THE RELATIONSHIP BETWEEN SOCIO ECONOMIC FACTORS AND USE CONTEXT IN PRODUCT USABILITY

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Approval of the Graduate School of Natural and Applied Sciences.

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ABSTRACT

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Developments in the usability discipline have lead to new paths in new product development processes. The methods for development of usable products are abundant and the area is crescent for new research. One of the concerns in usability lies in the question of employment of user centered design in the prevailing product development processes. In this study, it is aimed to be clarified that inquiry into the use context should be an initial step in user centered design. However, use context is one of the less explored areas of usability. Detailed examinations of contextual factors may open paths to new methods of integrating usability into products.

This study aims to take a step towards the analysis of the impact of socio economic factors on usability of product. A field study is made in order to acquire a deeper understanding. Samples of two different socio-economic groups are defined from the marketing perspective. Contextual factors are specified on the example of washing machines. Comparison of problems between the users from the two socio economic groups shed light on the relationship between socio economic variables and usability problems.

Keywords: User centered design, usability, socio economic level, use context, user characteristics, use environment, user goals, new product development.

ÖZ

ÜRÜN KULLANILABİLİRLİĞİNDE SOSYO EKONOMİK FAKTÖRLER VE KULLANIM KOŞULLARI İLİŞKİSİ

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Kullanılabilirlik alanındaki gelişmeler, ürün geliştirme sürecinde yeni açılımlar yaratmıştır. Kullanılabilir ürünlerin yaratılmasında uygulanan çok sayıda metod vardır ve konu yeni araştırmalara da gebedir. Ürün kullanılabilirliğinin sağlanmasındaki problemli yönlerden biri, kullanıcı odaklı tasarımın mevcut ürün geliştirme sürecine entegrasyonunda ortaya çıkmaktadır. Bu çalışmada, kullanıcı odaklı ürün geliştirme sürecinde başlangıç noktasının kullanım koşullarını anlamak olduğu gösterilmiştir. Ancak, kullanım ortamına yönelik araştırmalar oldukça kısıtlıdır. Kullanım koşullarını oluşturan faktörlerin detaylı incelenmesi, kullanılabilirliğin ürünlere entegrasyon metodları ile ilgili yeni yollar açacaktır.

Bu çalışma, sosyo ekonomik faktörlerin ürün kullanılabilirliğine etkilerini analiz etmeyi amaçlamıştır. Bu amaç doğrultusunda, konuyla ilgili bir alan çalışmasının gerekliliği öngörülmüştür. Pazarlama bakış açısına dayanarak iki farklı sosyo ekonomik gruptan kullanıcı örneklemleri oluşturulmuştur. Çamaşır makinası özelinde, bu gruplardaki kullanım koşulları belirlenmiştir. İki sosyo ekonomik grupta izlenen kullanılabilirlik problemlerinin karşılaştırılması ile kullanılabilirlik ve sosyo ekonomik faktörler arasında bir ilişki saptanmıştır.

Anahtar kelimeler: kullanıcı odaklı tasarım, kullanılabilirlik, sosyo ekonomik seviye, kullanım koşulları, kullanıcı özellikleri, kullanım ortamı, kullanım amacı, ürün geliştirme.

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CHAPTER I

INTRODUCTION

Products are meant to provide utility; this is their reason for existence. In order to provide utility, they should have been designed to fit the requirements of user. They should satisfy user's needs, they should satisfy them safely, and via humane patterns of action. Usability is a research area where the aim is to enhance afore mentioned aspects of products. Usability literature holds the view that usability problems in products originate from the ignorance of producers about the end-users. Especially in consumer-product industry, one of the causes of the ignorance is due to the prevailing ways and means of new product development processes.

1.1 Problem definition

Usability is attained when a product functions in such a way that it is used naturally. The functions should be easily understood and operated. What is required to use a product should be within the scope of physical and cognitive skills of the user as well as his environmental constraints.

In the literature, there is consensus that the usability level of a product depends on the level of knowledge about its prospective users (Bevan, ISO 20282). One of the reasons for poor usability is the inadequate knowledge about context, which is comprised of the users' characteristics, their environment and the tasks they do to achieve their goal. Obviously, collecting data about each and every potential context is not feasible for today. On the other hand, theoretical models or knowledge base has not developed enough to have a clear idea of the factors that effect usability of products in certain settings. Thus far, research continues in creating a structured knowledge about contextual factors in usability (Maguire, 1997; INUSE, 1996; Thomas and Bevan, 1996; ISO 20282).

In consumer products, the contextual ignorance is partially due to the way the products are developed. New product development process can be seen as a chain, where the previous step has to be integrated into the next and the product is matured in each step on a cumulative flow of knowledge which is released by related branches: from marketing to design team (including the usability specialists), then to engineering, to manufacturing and finally to sales. In a firm, a generic new product development process begins when the top management or the marketing department see an opportunity in the market and decides to produce a new product (Ulrich and Eppinger, 2000; Kotler, 2000). Primary research is done to see the validity of the product idea, if found feasible, the idea is explained to the design team. The marketing people pass information obtained by their research to design team. This information is as such: what the product is

going to be, which features and functions will be present in the product, who the purchasers of this product are, why they are going to purchase it, when they are supposed to use it. The design team bases the concept and the major design decisions on this information provided by marketing. From the point of usability, the information given by marketing has to be taken as a basis for contextual input. However, the necessary information for usability is not in the same format with the one provided by the marketing department. Both marketing information and usability information are about the people and their relationship with the products, but usability focuses on user-product interaction, whereas marketing focuses on purchase and consumption. The so-called contextual information provided by marketing does not fit to the type of contextual information needed by the usability department. As a result, the intricate chain of product development process is broken from the beginning with the loss of connection between marketing and design team. Context is not fully understood by producers and the resulting products have usability problems.

Establishing the connection between marketing and usability would be beneficial for the firms to strengthen their ability in creating usable products. In this way, an existing information base (created by marketing department) about consumers could be utilized as a basis for contextual information in usability. Revealing the priorities that the marketing information implies for design of usable products promises a new method of integration of usability into product development process.

Marketing information may provide clues for user characteristics, use environment and user characteristics. One of the widely applied researches by marketing is the socio economic condition in which people live. This classification might be promising for the purpose of eliciting clues for use context.

The socio economic level is defined by income, education and occupation of people. These three factors are determining in living conditions of people, which, in turn, may be influential on contextual factors. For example, literacy is a determining factor in usability of a product. Likewise, the space constraints in which a product is used are directly related with usability. Space constraints as well as infrastructure can be result of housing conditions, and housing conditions can be guessed by looking at the socio-economic level of people. The skills and knowledge of user is a usability concern, which is directly related by education of user and education level is by definition a component of socio economic level.

