Objetos intermediários de concepção: elementos da cultura projetual
Design Intermediate Objects: elements of project culture

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Neste artigo, aborda-se os objetos intermediários de concepção enquanto elementos de articulação entre a concepção e a produção de um produto. As bases dessa abordagem são a constatação empírica de que a atividade de projeto é mediada pelos objetos de concepção, e a compreensão do projeto como um processo social, de acordo com Bucciarelli (1994). O texto foi escrito com base na tese de doutorado da autora. Como elementos da cultura projetual, os Objetos Intermediários de Concepção são facilitadores das interações sociais inerentes ao projeto. Além de contribuir para integração entre as etapas do processo de desenvolvimento de um produto, os objetos intermediários de concepção são registros da memória desse processo e, como tal, elementos inerentes à cultura do projeto. Estes elementos são suportes para a ação, e podem ser resultados do trabalho: compreendidos como mediadores entre atividades diferentes ou como mensageiros no decorrer do trabalho, da ideia que se quer transmitir. Em ambos os casos, sejam mediadores ou mensageiros, os objetos intermediários de concepção permitem descrever o processo de desenvolvimento de um produto, referenciando-o às diferentes etapas deste processo (MER et al, 1995).

This article approaches design intermediate objects as connecting elements between the design and the production of a product. The bases for this approach are the empirical conclusion that project activity is mediated by design objects and the understanding of a project as a social process, according to Bucciarelli (1994). This text was based on the author’s PhD. thesis. As elements of project culture, Design Intermediate Objects are facilitators of social interactions inherent to the project itself. Besides contributing to the integration of product development stages, design intermediate objects constitute records of this process and, as such, are inherent to project culture. These elements form the basis for action, and may be the results of work: they are seen as mediators between different activities or as messengers. Throughout the work, that carry the idea one intends to communicate. In both cases, as mediators and messengers, design intermediate objects allow us to describe the development of a product, relating it to the different steps of this process. (MER et al, 1995).

1 The template piece and its central role in the clothing development process

In 1990, with the opening of the Brazilian market to the import of CAD (Computer Aided Design) and CAD/CAM (Computer Aided Design and Manufacturing) for apparel production, the textile and clothing industry in Rio de Janeiro received implementation guidance from SENAI/CETIQT – Center of Technology for the Chemical and Textile Industry –, including aid in the configuration and implementation of these systems and in the training of professionals to use them.
The use of CAD in clothing production allows the economy of cloth, starting from the moment the product is conceived, and also combinations of models, colors and sizes before the cutting stage, therefore optimizing the use of raw material in the production process.

With the still recent implementation of CAD systems, it was observed that companies would choose their operators by level of instruction, in the first place, giving secondary relevance to the know-how of these workers or to whatever knowledge they might have acquired from professional experience. Those companies eventually faced higher raw material expense, instead of the intended economy from the investment made in CAD systems. Considering this fact, systematic observations were conducted in 12 clothing manufacturing companies in Rio de Janeiro, with the objective of identifying what they were producing, which CAD or CAD/CAM systems were being used, who was operating these systems and what results had been obtained until then (MORETH, 1997; MONTEIRO, 2004).

In the first study, finished in 1997, it was proved that practical knowledge about the work is essential for the use of CAD and should be the main criterion employed by those companies in the choice of operators (DUARTE and MORETH, 1998). There was another research later, in 2004, when these same companies had already reviewed their expectations concerning the implementation of CAD systems and adopted a new form of work organization, taking into consideration the knowledge and the know-how of operators. The main objective of this second attempt was to observe the product development process in each case. (DUARTE and MONTEIRO, 2002).

The empirical reference for further research, with the objective of identifying specific characteristics of CAD in the product development process of the Rio de Janeiro clothing industry, was the reuse of previously-created models as a strategy to save time and resources from the starting steps of the process.

