

The Role of Interaction Design in Information and Communication Technologies Embedded Product Development Activity

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Abstract

This paper describes the role of interaction design in information and communication technologies (ICT) embedded product design and development activity. Besides presenting the relationship between industrial design and interaction design in the same activity, it also re-defines this relationship in terms of roles in ICT embedded product development activity.

This research has been accomplished by having an extensive interdisciplinary literature review, a series of interviews and also a case study based on a specific product's development process. The series of interviews have been conducted face to face in USA with professionals from 5 different industrial design and interaction design based consulting firms such as IDEO, Cooper Interaction, Smart Design, Swim Interaction Design Studio and LUNAR Design. The next step of the field research has been a case study based on gathering information of a specific product through secondary sources and then conducting in-depth interviews with designers, who have worked in that product's development process, from different professions.

Major conclusions of the research include as follows: Being a younger discipline relative to industrial design, the role of interaction design in ICT embedded product development activity has the similarities to that of industrial design in the same activity. The most extensive collaboration between industrial design and interaction design is seen at *Planning* and *Concept Design* phases in ICT embedded product development activity. As the products become more complex in terms of interactions, interaction designers will gradually need to manage the design teams. There will be a need for a new sub-field of interaction design which is supposed to emerge as interaction design management. Comparing with industrial design, interaction design is foreseen to have a wider activity area in *Planning*, *Concept Development* and *System Level Design* phases of ICT embedded product development activity. As interactions with products become more and more immaterial, be a new actor from service design is supposed to have a role in ICT embedded product development activity.

Keywords

interaction design; industrial design; information and communication technologies; role of the designer; product development activity.

Penetration of information and communication technologies (ICT) in daily life has been causing changes in products. When the intensive use of ICT in different sectors is taken into consideration, it becomes inevitable to say that this subject is even transforming design processes.

Industrial design, as a professional practice, has been influenced by different dynamics such as the development of information and communication technologies, changes in products, changes in the way users interact with products, emergence of different disciplines in product design and development activity, changes in the focus points of product design and development activity throughout its short history.

In a context where products become more complex and where the competition in ICT embedded product development activity increases day by day, interaction design discipline comes into question. Alike Industrial Revolution has led up to the emergence of industrial design, the development of digital technology, especially of ICT and its use has caused the emergence of interaction design.

Throughout 20th century, while the interaction between users and products has been material, along with beginning of the design of ICT embedded products, materiality has been giving its place to immateriality in terms of interaction. This change has led to the emergence of new roles and professions in product development activities (Margolin, 1998; Buchanan, 2001; Forlizzi and Batterbee, 2004; Zimmerman, et al., 2004). One of these roles, accepted to design of the dialogue between users and products by a general definition, is interaction design (Smith, 2004; Moggridge 2006; Cooper, et al., 2007; Kolko, 2007). The profession which provides users interact with a product or system in a short span of time, continuity of interaction, decrease the period of first experience and provide less complexity but more satisfaction is considered to be interaction design (Smith, 2004; Zanini, 2004; Moggridge, 2006).

The Role of the Designer in Product Development Activity

Even though there are not specific periodical distinctions, it has been determined that there have been changes ranging from the definition of design to its role in product development activities. Especially in terms of industrial design, it is determined products and product development processes have concentrated on different focuses (Sparke et al, 1997; Vertelney and Booker, 1990; Cagan and Vogel, 2002; Heskett, 1980; 2002; Er, 2007).

Both designing and production activities have been under the responsibility of craftsmen who had the roles of designers before the Industrial Revolution (Heskett, 1980; Vertelney and Booker, 1990; Rothstein, 1999; Dreyfuss, 2003; Cagan and Vogel, 2002).

With Industrial Revolution taking out design and production from one person's responsibility, products have no more been designed and mass produced for only one but wide range of users (Heskett, 1980; 2002; Buchanan, 2001; Cagan and Vogel, 2002). In this period, the role industrial designer had been limited to design of the skin, or in other terms form (Loewy, 1979; Heskett, 1980; Dreyfuss, 2003).

Beginning to take place in early phases of product development processes caused designers participate also in user research studies (Kelly and Peters, 2001; Press and Cooper, 2003; Brown, 2005). Previously working with user and market data which marketing professionals put forward, designers have begun to collaborate with social science professionals such as human factors specialists and with people from other professions; then they needed to have information on cognitive and psychological factors in order to understand user needs and preferences. It is possible to assume that this situation accords with the factors such as understanding users, designing products or services for as many as users that underlie interaction design. Looking from the perspective of different dynamics, it is possible to say that not only ICT, but also the changes in social and economical structures will contribute to the critical roles of both industrial design and interaction design in product development activities.

