual work.

This analysis, whose aim is to consider all the possible design chances related to a product, shifted the investigation field from office furniture products to equipment for intellectual work, not considering any more the office as the unique work place, but considering as reference to define the consumer's requirements all the intellectual jobs that can take place everywhere. *Equipment for intellectual work* was defined everything that comprises the physical and sometimes psychological support for working tasks, considering that the forms that intellectual work can take are variable and often deny definition.

3.1 The user point of view

Nowadays the equipment for intellectual work is just another commodity, whose success or failure may be triggered by new features that make it more or less appetising to human perception. The research observed how objects generate different reactions in different people, just as space influences behaviour. Identifying situations, interpretations and environments related to intellectual work was therefore a useful approach to vision creation.

3.2 An influence matrix: the concept blackboard

RU created an interactive matrix of influence factors, by relating product categories useful to equip intellectual work to each of the elements obtained in the primary analysis.

The matrix was named Concept Blackboard; in it, product categories are represented using simple icons: a seat stands for every support offered to the body, a table stands for every support to the working activity, a pencil case stands for all the accessories used to personalise the working place and so on. Each of the eight designers that took part in the design workshop had to choose which product categories to deal with in the design process. The influence factors identified during the Primary Analysis were organised into four categories: work tipology, situation, environment and behaviour. For each category, RU chose to represent the most relevant trends through pictures.

In this way designers were able to generate “narrations” that were the real back-drop for a design concept. The matrix provided a system that relates products to evolutionary factors and works in a Storyboard like manner. Designers could choose to consider one or more cells to point out a vision for their concepts.



Figure 3. The Concept blackboard

3.3 The polarities

The Blackboard is sequential and articulated and allows many visions of innovative products. When product concepts are developed, a polarity system can make clearer the new heritage of

innovation suggestions. The polarity system is based on the previously identified influential factors (typology, situation, environment and behaviour) that are resumed by a map. At the center of the map are positioned the product categories. The whole of the visions can be re-conducted to a scenario that can be shared by many actors. In order to create the real product scenario it is necessary to filter the concepts resulted from the design activity through the polarity system. In the map we can find four thematic macroareas corresponding to the four quadrants.

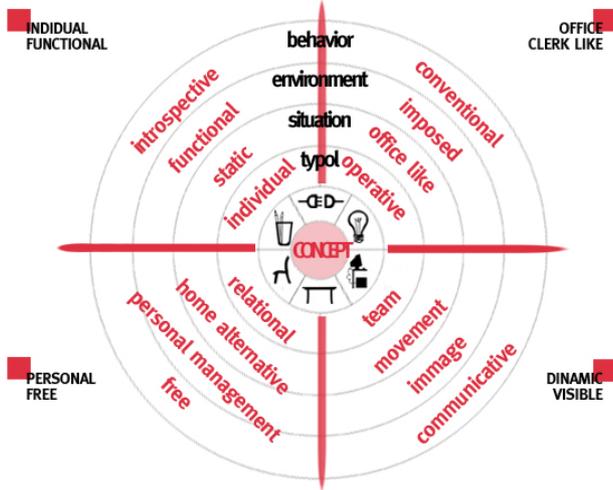


Figure 4. The polarities map

3.4 The areas of density and the scenario

Using the polarities map to analyse each concept, we can create a sequence of possible visions by the critical aggregation of the visions generated from the concept. The superimposition of the maps resulted from the analysis of each concept evidences the evolutionary factors and the product categoris protagonists of the innovation process. In other words, overlapping all the polar maps creates a map on which is possible to verify which are the most remarkable influential factors that have been translated by designer into product’s features. Thanks to such overlap, RU generated a general product scenario. In this research, we can identify a shared scenario in which the individual operativity is pre-eminent, but with relational and team-working propensity.