This issue, presented by the industrial director of one of the participating companies, was intended at the adaptation of clothes to a context of production and sale of low-cost products to the general public in Brazil. The theoretical framework of the survey encompassed two main concepts: Instrumental Genesis (RABARDEL, 1995) and Design Intermediate Object (MER et al 1995). The research hypothesis was a CAD simulation intended to estimate the consumption of material before the selection of a given collection of models by the style department.

Considering these concepts, and the Ergonomic Analysis of Work (GUERIN et al, 1990), it was observed that the use of CAD adds speed to the product development process due to: the reuse of molds previously digitized and recorded in the CAD system for the development of new models; the saving of material resources; and the increase of productivity. Economy takes place according to the experience of the product development staff and to their integration with production. The use of CAD in these conditions supports simulations of material consumption and of the time spent on production since the initial stages of product development.

The theoretical framework of the survey was also based on the theses of BUCCIARELLI (1994), according to which a project is a social process, and of SCHÖN (1983), which departs from the understanding that the design activity is a reflexive activity. With reference to the use of CAD, this paper considers the studies of CROSS (1999), who evaluates this use in its relation with the natural intelligence of designers, criticizing studies on Artificial Intelligence, the central idea of which is to transfer human knowledge to CAD; and the thesis of LEBAHAR (1997), according to which CAD is an activity regulation mode that fixes the conditions of product development according to its resources and to the use that is made of it.

To this author, the obtained model results from the production of intermediate steps of representation of certain parts or aspects of the product. These partial and temporary models establish interactive cycles between the thought of the designer and the basic elements he uses to draw. In these cycles it is possible to distinguish between the models which represent the idea and the models which represent production (MONTEIRO, 2004).

Drawings are intermediate objects which communicate the idea of models. The datasheet and the template piece define a prescription of the models in terms of size, color, material used, machinery and trading characteristics, for example, the total units to be produced, color and size by model, considering its sale prospects.
2 Instrumental Genesis

To RABARDEL (1995) the approach to an instrument-related question must be necessarily centered in human activity. The hypothesis of the author to study the techniques, having human activity as central, refers to the transformation of one's own conception of the world, over which the instruments act. The instrument is, according to the author, a mix of the artifact and of the schemes of usage of this artifact. An artifact is not a finished instrument, except when it is introduced in an activity as a means to reach an end. A scheme is an active organization of the experience that integrates it to action. This concept is equivalent to that of setting: both the scheme and the setting constitute a reference to treat new data. This reference can be an event, an object, a concept (MONTEIRO, 2004; MONTEIRO, 2011).

MONTEIRO (2004) presents the distinction made by RABARDEL (2005) concerning the concept of technical object as a fabricated material object (OMF), the way the concept of product designates this same object as something that will be conceived, produced or sold, and designates instrument as the object in use. The idea of fabricated material object is replaced by that of artifact, which, in anthropology, designates anything that has gone through the slightest modification by means of human hands. When the artifact is associated to the action of a subject as a means of this action, the instrument appears.

The instrument, in Rabardel's conception, is an intermediate entity, placed halfway between the subject, which uses instruments, and the object over which it acts. This intermediate position of the instrument makes it a mediator of the relationship between the actor and the object. Two major directions are distinguishable then:

- an object-subject oriented epistemic mediation, in which the instrument is a means of knowledge of the object;
- a subject-object oriented pragmatic mediation, in which the instrument is a means of transformation of the object.

Once the mediation is inserted in a real activity the epistemic and pragmatic dimensions are in constant interaction. Therefore, the instrument is, besides an intermediate universe, a means for action and, more broadly, for activity. The instrument-activity association is dynamic, but, at the same time, it saves this instrument for reuse in future situations which belong to the same category. Through this characteristic of preservation Rabardel considers that every instrument is knowledge.

This knowledge is part of the design process and accumulates in the several situations of use of the instrument. It also characterizes the actor-object relationship, expressing it and becoming an observable reference both in the transformations of the artifact and in the situations to which this artifact is related.