Interaction Design

Interaction, which naturally exists from the presence of human beings, is taken into consideration as a profession in product development activities in this study. As Cooper et al (2007) and Smith (2004) states, interaction design is a new discipline that utilizes methods and techniques from existing disciplines.

It is determined that the development of ICT, especially the Internet, decrease in hardware dimensions, changes in products, user numbers and profiles, user-product interactions,

changes in software and service development activities and the graphic user interfaces have appeared in the emergence of interaction design.

It is possible to assume that interaction design attempts to make the interaction that is becoming more complex and more immaterial be understandable, useful, usable and desirable for users. While industrial design concentrates on the form and function of a product traditionally, interaction design concentrates both on how users interact with ICT embedded products, softwares and services and on how information can be exchanged.

Alike industrial designers design products for different uses with the contribution of mechanical technology, interaction designers define and design the dialogue between users and products, services and systems (Smith, 2004; Kolko, 2007). This similarity between industrial design and interaction design indicates that both of these professions intertwine each other in terms of role sharing in product development activities. On the other hand, this similarity can be seen as an indication for potential changes in role sharing in product development activities.

Methodology

In this study an extensive literature review, including various disciplines, a series of interviews and a case study has been held.

“The role of interaction design in ICT embedded product development activity” being as the basic research interest of this study is a very new and limited field in terms of product development activity in Turkey. Therefore interviews have been conducted face to face in USA with key professionals from leading industrial design and interaction design based consultancies, that have pioneer work in the mentioned area internationally, such as IDEO, Cooper Interaction, Smart Design, Swim Interaction Design Studio and LUNAR Design. The interviewees were Bill Moggridge (IDEO), David Cronin (Cooper Interaction), Gitta Salomon (SWIM Interaction Design Studio), John Edson (LUNAR Design), Sheila Foley (Smart Design, SF Office). In this phase of field research, the definitions and design and development processes of those mentioned consultancies were examined.

The second phase of the field research has been planned as a case study based on a representative product's literature review and interviews with professionals from different disciplines on its design and development process. After product selection criterion was prepared, it has been corresponded with firms such as Apple, Nokia and LUNAR Design. At the end of this correspondence, the case study was held on a product called Pasco Spark which has been recently designed by LUNAR Design and planned to be shipped in August 2008. Interviews of this case study were held with specialists from different professions who have worked in Pasco Spark's design and development process through the Internet.

Findings of Interviews

Interaction designers of interviewees accept industrial designers as professionals who design product's form and its mechanical interaction with users and who has knowledge on production and materials. On the other hand, industrial designers see interaction designers as professionals who design product's digital interaction with users. Behavior has been stated to be the common point in both of these definitions.

Although interaction design has been considered to take part from the first step of product development activity as a common aspect of interviewees, it has been determined that there are different approaches in the related sector.

During the interviews except from IDEO, it is determined that there are significant phases in which interaction design and industrial design collaborate in the rest of the interviewee firms design and development process. When the design and development processes of the firms have been examined, interaction design based consultancies stated that some of industrial design based consultancies contacted with them to work together after having fundamental

design decisions, even after defining the product's form. Interviewers emphasized that this situation has negative effects on final product's success and innovation (Cronin, 2005; Moggridge, 2005; Salomon, 2005).

When industrial design and interaction design processes in ICT embedded product development activities are considered, it is possible to assume that the fuzzy front end of product development is the process where the most collaboration and corporation between interaction designers and industrial designers takes place. It is examined that when design concept has been being generated, roles of industrial designers and interaction designers on creating the form of the product and the location, form, color and material of physical controls which users interact with, has been indefinite.

Although there has been a common viewpoint that traditional product design and development process has been supposed to continue, it has been stated that there would be changes in ICT embedded product development activities. On the other hand, it is determined as a common approach that there would be changes in terms of new material uses and production technologies.

Case Study Findings

Pasco Spark which was designed by LUNAR Design has been the product of the case study. It is a product used for education that enables students aged between 12-16 years old explore the world and make discoveries in basic sciences both inside and outside the classroom. The interviews of the case study were held with project manager, interaction designers, industrial design lead and user researchers who worked throughout Pasco Spark's design and development process in LUNAR Design.

As well as having a role as interaction designers, the interaction designers also had roles as project manager and user researchers in Pasco Spark's development process (Author, 2009). It is determined that the reason one of the interaction designers took part as the project manager besides being an interaction designer has been because of the complexity in Pasco Spark's functionality and content. LUNAR's design and development process consists of 3 main phases including sub-phases: vision, magic (the design phase) and reality (Anderson, 2008; Lebas, 2008). Although the sub-phases seem to be similar, it is determined that there are differences in terms of the content proposed and the techniques used by industrial design and interaction design (Author, 2009). During the vision phase while the design and development team concentrate on user research studies, it is observed that interaction designers focus on researching user mental models and processes. On the contrary, it is determined that industrial designers research ergonomic considerations of users and competing products in the market. When the time spent on user research is considered, it is examined that industrial designers pass over to other phases in a shorter time than interaction designers. Thus it is determined that industrial designers have already created general qualities and form alternatives about product when interaction designers just begin creating concepts.