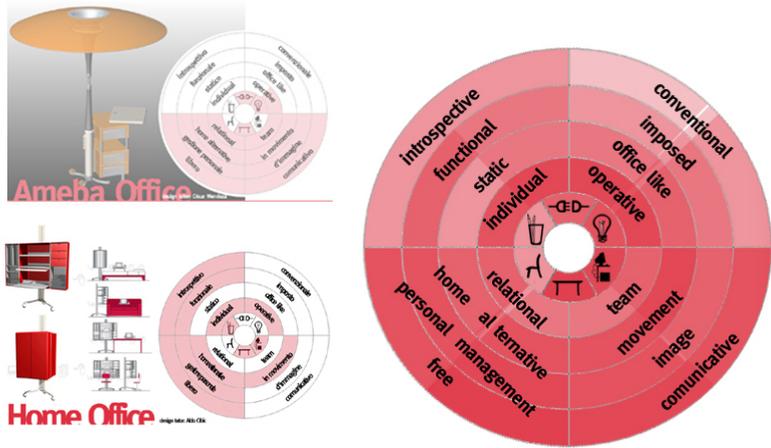


Figure 5. On the left: two examples of concept analysis using the Polarities map. On the right: the scenario, resulted from the overlap of all the analysis maps

3.5 Company strategy and new issues

In this case the principal accepted to introduce in its new product development process a new resource, redefining its working schemes. RU, marketing, sales, R&D and product development managers cooperated to develop new products. This cooperation produced two new product development chances that correspond to the two scenarios resulted from the research activity.

The definition of a system in which perceptive and trend aspects were related to functional and aesthetical renovation was considered by the principals as the key to set an innovative strategy and consequently a new product line. So the research activity created useful tools to manage the creative contribution of design in order to lead and then to obtain product innovation.

By following the process discussed in the first part of this paper and setting scenarios, the research project created the chance to experiment new kinds of products.

4. The second research experience: new ways for food preservation

4.1 The innovation process in Whirlpool

From the RU point of view, the collaboration with Whirlpool Europe was particularly interesting, because it gave us the possibility to investigate a structured company innovation process, to make a comparison between our and their process and to integrate our process with a highly structured internal one.

Whirlpool, which consider innovation one of its main strategic objectives, has an internal innovation division whose goals are to make innovation a core competence and to embed mechanisms wich foster continual innovation. In order to achieve these two aims, the Innovation division of Whirlpool has developed a well-defined innovation process made up of three main steps: the Discovery phase, the Innovation lab and the Action lab. For each of these phase a set of specific tools has been developed.

The specific aim of the **Discovery Phase** is to discover new insights using five lenses (Trend exploration, Customer Experience, Core Competencies, Economic Engine, Orthodoxies). The first two lenses are aimed at understanding market trends and customer needs. The other three are aimed at achieving a deep understanding of the company internal enviroment.

The **Innovation Lab** is the phase for opportunity generation; it consists in a diverging moment, that is creating a lot of ideas, and then a converging one for deepening and organizing the most relevant ones. The output of this second phase is a “new opportunity brief” that contains the time-frame for the launch of the new product onto the market and information about all the already available techonologies. Every new brief is assessed using the Idea Screnning Toolgate (I.S.T.), whose aim is to let the company pursue only ideas that are feasible and that provides clear customer benefits.

The intent of the following phase, the **Action Lab** is to both deepen the thinking and screen out opportunities still at an early stage of the development process. In this phase starts the real design activity, which aim is to visualize the ideas into product concepts. The concepts are then submitted to a Customer Feedback Session: at this stage of the process an immediate and valuable input from customers allows the company to readapt the idea very easily.

At the end of the Action Lab, starts an experimentation phase. If the product concept pass successfully trough the experiment, it enters Whirlpool industrialization process. Only few ideas pass successfully trough all the phases of the innovation process and become new innovative products.