Studying the impact of socio economic factors on use context seems to be worth the effort as socio economic factors may provide valuable insight into contextual dimensions of usability problems in products. In this way, the priorities that should be considered when designing for a certain socio economic group can be elicited. As a result, a step will be made to bridge the gap between the stages of product development process and usability studies.

1.2 Aim of the study

Aim of the study is to examine if socio economic conditions of users has any implications on usability of products. This question is traced through the following points:

What is usability and how is it attained?

What is user centered design?

How user centered design is carried out in product development process?

Why examination of use context is important in usability?

What are the contextual factors that affect usability of products?

How use context is inquired in user centered product development process?

Can a relationship between socio-economic level and usability be established?

Can socio-economic factors be defined in terms of use context?

1.3 Structure of the study

In this study, socio economic factors are framed within 'context of use' as accepted in usability terminology. Relationship between context of use and usability problems is examined.

The second chapter of this study is devoted to examination of usability as a concept. Definitions of usability are gathered both from the literature and ISO standards. Usability in products is argued from the point of users and present industry standards. Results of user centered design is debated from the point of view of firms; i.e. cost-benefit relationship, return on investments, company image.

Third chapter is about understanding how user-centered design is employed to develop usable products. The methods used in the industries for integration of user centered design into new product development process are examined. Divisions between methods and the relevant product development stages in which they are used are inquired.

Fourth chapter initiated with the aim of acquiring a deep understanding of context of use. Importance of context is justified from the studies in literature. The context definitions used in usability discipline is searched. For this purpose, usability standards are taken as a guideline to support the arguments. Simultaneously, socio-economic factors are derived from marketing literature. Set of connections between socio-economic factors and context of use are questioned.

Fifth chapter examines the intersection of socio-economic context and usability problems. A field study is made to test the connection of socio-economic context and usability problems. The base for methodological decisions and the frame of the study is given here. The connection is investigated through an example product, the washing machine.

In the conclusion, the chain of questions and answers that are followed through the framework of the study are put together. Comprehension of the big picture is reached and possibilities for further studies are sought.

CHAPTER II

USER CENTERED DESIGN

2.1 User Centered Design and Usability

A popular term today, user centered design (UCD) originates from the human factors/ergonomics discipline. It is both a goal and a path in human factors/ ergonomics discipline.

Human factors/ergonomics has its roots in the times of prehistoric man, according to Hutchingson (Weimer, 1995). Protection or farming tools of the time were in fact subject to an informal development process such as requirement definition, production test, evaluation, and system retirement (Weimer, 1995). After Industrial Revolution, production ways and methods have changed drastically. Tools became machines, people became users. Weimer (1995) identifies the first deliberate effort in human factors as the one made by F. W. Taylor, in 1898. At Bethlehem Steel, he restructured a loading task by employing a new work-rest schedule in addition to designing new shovels. In this way, he was able to increase the daily loading amount from 12.5 tons to 47.5 tons per worker. Taylor's main contribution to the

profession was to formalize time-motion study, which is the ancestor of today's task analysis.

Human factors/ergonomics research developed especially in the 20th century onwards. Asatekin gives the reason for foundation of ergonomics discipline as the emerging interaction problems between the working human and machine tools he used in addition to problems he experienced in his environment which was continuously changing with the developing technology. There was a need for a science which focuses on the interaction between human and his (work) environment (Asatekin, 1997). Ergonomics, as a discipline, established itself first in the military during the two world wars, emerging from the need to solve the problems in usage of weapons and military equipment by the soldiers. The following cold war and then space technologies increased the interest in human factors/ergonomics research (Asatekin, 1997; Weimer, 1995).

The accumulated knowledge in human factors/ergonomics has opened a path to user centered design. Today, in user centered design, the proactive approach taken by researchers aims to prevent any problems in user-product interaction before it happens.

Ours is an era in which the advances in electronic chips have started to alter the operation ways and means of products. The miniaturization of the components that are used has brought about a revolutionary decrease in the size of the end products, as well as a concealment of their structure. Now, it is not possible to see how the machines work, in which state they are (Norman, 1993). Because the functioning structure is hidden, what is reasoned out of a product is what the designer has provided. This means that, products have become "black boxes", designers have to stick additional signs in order to enable the users to understand them. In sum, an inverse relationship emerged between the advent of technology and usage problems.

In 1984, first Bennet and Shackel defined a concept: usability (Han and Kwahk, 2001) They pointed out that usability is achieved when one makes effective use of a product's full potential and does so willingly (Scerbo, 1995). This is how the concept of product usability was born.

Usability is defined in ISO 9241-11 as:

> Usability: The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.

These three components; effectiveness, efficiency and satisfaction can be explained as follows:

Effectiveness is, very simply, whether the user can accomplish the task at hand or not (Jordan, 1998). Effectiveness is defined in ISO 9241-11 (1998) as "the accuracy and completeness with which users achieve specified goals" (definition 3.3).

In fact, the line is not so strict. Keinonen (1997) defines effectiveness as the outcome of the interaction of user and product, that is, usefulness and utility. Jordan gives the example of word processors: the user may copy and paste a paragraph while she cannot change the type fonts. In this case, the product is effective in some tasks and not effective on others. There are some cases where the degree of effectiveness is quite easy to measure: the effectiveness of a lathe might be measured by looking at the degree of deviation of the produced parts from the required size (Jordan, 1998). Certainly, Norman (1999) notes that, the acceptable deviation from requirements does not always bear the same importance in different areas, for example, the degree of effectiveness of the parts in a nuclear power station is crucial, whereas, it might be considered merely as nuisance in word processors used by secretaries. Nevertheless, it is pointed out in ISO 20282 working draft (2003) that, in everyday products, effectiveness of a product is more important than the other two components, efficiency and satisfaction.

Efficiency is the resources spent, the process itself, in other words, ease of use (Keinonen, 1997).

There are "critical paths" for doing certain tasks as Jordan (1998) puts it. The efficiency is affected by the time, money and effort spent to do that task, even if there are no errors made (Jordan, 1998; Wilson, 2002). Jordan explains this with the example of the word processor again: if the user wants to "save" her work and she opens other "menus" such as "options, tools," and so forth, or she has to consult the manual, then this is a loss of time and effort. This implies a problem in efficiency of the product.

According to Jordan (1998), error rate is used commonly to measure the efficiency of a product. In addition, the kind of the error gives important clues about the type of the usability problem. For example, if the user knows how to do something but still makes errors, it might be that there are problems in the interface, such as the buttons are too close that she hits the wrong button. This type of error is called as a "slip" (Jordan 1998). On the other hand, when the user makes a mistake, it means that the product's working principles are not intuitive for the user; the product's model and the user's model do not match.