To the author, the use of CAD can turn this system into an artifact which creates new uses it had not been conceived for. This transformation occurs on a collective scale once the solutions are shared among different actors. In a psychological view of the use of contemporary instruments RABARDEL defines the artifact as a step towards action. This step constitutes, to the subject, an object to be apprehended so that its functioning corresponds to the criteria prescribed or expected.

The instrumental genesis represents, to the author, the contribution of users to the design of artifacts. Instrumentation processes constitute the other side of the instrumental genesis and are equal participants in the design process cycle. Designers partially anticipate modes of use, attributing space and practice to the user.

The invention of new functions for the instrument will allow action over the object and create new forms of mediation among the subject, the object and the instrument. Two factors are part of this invention: instrumentation, or the creation of new operating methods; and their insertion, in terms of new functions, in the artifact, what the author calls instrumentalization. Instrumentation and instrumentalization are parts of a complex structural and functional unit: the instrumental act which constitutes, according to RABARDEL (op.cit.), the unit of analysis of activities with instruments.

Instrumentation processes participate in the design process being inserted in a cycle: expected operating methods – schemes of usage – new operating methods; this cycle is parallel...
to and goes side by side with a second one in which the instrumentalization processes participate: constituent functions – constituted functions – insertion of constituted functions to the artifact. Through this constitution, the instrument is a means of capitalization of the accumulated experience and, in this sense, knowledge. This way, both the instrument and its components constitute a form of capitalization of experience.

Users of the instrument are also actors of design in a different way from the designers of these instruments. It is a singularity of the artifact that grants to it new properties which will, in certain cases, be part of the artifact structure. Design for itself that can also be done by collective work groups. These processes participate in the global cycle of design, as instrumental genesis, in solitary, private and autonomous manner, through transfer to other cycles of design (RABARDEL, 1995).

3 Design Intermediate Objects

Considering memory processes as being lived by social actors, SCHON (1983) identifies professional practice as a reflexive practice. To the author, reflection is a conversation between the designer and the elements of the problem situation. Once it is necessary to translate this experience to integrate it into action in a collective group, aiming at this conversation, one uses intermediate objects to describe the product development process as the elements to which this experience is directed. Defining a problem, situating it, enacting it, is a process which, interactively, aims at a question and features in a context for an intention. A good project process can be seen as a “reflexive conversation with the situation” (SCHÖN, 1983, pp. 40-68).

JEANTET (1998) adds a dimension to the reflexive model developed by SCHÖN (1983) by showing that the dialogue of the designer with the situation is mediated by objects, once the project is a social process and not only a creative one.

The drawing is a particular tool that helps designers think. The use of drawing is an important part of the natural process of a project, but the attempt at understanding what it represents is somewhat recent in researches about projects. The drawing is a type of dialogue between the designer and the situation, in the sense of SCHÖN (op. cit.) because it provides a model of the object – the product – which will be manufactured or constructed, and that is, indeed, the main objective of a project.

Furthermore, the drawing helps the structuring of problems through solutions envisaged and promotes the acknowledgement of characteristics and properties of the solution concept. The drawing contributes to the dialectics of product modeling: the dialogue between “seeing that” and “seeing how” something can be done. It allows one, in the sense of “seeing that”, to criticize the model and, in the sense of “seeing how”, to think in analogy by interpreting the drawing, what provokes creativity towards the development of new models based on the solutions already obtained for the product in progress.

A drawing is an object that represents an image of the future product, mediates interactions and translates an idea. This object lies in the center of initial discussions about the product. Once seeing the drawing, each actor will react in a different way: the designer in aesthetic and functional terms, considering client specifications and the compatibility with these aspects; the manufacturer trying to clarify aspects related to production: manufacturing conditions, raw material, suppliers; the trader considering the variety of products available and the position of the product regarding price and market; the client possibly associating it to comfort, price, compatibility with its function, and with the capacity of being combined with other products of the same kind.