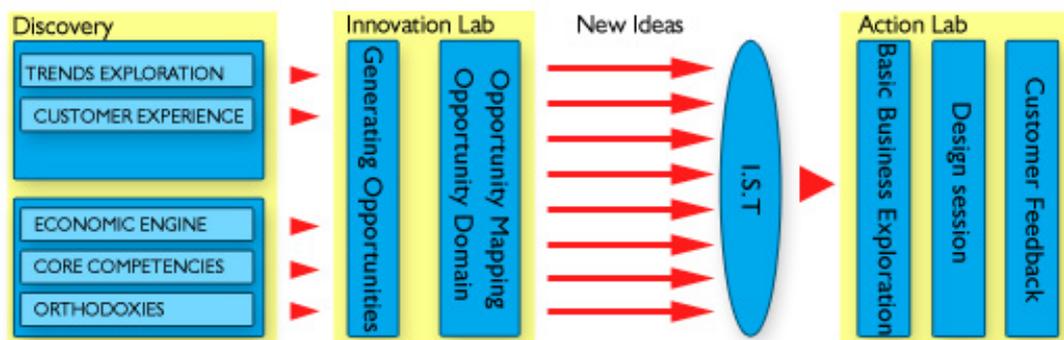


Figure 6. Whirlpool Innovation Process

4.2 The research objectives

Whirlpool decided to collaborate with the RU in order to investigate new innovation chances for the household appliances for food preservation. Up to today, the food market has been characterized by a great resistance to change, due to the fact that food is a theme that touches deep and ancestral cords and it is connected to our self-survival. But at the same time, in feeding strong trends of change are verifiable today, also relative to the researches in progress in the fields of food technology and packaging. The research objectives were to provide Whirlpool with a deeper knowledge of the food market and to transform the most relevant market trends into real product innovation chances.

4.3 The user point of view

In order to investigate the latent necessities of the users, the RU carried out an investigation in new rituals connected with food. A nodal point was to understand the possible modes of evolution of the equipments and tools for preserving, preparing and consuming food, in relationship to the accelerating development of all the technologies connected with food preservation, preparation and cooking, on one hand, and with the rapid evolution of customs, life styles, habits on the other.

The first step was to individualize the most remarkable phenomena in food purchasing, stocking, preparation and consumption. Europe was considered the central field of the researches, but, however, the attention was also constantly referred to American trends that always anticipate and influence European ones, at the level of macro-trends of nutrition styles too. From this research we extrapolated the modern macro-trends in the feeding field that mostly influence the household appliances field.

4.4 An influence matrix: the consumption map

After having deeply analysed the context, namely the feeding life styles in the western world, it was necessary to define a tool able to guide designers creativity in relationship to both the research objective, (products' innovation possibilities in the field of food preservation), and to the factors of influence discovered during the primary analysis phase. As already said, to provide design tools means to systematize the results of the research activity and to define the macro trends so that they can be used by designers during the design activity. In this case RU created a tool, the Consumption map, which related the new products that had to be conceived (the preservation system, at the center of the map) to the main moments of the purchasing and consumption process: food buying, food managing, food preservation and food preparation. The food is present in the map as the input of the whole consumption process.



Figure 7. The consumption map

4.5 The polarities

At the end of the design activity, RU received from the five designers involved in the design workshop nine concepts. In order to analyse the most important aspects of every concept it is necessary to define a series of polarity. In this case, the polarity system is based on the previously identified influential factors: food typology, buying situation, food management, food preservation and food preparation. Each quadrant represent a thematic macroarea.

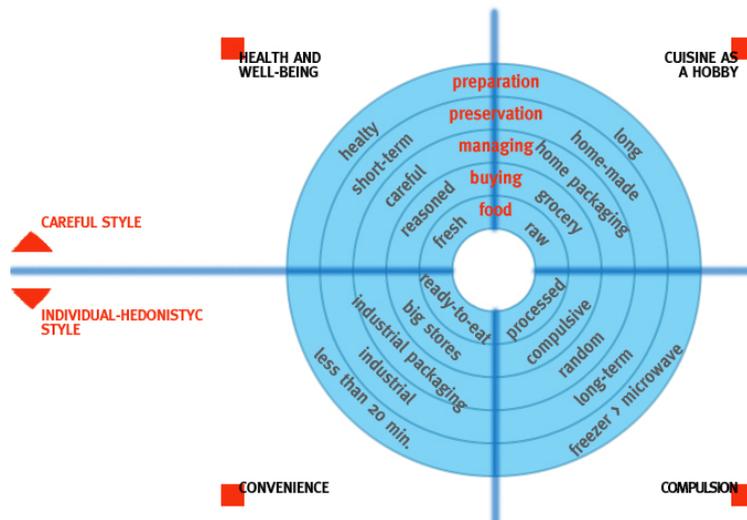


Figure 8. The polarities map

4.6 The areas of density and the scenario

As already explained, the objective of each RU research activity is to create a product scenario, intended as the "intersection" of different designed product visions; the scenario scope is to stimulate the partner company to start a strategic discussion that explores new products possibilities.