Another widely used measurement for efficiency is to evaluate the time spent by the user to complete a task (Jordan, 1998). Jordan notes that, the cost of error is assumed as the time lost but there can be more than that, depending on the irreversibility of the error.

Mental workload is an attribute of efficiency, especially if the completion time is fixed and the error rate is low. This aspect of usability is important in "safety critical processes" like driving, operating an aircraft and so forth (Jordan, 1998). The higher the mental workload required by the product, the higher is the probability of error.

Satisfaction is how user likes the product. Wilson (2002) defines satisfaction as “users’ physical comfort, subjective acceptability, attitude toward a product” (p.27). In ISO 9241-11 (1998) satisfaction is defined as "freedom from discomfort and positive attitudes to the use of the product" (Definition 3.4).

It is worth noting that usability and functionality are related, but different attributes of a product. Functionality is related to proper working (functioning) of a product. It may be doing all the tasks correctly, may be very high quality, but still be unusable. Usability is how functionality is implemented, as Scerbo (1995) puts it. A product may be doing its job perfectly well; but the question is, whether users can make it do its job perfectly well. For example, a camera might be taking extremely sharp pictures however, people might be shaking it as they release the shutter because of the inappropriate placement of the shutter release button. The resulting photos will be out of focus. A product should increase the performance of its user (Scerbo, 1995). On the contrary, a camera might have every button in place, might have every function needed to take all kinds of picture, provide night shooting without flash, can take 60 second movies, can even be used underwater. Besides, this time, its functions can be utilized without any mistakes by the user; if only he figures out how to activate them. Whether the reason is not being aware of the existence of a feature, or not being able to learn how to use them, or not needing to use them at all; this camera can be said to have usability problem(s). "Therefore, usability is the degree to which potential utility becomes actual utility" as defined by Wilson (2002).

A product is designed for usage by people (Rubin, 1994). Scerbo explains that usability is how well a person can interact with a product (Scerbo, 1995). This makes sense, since a product is used to do a task unless the product usage itself is the aim, for example sports or hobby equipment like puzzles, bicycle and so forth. Even in this case, these equipments might be thought of having a special way of

usability. In everyday products, people prefer to focus on the task at hand, rather than on the product which they are using as a means to achieve it (Rubin, 1994).

Usability starts before the user learns how to operate a product. In many cases, a product is meant to be used rarely or by inexperienced users. A fire extinguisher (Jordan, 1998) or a (ticket) vending machine are examples to such products (Bevan ISO 20282). According to Jordan (1998), during the life cycle of usability, at first, the user makes a guess what are the functions of a product and how could they be used, then he learns how to use it. The product should satisfy an experienced user too. Then, system potential, which Norman (1988) names as the deepness of a product, comes into stage; that is when it is possible to use a product in an advanced way. Jordan (1998) adds another stage which he names as re-usability of a product after a long time. A usable product should be preserving its effectiveness, efficiency and satisfaction attributes in all these stages (Jordan, 1998).

Consequently, Jordan (1998) organizes the components of usability as the following (pp 11-16):

Guessability: The effectiveness, efficiency and satisfaction in first use.

Learnability: The same attributes after the first use.

Experienced user performance: The above attributes when a product is used by an experienced user. Norman, Draper & Bannon calls this "shells of competency". (Jordan, 1998). Jordan gives here the example of a plane: pilot should be able to fly the plane in the best way.

System potential: The maximum of effectiveness, efficiency and satisfaction that can be obtained from a product. The level attained by the most experienced user. If there is a system potential, users may discover more of a product, as they pass the levels of experience.

Re-usability: Known attributes after a period of not using the product. For example, it is said that you never forget to ride a bicycle.

According to Wilson (2002), usability is a dynamic relationship between product, user and task. He adds that it is this dynamic character that makes usability so hard to attain and evaluate.

The word usability is used interchangeably with the terms such as ease of use, quality in use, user-friendliness, humane technology, usability engineering, human factors engineering, user centered design, and human centered development. All these expressions are in fact related to the concept of usability. Some of the above listed terms are actually outcomes of usable products, that is, a usable product is a user-friendly one which is easy to use. Humane technology is application of technical availability to products in such a way that people are able to use them. Usability engineering and human factors engineering is the name of the discipline. User centered design or human centered development is a product development process which leads to usability of the final products. Norman (1999) defines human centered development as "a process of product development that starts with user's needs rather than with technology" (p.186). Quality in use is in fact defined in ISO/IEC standards as: "The extent to which an entity satisfies stated and implied needs when used under stated conditions" (INUSE, 1996, p.25).

Today's high-tech products, from computers to food processors are subject to usability problems. There is considerable amount of research on this subject. According to Norman (1988), designer's way of thinking (designer's model), is different than that of the people who use the products (user's model). Designers are oriented to forming physical and logical structures. User's model is to evaluate a formed product. Unfortunately, designer's only way to communicate what he intends is through the product; he cannot go and talk to users and explain them the

product. Conflict appears when user understands something other than the designer aimed to say.

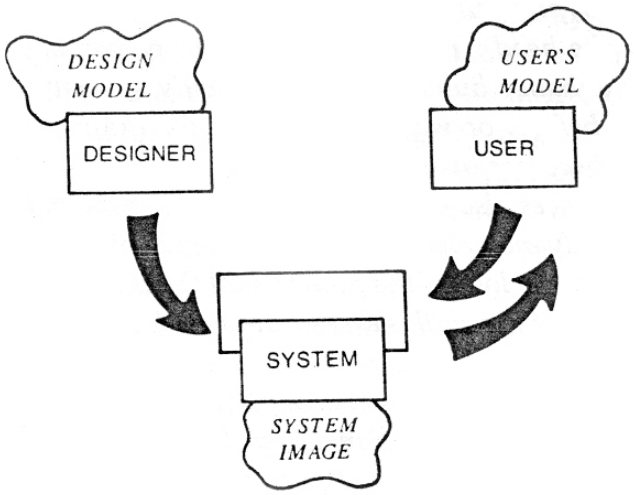


Figure 2.1 Communication between designer and product**.**
Note. Reprinted form *The psychology of everyday things*. (p.16) by D.A. Norman, 1988, New York: Basic Books.