In Pasco Spark's development activity, the phase during which collaboration and corporation between industrial design and interaction design take place is determined to be concept generation. During this phase there is information needed to be exchanged between industrial designers and interaction designers; that is to say, there are sub-phases in which both designers are dependant to each other (Author, 2009): interaction designers need to get information about the screen dimensions in which the content and interaction is supposed to be embedded from industrial designers. Thus the dimensions of the product affect the dimension and resolution of the screen and those are the factors which affect the quality and quantity of information and the interface that are supposed be embedded in the product. But at this point, it is foreseen that not only industrial designers but also interaction designers might propose the mentioned dimension information. Although this information is directly dealt with the product's form and is supposed to be within the role of industrial

designers, it can be accepted as type of information in terms of product's content and its dialogue with users at the same time. On the other hand, the prototypes concerning the use of both the digital content and physical content are supposed to be compatible with each other and constitute an entirety. Because of these reasons industrial designers and interaction designers are needed to work dependant to each other.

Conclusions

This study attempts to define the role of interaction design in ICT embedded product development activity, to re-define its relationship with industrial design within the same process. According to these mentioned aims, the results of this research are explained below.

Development of Interaction Design

Being a younger discipline relevant to industrial design, the role of interaction design in ICT embedded product development activity has similarities with the changes industrial design's role in product development process (Author, 2009). Alike industrial designers being included into the development team after basic design decisions have been determined, interaction designers have had the similar experience. Also, alike industrial designers have been accepted to be who only design the form, interaction designers have been seen professionals who only design the graphical user interfaces. This belief and approach is still been observed in the sector. Although there are exceptional approaches are determined in literature review and interviews which constitutes the first phase of field research, it appears that interaction design has been involved in the development process after Planning and Concept Generation phases. On the other hand, it is determined that interaction designers both work as user researchers and project managers in the case study. Although the second phase of the field research has been conducted as a single case study, the above mentioned development shows that interaction design will gradually continue to have a wider role in ICT embedded product development activities.

Additionally, ICT embedded products are becoming more and more multifunctional and the behavior of such products are provided by dynamic interfaces instead of static ones. In this situation, it can be accepted that the products are becoming "boxes" that shelter the hardware and functions in terms of physical considerations. This determination also shows that interaction design has begun to have a wider role than industrial design has in ICT embedded product development activities.

The contents and functions of products becoming more and more dynamic causes the interaction shift from material qualities towards immaterial qualities. The said interaction moving toward immateriality is supposed to cause the emergence of another new actor on service design in ICT embedded product development activities.

The Relationship Between Industrial Design and Interaction Design in ICT Embedded Product Development Activity

It is essential for interaction design and industrial design to be in corporation and collaboration in ICT embedded product development activities. Although this situation has come forward in the literature review, it is determined that the said necessity is taken into consideration in the sector except for the leading design consultancies. The findings of interviews which consist the first phase of field research, support the literature review. As a matter of fact, design consultancies in which there are no in-house interaction designers, outsource interaction design at the end of *Concept Generation* and *System Level Design* phases. This situation which is supported by both literature review and interview findings is in contradiction with case study findings.

Table 1 The relationship between industrial design and interaction design in ICT embedded product development activity

	INTERACTION DESIGN	INDUSTRIAL DESIGN
User	Mental models Perception	Ergonomic factors Anthropometrics
	Need and preference	
	Experience	
Feasibility	Software structure Interaction generation environments Facilities of generation environments Hardware and software relation	Production techniques Production feasibility Material qualities Form
Design Approach	Scenario based approach Complex interaction Graphical user interface Typography, Color factors, Pattern	Form based approach Mechanical interaction Material Color and pattern
	Dimensions of the product Dimensions of the screen Affordances	
	Persona creation	
Problem Solving Approach	Synthetic thinking Text Language Visual Language	Drawing and Synthetic thinking Visual Language
Prototypes	Paper prototypes	Mock-ups
	Virtual prototypes	

It is considered that industrial designers and interaction designers collaborate and cooperate starting from first step of the development process which is the *Planning* phase. The reason of this contradiction might be the 3 years time period between interviews and the case study and also the rapid developments in this field. Another finding that supports the mentioned development is that in-house interaction designers began to work in LUNAR Design, one of the product design consultancies which interviews were conducted within this period of time.