To create the scenario, each of the nine concepts was filtered through the polarities system in which influential factors are resumed by a map. Even in this case, the overlap of the polar maps resulted by the analysis of each concept, generated a general product scenario.

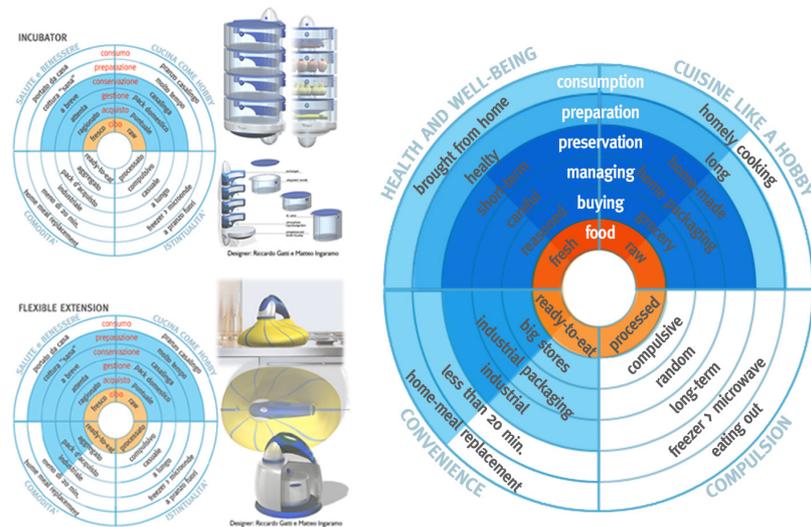


Figure 9. On the left: two examples of concept analysis using the polarities map. On the right: the scenario, resulted from the overlap of all the analysis maps

In this scenario, it is evident that the most innovative products were generated by designers in order to satisfy the new consumer attention to health and quality and to the convenience area. In fact, the research highlighted that, in order to satisfy the growing convenience area, food companies constantly introduce on the market new products conceived so as to allow the end user to save time. Contrarily, during the design activity no new products were conceived in order to satisfy the compulsion area. RU believes that this depends on the fact that the needs of this area are sufficiently satisfied by the products already available on the market, so they were not able to give to designers innovation chances to meet.

4.7 Company strategy and new issues

As in the furniture case, the presence of a company allowed to verify the pre-eminent aspects of the scenario. Even in this case the main aspects of the product scenario were confirmed by the concrete interest of the company in three specific concepts. The company, thanks to the collaboration with RU, managed in a different way the creative process. The effectiveness of this new approach was well understood by Whirlpool, which realised which were the innovative potentialities of the food preservation area and asked RU for new collaborations, in order to extend such potentialities to its whole range of products.

From RU point of view, this fact is particularly important, because it points out how the product scenario contributes to produce a change in the company strategy in terms of views widening and in terms of products ideas to enter the new product development process. From the company point of view, this change in its new product strategy means a great effort that takes a certain time to happen and needs the cooperation of several internal departments and of external consultants. This is what happened at Whirlpool where the internal Innovation group, R&D, Marketing team and RU cooperated for the further development of the three selected concepts.