This conflict leads to problems in product usage. He argues that, "In the past, technology had to worry about fitting people's bodies; today it must fit people's minds" (Norman, 1988 p.17) Similarly, Bevan (1999) indicates that, in the past, the focus was on the function of the product, if it did its functions without errors, it was enough to be accepted as a successful product. Rubin (1994) connects this situation to what he calls next-bench design. Next bench design happens when a product is designed; the designer makes the person next-bench try and comment

on it. Thus, another designer tests it on behalf of ordinary users. In fact, at those times, ordinary users were people who loved technology. They liked to examine the technological products, to be able to use it was their challenge, they were proud of using hard-to-use gadgets (Rubin, 1994). However, today, the user is not technologically competent, nor he wants to be so to be able to do everyday tasks (Norman, 1999). Hence, low usability is a real problem in contrast to times when designers were not concerned by the use context.

The situation has improved considerably since 1985, when the user centered approach to product development made its way into the quality standards for software (at least) and usability became a requirement. However, this is just the beginning and there is still a long way to go.

Today, product development is made by several specialized teams, each doing a part of the product. However, their work is not integrated in the product (Rubin, 1994). He argues that, while user interface indicates something, help wizard says another. He claims that even usability tests are made separately for each part. This creates usable parts but an unusable product as a whole.

Jordan (1998) states that everyday products, including sewing machines, video cassette recorders and even cookers, which are meant to make life easier do just the opposite when they are unusable and the ones that are produced to enjoy the users actually annoy them (Jordan 1998). It is argued that the products in the market are not designed according to the needs of the actual users, that is, they do not fit the abilities, skills, and preferences of the people who are meant to use them (Porter and Porter, 1999). This is why, according to Norman (1999), everyday tasks are so complex, the complexity is not because of the task, but it is because of the tools that are used to accomplish them. As an example, he indicates that computers are made for the world market, which means that there will be a wide range of users with respect to age, educational level, social and cultural group andso forth. Moreover,

the tasks for which they are using the computer are as diverse as their characteristics. It is impossible to fit one product to every work type and every usage style. Norman argues that the computer is built to accomplish all the tasks that all types of users might want to do. He calls this "the sure path toward an unsatisfactory product; it (the computer) will inevitably provide unnecessary complexity for everyone".

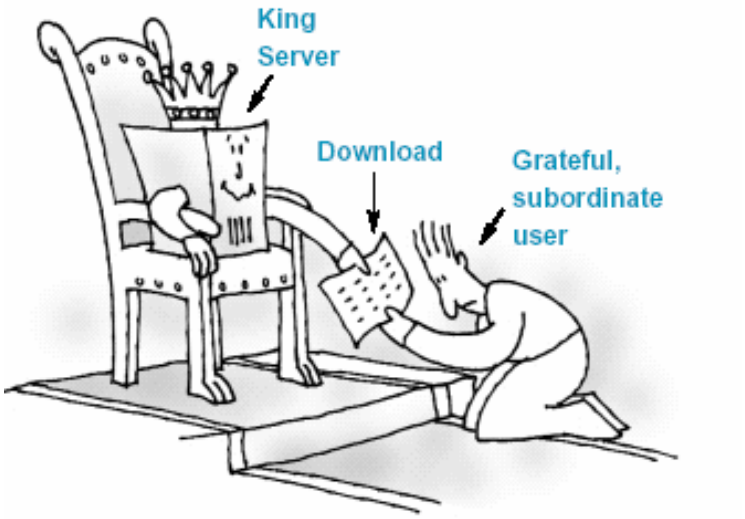


Figure 2.2 How producers see their products. "Today, our industry sees the computer as king" that's why it downloads info to users."
Note. Reprinted from Dr. Eric M. Schaffer, Human Factors International, Inc. http://www.humanfactors.com/downloads/UCSbooklet.pdf

Some researchers think that, as well as the above inadequacies, there are other attributes in products that enhance the usability, and improve their usability a step further. Jordan (1998) introduced the concept of pleasure in use. Han and Kwahk, 2001) introduce image/impression to usability of consumer (electronic) products.

Overbeeke et.al. (2000) say "forget about ease of use!", the important thing is the beauty of use experience.

To achieve (usability) problem free products, it is recommended that firms take a user centered approach in their product development process. This is achieved by implementing usability concerns to product development from the beginning of design process and understanding the context in which the products are used. The specification of users is also crucial to have a good fit. The knowledge of users and the context should be grasped by the designers. According to Rubin(1994), this should be an outside-in approach, understanding the users first and then implementing the things learned into the product. Bevan (1999) points out that; this is easy when the products are targeted to organizations. But is more complicated when the products will be sold at consumer market. This time, representative users and probable use context should be included in the design process. The focus must be shifted form inside the machine to its interaction with the user (Rubin, 1994). In this way, a fit between the products and their users must be attained.

Rubin (1994) claims that new methods are needed to teach designers how to understand the end users' needs and abilities as usability evaluation will be useful after this change in designers' view of users. Moreover, most usability research is done on software products, however, 3-dimensional products have their differences. How the usability of these products should be evaluated remains as a challenge yet.

There are some concerns about usability as a science though. Porter and Porter (1999) claim that usability evaluation methods are not fully developed yet. Spool (2002) views this idea from another angle: as he begins to design, the designer does not know how a usable product should be like eventually. Today, usable design is

reached after many trials and errors. It is not feasible to start iterations from the beginning, every time a new product project is initiated.

Standards are being prepared just to fill this gap. ISO 9241-11 (1998) is related with usability in general. ISO 20282 (2003), dealing with context of use and use characteristic in everyday products and interfaces is still a working draft, and is aimed to provide more detailed guidance for usability. This standard will be mentioned later in the next chapter.

ISO 13407 (1999) provides guidance for user centered process. It leads readers to identify stakeholders (customer, user, supplier, developer, etc). The second part is about eliciting their requirements, emphasizing on context to understand needs that are not explicit. Finally, prototype trials are recommended, as the real problems are revealed during actual usage (Bevan, 2003).

There are also other attempts to make the usability evaluation reports "usable" as well. In a joint project, nine usability organizations examined Microsoft Hotmail™ and each of them gave their reports independently (Redish et.al., 2002). The reports were compared and effort was made to reach consent on what a usability evaluation report should be consisted of. Redish et.al. (2002) discuss several methods in report writing and try to establish some advisory principles such as "the reports should consider 20 to 60 most important usability problems in order for the corrections to be feasible".

Another work is a project conducted by US National Institute of Standards and Technology. The project is being participated by 50 bodies consisting of firms, organizations, academics and consultants (Wichansky, 2000). The aim is to set up a Common Industry Format (CIF) for usability test requirements so that usability evaluation results will be made in such a format that could be “empirically validated” (Bevan, 2003). In CIF, the ground for the usability evaluation is set. When the contract between the usability provider and the client in CIF-R is signed,

both parts have clear ideas on what is expected out of user performance and satisfaction. What to look for in a product, criteria for deciding on user characteristics, and what can be influential contextual factors are structured. The methods for usability evaluation is not included in CIF, but they can also be agreed upon separately. By the completion of CIF, goals for human centered design will be more clear, measurable criteria for usable products will be documented. For example, a usability evaluation report written in CIF is going to serve for consumer and consumer rights related institutions in making comparisons between the usability of different products. All these attempts are to establish principles in usability.