Table 1 shows that there are common factors that both industrial designers and interaction designers focus in terms of design processes. Thus these common factors, which did not come out in literature review but in interviews, constitute the steps that interaction design and industrial design are dependant to each other in ICT embedded product development activities. Although both industrial designers and interaction designers have been considered to propose alternatives about the mentioned common factors in the case study, it is seen that industrial designers' information is still needed (Author, 2009). Yet determination of ergonomic factors and form creation are still in the profession of industrial designers. In the case study although two design professions seem to propose alternatives about the screen dimension of the product, it is believed that interaction designers should be responsible

because of designing the information and the functions embedded in that screen. Although both of the design professions seem to propose alternatives for affordances, it should be accepted as a problem to collaborate and cooperate. As a matter of fact, these relationships are being solved by using users' hands instead of other physical controls such as a mouse, handle etc. This situation is gradually shifting interaction design into its individual area from being dependant to industrial design profession. Affordance which is located under the user title also is moving into the profession of industrial design.

Redefining the Roles in ICT Embedded Product Development Activity

The subjects which were supposed to be solved collaboratively and cooperatively by industrial design and interaction design in ICT embedded product development activities have begun to move towards to the responsibility of interaction design profession (Author, 2009). Because the physical controls that take place in user product interaction have been gradually disappearing,

Disappearance of physical controls that take place in user product interactions shows that the activity area of interaction design will be wider and wider in ICT embedded product development activity. This extension points out that interaction design profession will have a leading role on the process and design management comparing with industrial design.

In Table 2 the roles of industrial design and interaction design are redefined in ICT embedded product development activity: in *Planning* phase, both industrial designers and interaction designers have active roles in identifying user needs and preferences, company and market needs. But at this point, as interaction designers focus on especially user mental models and processes, their role in user research studies have dominancy than that of industrial designers. At the end of *Planning* phase, both industrial designers and interaction designers have roles in creating concept, use and context scenarios. These steps in *Concept Development* phase are the ones which collaboration and cooperation are seen the most between industrial designers and interaction designers. Thus in *Concept Development* phase, the basic design decisions are taken. Due to the basic design decisions, both design professions create alternatives for the project. These alternatives are tested by gathering the mockups generated by industrial designers and paper prototypes generated by interaction designers. Both design professions generally work in their teams in *System Level Design* phase. At this point, although neither of teams are totally independent to each other, it is foreseen that they frequently cooperate in order to discuss and exchange ideas. In *System Level Design* phase both industrial designers and interaction designers continue creating design alternatives. Ulrich and Eppinger (2004) shows interface issues within the scope of industrial design. But creating an interface depends on creating physical controls which are not only in responsibility of industrial designers but should be also of interaction designers.

Table 2 Redefining the roles in ICT embedded product development activities (adapted from Ulrich and Eppinger, 2004)

<i>Design</i>					
	Marketing	Industrial Design	Interaction Design	Manufacturing	Other
Phase 0: Planning	Market opportunity articulation Market segments definition	User Company Market needs Product platform and architecture New technologies assessment Persona creation	Hypothesis generation Research Stakeholder research User research Field research Modeling Persona creation Workflow generation Use scenarios generation Requirements Definition	Production constraints identification Supply chain strategy setting	Research: Demonstration of available technologies Finance: Providing planning goals Management: Allocation of project resources
Phase 1: Concept Development	Customer's needs Lead users Competitive products	Use and context scenarios Industrial design concepts Form Feasibility of product concepts Building and testing experimental prototypes	Use and context scenarios Other requirements Design Framework Elements Framework Key path & validation scenarios	Manufacturing costs estimation	Finance: Facilitating economic analysis Legal: Investigation of patent issues
Phase 2: System Level Design	Plans development for product options and extended product family Target sales price points setting	Generating alternative product architectures Choosing materials Defining major sub-systems Refining industrial design	Design refinement Detailed design	Suppliers identification for key components Final assembly scheme definition Target costs setting	Finance: Make-buy analysis Service: Identification of service issues
Phase 3: Detail Design	Marketing plan development	Defining part geometry Choosing materials Assigning tolerances Completing industrial design control documentation		Piece-part production definition Tooling design Quality assurance definition Procurement of long-lead tooling	

disappearing as might be observed in ICT embedded products in the market. Consequently, industrial designers will gradually leave their roles in this subject to interaction designers. In this case, it is possible to foresee that interaction design profession will play role more and more in this mentioned step.

Starting from the above evaluations, it is possible to say that interaction design will have a wider activity area in Planning, Concept Development and System Level Design phases comparing with that of industrial design.

According to the results of this study, there are differences in terms of methods, techniques and design language in approaching the design problem and understanding users between industrial designers and interaction designers. Conducting more case studies regarding this result might contribute to affect and develop thriving techniques, design and representation languages.

The results of this study foresee that interaction design will gradually play a wider role in design and process management in ICT embedded product development activity. Hence a conducting a research in the near future on interaction design management might contribute to both interaction design profession and ICT embedded product development activity.

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