4.8 Comparison between the two innovation process and their integration

The description of the Whirlpool innovation process makes it possible a comparison with the innovation process of the RU. The differences between the two processes and the way the two processes integrated during the research activity are visualized in the following scheme:

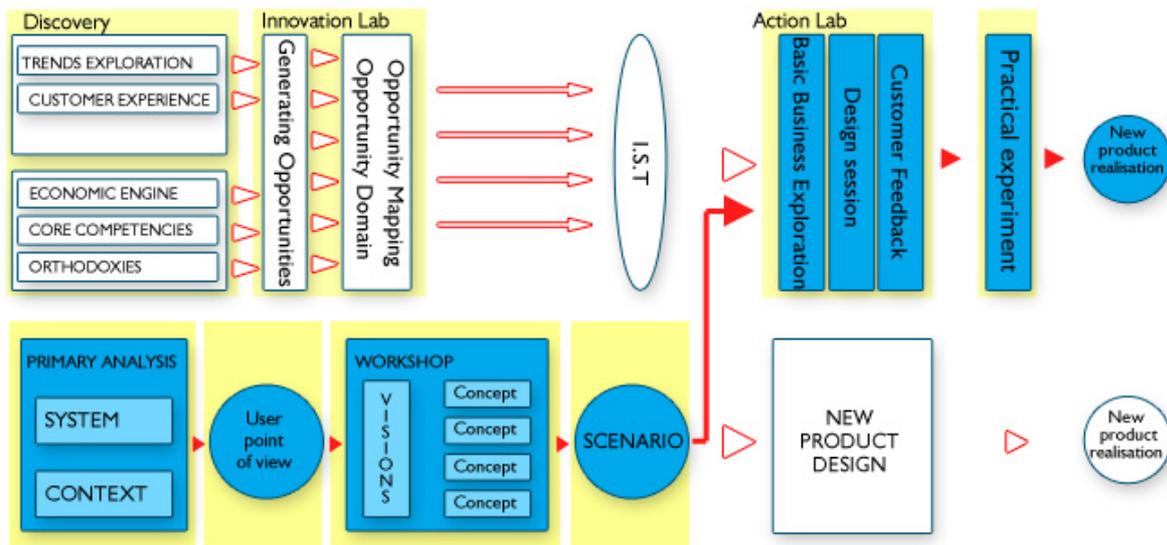


Figure 10. Whirlpool Innovation process and its integration with RU process

In the RU process, to the Primary Analysis follows the definition of some "visions for the project". On the basis of these visions, a group of designers is involved to design a certain number of product concepts. These concepts, as previously described, are analysed by the RU in order to define a general product scenario. The final aim is to determine the innovative factors that are dominant in the designed concepts and to make them communicable in a synthetic and univocal way to the company which can use them as the starting point for an internal strategic discussion. It is only at this stage of the innovation process that the company, on the basis of the defined scenario, has to determine which idea shows the best potentialities to be developed during the new product design phase, phase that we can name, using a term coined by J. Eekels, *strict development phase*.

Differently, in the Whirlpool innovative process, the choice of the idea to be pursued happens when no design activity has yet been carried out. In this way, the choice is made thanks to the application of a series of tools conceived to assess an idea expressed in a written opportunity brief and the most promising ideas are chosen on the basis of a series of criteria that do not include any design activity. But we claim that it is only the design activity that can fully express the innovative potentialities of an idea. In the Whirlpool innovation process, the stage at which designers are involved is postponed to the third phase, when the most important strategic decision in order to accomplish innovation (that is, in which innovative idea to invest) has been already made, and discarded opportunities will remain unexplored from a design point of view.

We can therefore affirm that the RU anticipates the design activity to the first phase of a new product development process, the *product planning phase*. This is done with the purpose to use the design activity as a lighthouse able to address the strategic choices of a firm.

Furthermore, the collaboration with Whirlpool allowed us to evaluate how the RU innovative process is able to integrate even with highly structured internal processes. In fact, three concepts developed during the RU design workshop, easily entered the Action Lab, in order to be submitted firstly to a redesign phase (during which the concepts were adapted to the company requirements for technical feasibility, materials usage, production costs, etc.), and then to the Customer Feedback Session. So, concepts coming from an external resource (RU) entered successfully the internal product innovation process, as also showed in figure n.10. This shows the possibility to advantageously integrate two innovation processes and internal and external resources, in order to better manage the difficult challenge to achieve product innovation.