It is claimed that the concepts associated with usability issues are not universally agreed upon (Jacobsen and Jorgensen, 2000). According to them, every research team has its own terminology and definitions. Usability theories are borrowed from other disciplines such as psychology. There is no tradition of usability, so everybody tries to find a path "by fact gathering almost randomly". (Redish, et.al, (2002) argues that this is happening because usability is a new discipline and "in new disciplines, rules, principles, methods evolve in time" (Redish, et.al.;2002, p889). As a result, it can be said that usability is in the initial stage of becoming a science (Jacobsen and Jorgensen, 2000).

What is to be studied as usability? What should be the methods? What are the instruments? What are the main theories? All these are still ambiguous. A detailed examination of state-of-art of usability evaluation methods is given in Chapter 3.

2.2 UCD for Safety

The problems in the interaction of users with products cause not only discomfort and inconvenience but also serious injuries and even fatalities. "Human error" is claimed to be the cause in these cases. Norman (1993) argues that the error is not in the humans, but in "the technology that requires them to behave in machine centered ways" (p11). Actually, humans do make errors; so, the products should be designed by taking this fact into consideration (Han and Kwahk, 2001). Accidents still occur because of the usability problems in products and systems.

Three Mile Island nuclear power station accident in 1979 is one of the most famous examples for this. Everything started with a small problem. However, the confusing feedback given by the system led the operators take the wrong action. There were 100 alarms either sounding or displayed and as the problem got bigger, an additional 750 alarms activated. According to Weimer (1995), "the information was presented in a manner to confuse operators" (p.8). The instruments that needed to be checked were on the back of control panel (Jordan, 1998).

Less drastic but still vital examples are given by Jordan (1998): non-usable car radio would require the driver to take his glance off the road and to the radio. This would easily cause a pedestrian got killed or other car accidents might happen. Papanek (1971), Jordan (1998), and Norman (1988) mention cooker knobs. Users sometimes turn the wrong knob and leave the room thinking that they have put off the hob. An extensive list of such real-life accidents can be found in UK Department of Trade and Industry and US Consumer Product Safety Comission accident databases (DTI, n.d.).

Wiklund (1994) warns the producers of a potential product liability case if they have not followed a user centered design process. This is also true for Turkey, as product liability article is accepted in the parliament in May 2001. As mentioned above, unusable products may cause accidents. According to the law, "burden of

proof is on the defendant" (Wiklund, 1994; p13). By following a user centered design process, developers may decrease the probability of accidents caused by their products. Besides, if an accident happens, they may be able to claim not-guilty by showing the the extensive research they did to assure fool-proof products and that the misuse in question was not foreseeable (Wiklund, 1994; p.13). Figure 2.3 shows how seemingly small usability problems may lead to serious hazards.

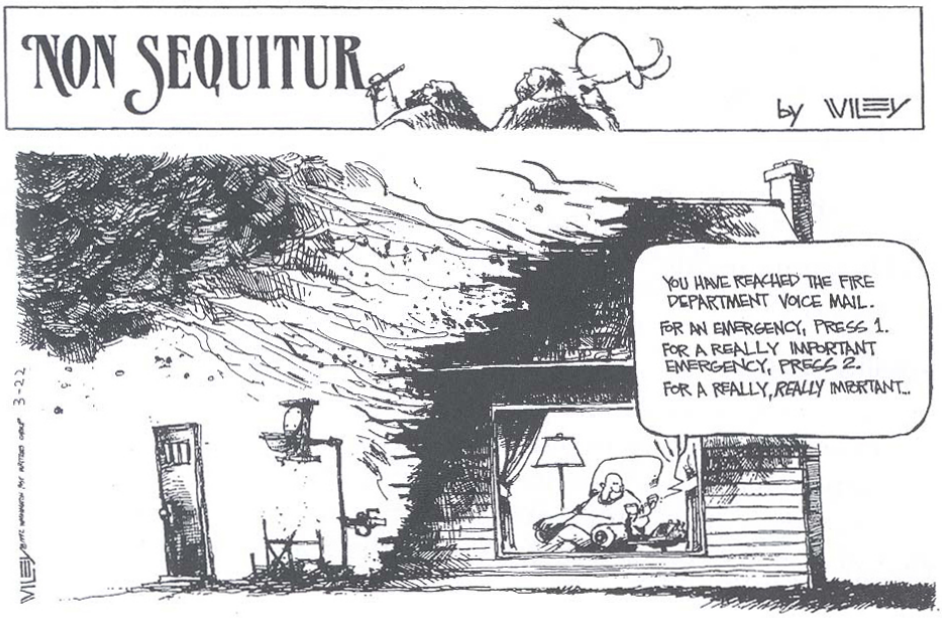


Figure 2.3 Usability as safety.
Note. From. *Usability in practice: How companies develop user-friendly products*. (p.13), by M.E.Wiklund, 1999, Cambridge, Massachusetts: Academic Press.

2.3 UCD for Marketing

Usability problems may seem like little inconveniencies of life, however, they have greater connections than that (Scerbo, 1995).

People give a lot of money to multifunctional products, just to be trapped in a few main functions that they are able to use because of the complexity of products. Sometimes, they do not even know how many functions exist in a product (INUSE, 1996). If they happen to discover the existence of the functions, this time, low usability prevents users from learning and utilizing all of them. So what is the difference between a hyper functional, do-this and do-that product and a simple, few-function one except for the amount of money paid? Norman (1999) argues that users were once proud of being able to use complex products as such, because complexity was associated with high technology. Today, most of the products are functioning perfectly well, but consumers cannot use them. Unfortunately, they do not go back to the seller and give it back because they will have to admit that they are not capable of using a "simple" product (Scerbo, 1995). In this way, for years, firms had satisfactory sales without bothering for usability of their products (Norman, 1999).

This has begun to change from the 1980s on. Especially in the U.S.A., the business policy has changed. Firms became more consumer-oriented by the increase of foreign competitors in their home markets (Scerbo, 1995) the U.S industry was mainly formed of big firms in the 80s. Small businesses had the ability to change their offerings quickly according to new requirements of competition, that is, they could immediately adopt themselves according to consumers' demands. Large firms on the other hand, had to ask themselves "what consumers want?" instead of "what consumers buy?" (Scerbo, 1995 p.75)

There is a public awareness about usability and this can be seen in the ads emphasizing "ergonomically designed" products (even when they are not so) (Jordan, 1998; Zimmerman, 1999). Today, consumer reports may blame a product for not being usable, and consumers demand easy to use, satisfactory products (Beu, et.al., 2000). Palm and Nokia differentiated their products and gained their market share due to creating usable products (Roberts, 2001).