Although the design process is organized into a sequence of stages, its translation is not linear: a point of arrival does not constitute the exclusive point of departure for the following operation, but it is only one of its elements. The image of a network, more than the idea of a sequence, prevails; translation consists of the entwinement of different elements, the result of a collective intervention, of enriching, of a game between what is real and what is invented and which, when validated by the collectivity, renovates initial agreements.
The translation of the drawing into specifications incorporates the vision of the actor: clients will define the product according to their needs and to the relationship between these needs and cost; the producer, in terms of the different production phases, that is, of the relationship between the production stages and the resources required; the designer or planner projects the product in aesthetic and functional terms, considering client specifications and the compatibility with these aspects. The interaction of all these actors defines the intermediate object as a vector of communication in the project, and, above all, as an instrument of association among the actors, according to JEANTET (1998).

As seen in MER et al. (1995), in the case of an action which involves other actions and other people, objects are vectors of communication in the product development process. They represent, in this sense, the relationship between two actions, and are also reflections of project actions in different moments. This characteristic of design intermediate objects relates to awareness-raising concerning action (BUCCIARELLI, 1994).

MER et al. (1995) propose a classification of intermediate objects from the characterization of their hybrid nature. That grants intermediate objects a double character: they are, at the same time, a model of the future product and a vector of the association of design actors. There is an attribution of senses to the object, linked to the roles of the actors and to the conventions adopted for the creation of the product, which varies from culture to culture. This attribution of senses is shared among the group, but the attributed sense cannot be renegotiated, otherwise it will lose value as a basis for decision, as observed by VINCK (1999). On the other hand, the more effective intermediate objects are to the activity of designer, as traces of the design process, the less they relate to decision-making processes.

Some objects, which are useful for decision-making, fail as an aid to memory: they do not allow the recall of why a choice has been made. To reach this effect the intermediate object must indicate the transition from a moment of the designing process to another. JEANJET (1998) gives the example of the drawing, which, being so important to decision-making, does not show this transition. Although the differences between two drawings of a same model allow the observation of changes from a solution to another, they do not justify, except for notes or verbalizations, why that transition has taken place. To the author they are, most of the times, oral interactions that give life to memory, in a reference to Descartes, to whom memory did not represent a remembrance only, but also a way of reliving. (Descartes, Letter to Arnaud, of July 29, 1648, in MAGALHÃES VILHENA, 1958).

As stated by JEANTET (1998), the different stages a product goes through during its development are objectives when it comes to design intermediate objects. These stages address to specific dimensions, to functional, structural, technological, geometric, industrial ones, which evolve from an image of one of the actors' mental representation, and are then shared, modified, commented, erased, validated or rejected by the group. The passage from a registry established in functional terms (with the client, the request) to a summarized registry (which represents the same request for the specialists which will perform it) is a first approximation to what the idea of translation means. With the change of language throughout the different stages of product development, rules change and so do internal conventions, which instrumentalize and support definitions: on the one side, functionality; on the other, simulation of function behavior. By making the product explicit in each of these registries, the actors of design form a “sandwich” with them applying the concept of the product and the logics and internal structures of the instruments. Going a little further in what translation consists of, the author shows that in the phase of product development there is difference in the situation itself and not only among the situations. This way, translation can also be observed within the same dimension or stage of the project.

Depending on the type of product, the actors and the interactions among them will guide the design of the intermediate objects, their translation into product specifications, and the representation of these specifications in plans of definition and of fabrication, as well as possible types of mediation among the actors (MER et al., 1995, pp. 24-25). The intermediate object must be a shared model which "communicates something" to the actors and also have an evolving character. This evolution is related to the conventions for description of the product, by its different objects. This way, an economic model supports the commercial representation of the
product, and it is not familiar to all the actors. On the contrary, the datasheet, technical information, has a common meaning to the different actors. These conventions will influence associations among the actors and characterize the future representation of the product. They will only be effective if, being transmitted to the actors, can promote associations among them.

The authors identify the following characteristics of design intermediate objects: the messenger object transmits an intention without modifying it and the mediating object interposes between the idea and its use, transforming itself into an actor, in the sense of representative of a category. One of the examples given by MER et al. (1995) is the drawing, which is an object that conveys a message; the more this message takes into consideration the viability of production, the closer to a mediator the drawing will be. This way, a technical drawing is more of a mediator than a sketch, when production is concerned. A sketch is, consequently, more of a messenger than of a mediator.