5. Key conclusion

In order to generalise the main findings of our research activity, it's useful to present a standard new product development process which identifies three main stages: *Product Planning, Strict*

Development and Realisation (based on Roozenburg and Eekels, 1995). It is a broad way of segmenting the development process, but useful to obtain clarity.

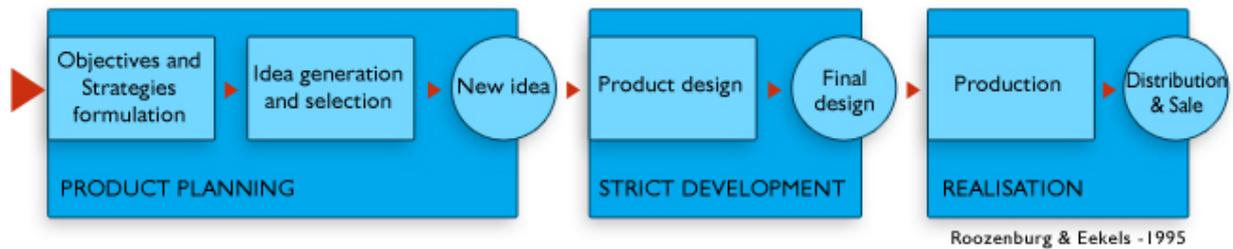


Figure 11. A standard new product development process

In order to achieve a real product innovation, the Product Planning Phase is the most critical one: this is the real creative phase, where creativity is intended as the act of coming up with new products' ideas. Then there is the need to put this new ideas into practice, to transform them in real products throughout the Strict Development and the Realisation Phases. According to Bettina Von Stamm, we can define innovation as the sum of creativity and succesfull implementation. Thus, there is no innovation without creativity, but creativity alone, without implementation, is useless.

We claim that the most innovative companies are those that use structured methods and tools to better manage the creative phase of the new product development process, as Whirlpool Europe does. But generally, the design activity is not involved in this phase.

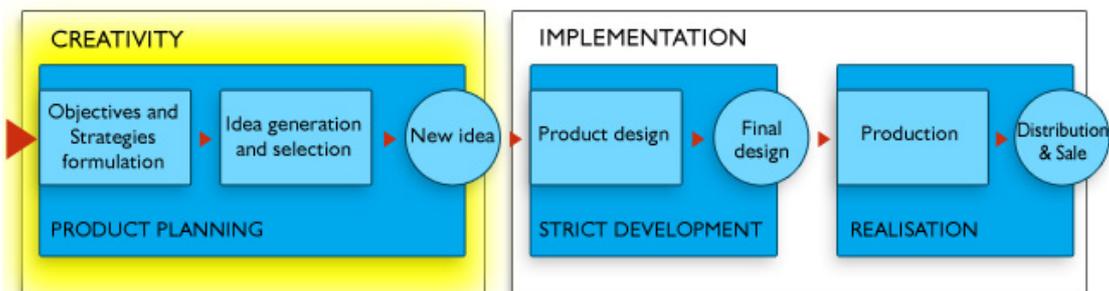


Figure 12. Creativity and implementation within a standard new product development process

The aim of our innovation process is to help companies in the difficult activity to come up with innovative and feasible product ideas, showing them the strategic role that the design activity can play in such a challenge. In order to do this, we have developed a process and some creativity management tools that have showed their potentialities in several research experiences like the two presented cases. Results of these experiences show that concepts creation becomes the source of a new knowledge about product design. In fact, giving a projectual solution to product-system issues means not to be limited at the design activity, but also to explore, using the design creativity as a tool, all the variables of said system. So, creativity and knowledge management becomes the key of an efficient product development method that generates a real interaction between company organizations and designers. According to the proposed process, design should be a part of every Product Planning Phase, before the Strict Development phase, with the same role of the other widely used strategic tools (i.e. marketing tools).

Finally, we are suggesting that Design and Creativity Management inside companies should deal not only with internal resources, but also with external resources and tools that can be found into academic research prerogatives.

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