Jordan (1998) believes that the main reason for the success of Apple Macintosh and Windows was their usability advantage over the "command line operating environment" (p16). Apple directors say that the firm followed informal usability engineering from the beginning. That was why Mac had a fame of easy and enjoyable usage according to its contemporary competitors. The case of Apple PowerBook is explained by the directors of usability engineering team of the company (Gomoll and Wong, 1994) as follows: After the establishment of User Aided Design Group, usability studies gained a formal status. The design awards collected by Apple PowerBook, was the result of an intensive usability procedure. The innovative trackball which was substituted for the mouse had undergone many iterative stages. Non-working models and prototypes were tested by users before the final design was reached. The result was an impressive amount of sales ($1.000.000.000 in the first year) and many design awards were given (IDSF Gold Award, ID Magazine Award, IF Award).

Microsoft, in contrast, has founded a usability group in 1988. It was the technical writers who realized a need for usability test, since they are the first who use a product (Dieli, et. al, 1994). Microsoft seems to give so much importance to usability, it might be thought that better late than never.

In an interview made by Bill Robertson in 2002 for Electronic Business magazine, the executives of Nokia, Cupertino, Handspring and Mountain View claimed that they see usability as strategic advantage and that therefore; they wouldn't discuss it publicly. Kodak managers claim that human factors is practiced in the firm for 33 years. Kodak develops new products and puts usability team in an effective place in the organization, "human factors is applied in Kodak to achieve a competitive edge" (Caplan, 1994).

Firms like Siemens consider usability of their products as a core competence too, simultaneously using their laboratory as a marketing tool (Beu, et. al., 2000). Their

usability laboratory in China is visible from the entrance of Siemens building in Beijing, because they discovered that a usability laboratory is a way of showing their affection to their customers (Honold, 2000). Similarly, Caplan (1994), an internal company consultant at Kodak, advices the firm's human factors team to learn how their product is marketed to customers so that they can help the sales department in promoting high usability of their products. These examples justify the usage of usability evaluations for marketing as well. By applying usability evaluation, companies obtain accurate, ready to use marketing claims (Wiklund, 1994).

Usability creates brand loyalty (Roberts, 2001). A usable product satisfies the customer. Satisfaction is especially crucial in consumer products, because unlike, e.g. an employee in a firm, the consumer has the power of choosing what to use and what not to use (thus, what to purchase and what not to purchase) (Jordan, 1998). People who are experiencing inconveniences will not buy another product of that manufacturer again (Scerbo, 1995). Usability in a web site increases number of visits (Roberts, 2001). On the contrary, low usability in the web site of a firm creates a bad experience for users. They associate this experience with the inferiority of that firm and assume that that brand is an inferior one (Usabilitynet, 2003). Brand image of the whole company is affected because of its unusable web site (Usabilitynet, 2003).

Further, let us think of an e-commerce site that the customers cannot figure out how to purchase a product they want to buy. In this case, usability is a lot more than a strategy, it is vital for the existence of the business! (Han and Kwahk, 2001). Besides, a web site aims to encourage the visitors to buy. In usable websites, people stay longer and buy more (Usabilitynet, 2003). A good indicator of usability is the conversion rate, that is, how many of visitors are turned into buyers (Usabilitynet, 2003).

According to a research in 1998, half of the purchases via internet sites are not realized, because the users cannot locate the necessary information (Usabilitynet, 2003). Usabilitynet, a European Union funded project to provide resources and networking in usability, lists some data about poor usability in websites as follows:

- Almost 50% of users do not come back if they found it hard to find relevant information on the website.
- 82% of the customers who intended to make a purchase changed their mind when they couldn't overcome the bad usability of the site.
- 60% of users give up their search when they cannot locate what they are looking for.
- 50% of visitors do not come back to that site, if they found the site hard.
- In year 2000, $3.8 billion of sales is lost because of bad design and poor usability of web sites.

As a result, it is not unexpected to see that many successful firms invest highly to usability. They use it as a tool in increasing competitiveness. According to Norman (1999), users, in some way or other, perceive usable products better and pick them. Keinonen (1997) argues just the opposite in fact. He claims that users do not understand and evaluate the usability of products. At the moment, this does not seem to prevent firms from advertising and investing in usability.

As a result, usability is better taken as one of the components of marketing strategy next to pricing, service and availability (distribution) (Roberts, 2001).

2.4 UCD For Cost Reduction

Usability evaluation, at first sight, seems to be an extra cost in product development phase. "After all, designing with common sense will do usable products" is what many firms think according to Rubin. If that was true, every common product would be usable (Rubin, 1994, p. 6,7). Firms usually go through a "usability check" after everything is finished: the concept is decided, models are tested, prototypes are made, even the marketing strategy may be developed. If, at this stage, problems are discovered because of usability reasons, the whole project will have to undergo a major change. This would, in this case, be too expensive for the firm (Munshi, 2000), therefore, the difference between a last-minute usability adoption and a user-centered approach should be made clear. The major distinctive feature of user centered product development is that, it is a process in which products are made by taking the usability issues into consideration right from the beginning. The results of a study conducted in 1985 indicated that more than half of the production companies were not aware of user centered design process. (Rubin, 1994). Rubin claimed in 1994 that it is still the same, however, there is considerable increase since that date.

INUSE (1996, p.11) describes main advantages of user-centered approach as the following:

Benefits of user-centered product development process:

- Decreased product development time,
- Decreased product development costs,
- Increased user knowledge as an input for future designs.

Benefits of usable products for seller after the product is sold:

- Decreased training costs for staff of buyer firms,
- Decreased after-sales maintenance time and costs,
- Increased competitive edge.

Benefits of usable products for end-users:

- Increased quality of life,
- Increased productivity,
- Increased user health and safety.

When the deserved importance is given to user centered design, the firm will not go all over the design process again and again as more problems are discovered in the product just before marketing. That is, the risk of recycling the analysis, design and implementation during the product development process will be avoided (INUSE, 1996). This will decrease product development time and costs. Savings include the simplified product documentation as well (Wiklund, 1994). Employing usability techniques decreased product development time by 40% in a firm, while in another firm; the decrease was between 35-50% (Usabilitynet, 2003).

At the same time, information gained from usability evaluations by the product development team in a firm will continue to be helpful in the future too. The experience of the firm will increase with each new product cumulatively and this will reflect in better designs (Gomoll and Wong, 1994).