A second characterization, by MER et al. (1995), places the object as “open and closed”, according to its capacity of being understood and modified by other social actors. The open object incites a work of interpretation, whereas the closed one conveys a prescription. An object is more closed as it is less hypothetical, when only one version is presented without an alternative other.

4 Existing is not logical

In Schön (in NÓVOA, 1992, p. 81), we see that professional practice establishes an agreement between rigor and pertinence. The grouping of objects according to the situations in which they are used or created is pertinent from the perspective of practice even if it is little rigorous from the perspective of knowledge of these objects. The grouping of objects into categories is rigorous from a scientific perspective, from the point-of-view of knowledge, and little pertinent from the point-of-view of activity. To the author, from a positivist perspective of science, one tends to see it as a body of propositions derived from research. When one recognizes the limited practical usefulness of these propositions, they experience the “dilemma of rigor and pertinence”. To Schön, in the model of technical rationality, professional activity consists of an instrumental way of solving problems by the strict application of scientific and technical theories. However, technical rationality depends on clear objectives for the construction of an instrumental problem. In the practice of activity, even if a problem is constructed according to clear objectives, it can escape the categories of scientific application for being unique or unstable.

Uncertainty is an intrinsic characteristic of project activity which cannot be eliminated by the meticulous planning of design tasks. As an actor of this process the activity of creating a model in the clothing industry plays a role of mediator and translator among the idea of the fashion designer, materialized into a drawing, company prospects in relation to the sales of a model, the simulation conducted in CAD having similar, previously develop models as parameters, and production: cutting and sewing.

As a mediator and translator of the language of drawing into the language of production, the creator of the model acts by analogy. This person will search in a mental “compartment” a product whose characteristics are similar to those recommended by the fashion designer and whose industrialization has occurred. So, the designed product finds its origin in an industrial memory of previously developed products, which can be stored on a digital database and in production specifications. This activity has analogue characteristics to that of the designer and its result articulates a new knowledge, autonomously, transversally and asymmetrically formed, in a process of social learning during the product development process (MONTEIRO, 2011).

Intermediate objects generated by the model creator are mediators of clothing creation and production. These molds keep the memory of the product development process, in terms of material and resources used and of the distribution of these molds through the range of sizes projected for each model. This memory of the product development process is essential for the clothing industry, both for the effective use of CAD and for the desired quality and productivity (MONTEIRO, 2004).

Concerning concepts relative to the survey, it was observed that the model creator is a
mediator between the style and the production of clothing, one who interprets and translates the commercial requirements of the product into a model chosen for production. And the template piece developed by this professional - considering the drawings of the fashion designer - is a design intermediate object of the product that permits decision-making about the economic viability of a model in the initial steps of the clothing development process.

This activity is essential for the process once it involves the translation of functional aspects of the model being developed, relative to style and fashion trends in an industrial language, of the cutting and sewing of clothes, as well as of the interpretation of these different perspectives: the commercial, of the fashion designer; and the industrial, of cutting and sewing. The template piece is the design intermediate object around which these different actors interact. The CAD system is used as an instrument in the stage of preparation for cutting, after the template piece is ready. This way one can avoid waste of cloth and accelerate the stage of product development for industrial production.

The description and understanding of product development process in the clothing industry cannot be linear. The logical fundaments, according to which the CAD system is developed, require that operators generate new forms of use of these systems in order to bring them closer to the reality of industry. The description of this process through design intermediate objects allows us to understand industry by respecting its reality, without imposing procedures that might alter the routine observed. This adaptation, labeled catachresis by RABARDEL (1995), in an analogy to the figure of language used to express something to which there is not a specific term, generated new operating modes in the company. Its insertion, in terms of new functions in the CAD system, or instrumentalization, to the author, is a longer process that has been started, but whose conclusion has not been observed in this research.

Bibliographical References