A usable system motivates the user to learn and explore new system solutions. Since the products will be easy to understand and use, training costs for staff will decrease. An internal accounting software for multinational firms may be a good example for this arguement. Especially in software products, maintenance costs consist 80% of all lifecycle costs (Bias and Mayhew, 1994). Maintenance time required and costs incurred will decrease with usable products. Most of the maintenance costs comes form unforeseen or unmet user requirements and usability problems (Usabilitynet, 2003). Nielsen and Mach (1994) point out that support calls by users of electronic products and software decrease by half when usability is provided. They found out that users request the service team because they cannot use the products properly or they use them in a wrong way. This point is also expressed by IDEO executives (Beu, et.al.; 2000).

As stated in Section 2.3, usable products will increase the competitive edge of producers. As a result, quality of life of users will improve, their stress level will drop and satisfaction will increase.

Usable products will create more efficient and thus productive users; this will be reflected to the operational efficiency of organizations as a whole. If the employees cannot use a tool or prefer not to use it, then the productivity is decreased, thus success of the business is risked (Scerbo, 1995). While usability is now considered as a competition tool in consumer market, it is given importance in business-to-business market too. Organizations need to be as cost-effective as possible. How to increase efficiency has long been one of the primary concerns of managers, from the times of Taylor. Firms give much emphasis on the usability of the tools they buy for usage inside the company, since they believe that usable work tools increase efficiency of workers (Scerbo, 1995). Actually their belief is justified by numerous studies. A striking example is a study made in a firm in which the usability of a system used by 100,000 employees has improved. The cost of the improvement was $68,000 but the resulting increase in the productivity of

employees saved the firm $6.8 million, which is hundred times the money spent for usability (Bias and Mayhew, 1994). In another case, usability of a data entry system has been improved, which resulted in one thirds decrease in the required personnel. After this improvement, 2 employees could do the same job instead of the previous three (Bias and Mayhew, 1994).

With usable products, improvements in user health and safety will be attained. Even if responsible product design concept is put aside, the cost of possible liability litigation will be a sufficient reason for the firm management to take usability issues more seriously.

As seen above, there are many attempts made to quantify the benefits of enhancing the usability of products. For example, cost-benefit analysis is made in computer interfaces (Caplan, 1994). Another method used was to derive connections between customer satisfaction ratings and purchase decision (Caplan, 1994). According to Roberts (2001), the Return On Investment (ROI) might be calculated by analyzing the trends in the calls to service center before and after the introduction of usable products. The amount of time it saves the user and the decrease in the support phone calls are indicators of benefits. Calculation of the amount of time it takes to complete a task is also an indication.

Bias and Mayhew (1994) point out that although the benefits of usability are not easily reflected on the balance sheet, this does not mean that intangible benefits exceed the tangible cost of investment. Moreover, the cost of trying to quantify the benefits of usability is not worth the effort (Caplan, 1994). Nevertheless, utility cannot be measured by numbers yet. Caplan advices usability teams to present a report to other stakeholders in every product development or testing project. In this way, the accomplishments made by the usability team will be more visible.

2. 5 UCD for Usability

Absolute usability can not be achieved by an error check conducted after the whole development process is finished and/or just before launch of the product. It should be an approach in product development. Like quality, usability is an inherent part of products, inherent in the product concept itself.

As technology advances, it is becoming harder for ordinary people to catch up with the novelties in the environment. Also, due to this advance, ironically, it becomes simpler to create non-usable products. As a consequence, the market is full of irrelevant products. A user centered approach has long been needed in this respect.

To attain usability, the users and their nature should be investigated. There is a vast amount of study on what to examine and how to examine the user and context. For example, Norman (1999) argues that today's computers are not usable because they are tried to be fit for every user in the world and be capable of every possible task these users might make. He indicates that it is not possible for one product to be fit for every educational level, social and cultural group and still be usable (Norman, 1999). Similarly, Han and Kwahk (2001) reminds that users are different; one user may be an "audio-maniac" and the other may be someone who just wants to be able to play a CD. So there are different dimensions of usability and user satisfaction. Multinational firms seem to be aware of this diverse-users problem too and they already started to take measures: Siemens established in-house usability laboratories in his largest markets, namely China and USA- they already have one in Germany. They believe in cultural adaptation of products and that this adaptation should not be exclusively linguistic (Beu et. al., 2000).

When a user centered approach to product development is followed, a design concept is formed after some initial insight to user and context. Some solutions are arrived at, just to be turned back and referred to user feedback again.

The solutions are tested according to real world context and necessary changes are made. This user based assessment should be continued until the product meets or exceeds the user expectations (Kanis, 1999). In other words, context knowledge and user feedback is integrated by iteration of design solutions. The earlier the usability evaluation is made, the easier will it be to make necessary changes and the less cost will be incurred (Bevan, 1999). This is a circular, interdependent process (Kanis 1999 , INUSE, 1996).

In order to achieve all this, design is accomplished by a team, including marketers, engineers, designers and usability experts. In software industry, there are also "user experience specialists, (UEs)" (Norman, 1999). According to Norman, marketers and user experience staff are in conflict, they both think they own the user. Actually, their expertise lie in different aspects of the consumer: marketer knows what they buy, UEs know how they use it (Norman, 1999).

It should also be noted that there are some differences between 3-dimensional products and software, therefore, the usability criteria must also be different. Green (1999) questions the usability evaluation methods for 3-dimensional products, claiming that the present methods are developed for software. With software, the emphasis is on efficiency and effectiveness. Easy to learn and apply tasks are usually the most important aspects of usable software. On the other hand, usually both hardware and software is present in 3-dimensional products. In addition, especially in consumer products, appearance of the products comes into scene. People put them in their home or office, next to other furniture. Therefore, it is claimed that these products should also be appealing for the feelings of users (Han and Kwahk, 2001; Jordan, 1998). Home usage is different from office usage. At home, there are unplanned users, like children. Also, temporary conditions like users being in a hurry, ill, tired or under stress, may be present. Permanent conditions might be characteristics like the educational level of users. All these factors can lead to their perceptions and actions. Contextual factors are important

in product usage. Product developers should have these in mind when they design a product.

CHAPTER III

METHODS OF USER CENTERED DESIGN

Designing products by putting the users in the center of development process is the aim of user-centered design. The WHY? question is tried to be made clear in the previous chapter. This chapter attempts to shed light on the HOW? aspect of a user centered design process.

To begin with, it is important to note that user centered design (UCD) is attained by establishing an organizational structure in accordance with the necessities of the process. This is more a subject of business administration discipline but it would not be irrelevant to point out that, like total quality management (TQM), user centered design is a "way of seeing life" for firms. UCD is attained by collaboration of mainline departments of a product development organization, i.e. marketing, design, engineering and -if present- human factors. According to Redish and Dumas (1999), top level management sets UCD as a mission and takes measures to employ it. This implies the need for considerable deviation from today's bureaucratic and traditionalist organizational structures of firms, because they obstruct the integration of UCD (Redish and Dumas, 1999).

Rubin (1994) argues that a task is realized through the interaction of three components: someone, something, and somewhere. He bases this on Bailey's Human Performance Model in the Figure 3.1:

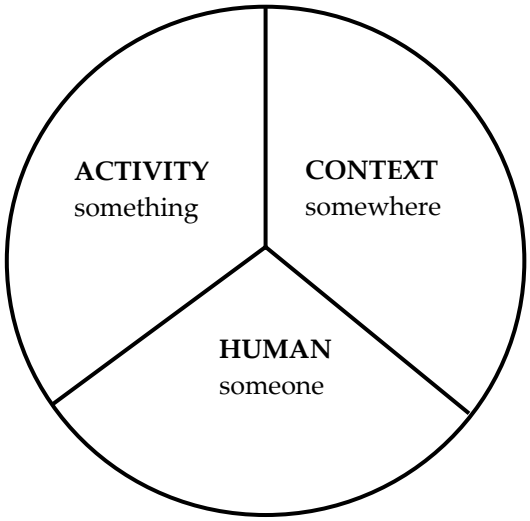


Figure 3.1. Realization of usage. *Note*. Reprinted from *Handbook of usability testing: How to plan, design and conduct effective tests.* (p. 4) by J. Rubin, 1994, New York: John Wiley & Sons Inc.

According to Rubin (1994), a product is used to increase human performance, then it is not just the activity but the context and the human dimensions of the interaction should also be taken into account. He argues that the "activity" dimension was focused for years but neither the other two components, nor the relationship between them was considered. In an interview, Norman claims that there is a misconception of usability in the industry (Roberts, 2001). They think that UCD is conducting a usability test in one of the final stages of product development process. This is because production processes are mainly based on

technology push (Norman, 1999). However, usability, just like quality, is *designed in* the product (Roberts, 2001).

In fact, user centered design is connected with total quality management (TQM), since TQM too is based on the firm's consideration of user needs in the first place. Therefore, they have parallel initiatives, where, "...(in UCD), early and continual involvement of user is emphasized" (Wiklund 1994, p9). Wiklund gives the example of user interface to explain the relationship between TQM and UCD. He claims that users get the impression of quality at first from the interface of a product. On the other hand, quality improvement of the interface can be attained through making it more usable.

In a firm which employs UCD, users are put in the core of any activity. Rubin (1994) describes this concept as "designing from the human-out". According to him everything, goal, objectives, context and environment are derived from the users' point of view and aspects of the products (like task content, organization, flow, detail) are set accordingly. Figure 3.2 visualizes the human-out concept in user centered product design.

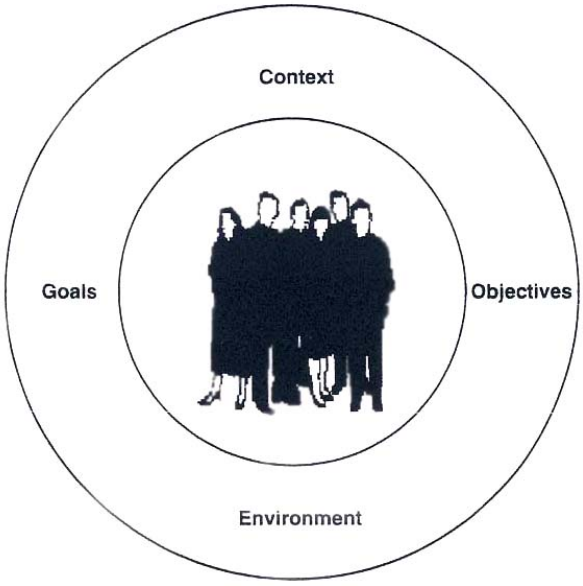


Figure 3.2. Priorities of user centered design process.
Note. Modified from *Handbook of usability testing: How to plan, design and conduct effective tests.* (p. 11) by J. Rubin, 1994, New York: John Wiley & Sons Inc.

Rubin (1994) claims that the underestimation of UCD for years is due to the prevailing understanding of producers: they think humans are adapting creatures, so it is better to bend them instead of the artifacts. The reason, he adds, is that producers are usually people who are "...black and white engineers and they are alien to ambiguous, grey human" (p. 5). He argues that engineers are hired because of their technical skills, not for understanding humans. The final important reason for usably failing products is that designers make them with their colleagues or themselves in mind. However, as mentioned in the Chapter 2, users' minds work

in a different way compared to the designers' (Norman, 1988). In sum, UCD is not possible if the emphasis is on the machines (Rubin, 1994).

ISO 13407 (1999), recommends generic measures to be taken in attaining user centered design. Bevan (1999, 2003) explains these as follows: It is recommended that the stakeholders are identified first. These may be users, customers, suppliers and developers. Then their requirements are elicited. The steps are as the following:

a. understanding and specifying the context of use

b. specifying user and organizational requirements

c. producing design solutions

d. evaluating designs against requirements.

In the draft for Common Industry Format (CIF) (Bevan, 2003), it is noted that requirements may not always be stated explicitly by the stakeholders. In this case, it is recommended to look at the context of use to gain insight into implicit needs and requirements. It is stated in CIF that, product requirements are better understood in actual usage; either it is carried out by a prototype or a final version of a product.

UCD is attained by involving users in the product development process as early as possible. Jordan (1998) explains this by iterative design. Iterative design is the continuous evaluation of products from concept level to final product and making necessary changes according to user needs. It starts as early as product specification, even if it is a verbal decision of what will be produced. Wiklund (1994) explains how this early involvement of users is ensured. He gives the example that the user is brought to laboratory to work with the existing products. Simultaneously, contextual inquiry is conducted as people use a product in their own environment. Focus groups are gathered to help define new product concepts

and requirements. As the ideas are developed, alternative design concepts or models are presented to the users to elicit their ideas. If possible, working models are given to them for a "test drive".

Here it is worth mentioning again that when a firm follows such a development process, it is unlikely to "mess up" a design. Even if there is a mistake, it will be found in an early stage, when the cost of making changes are still affordable and there is adequate time to make these changes (Wiklund, 1994).

As a last comment before starting to examine the methods in the following sections, it is recommended that as a UCD strategy, research should be continuous and free from individual product development projects. Otherwise, it will take too much time and effort to start a new (user/context) research from the beginning with each and every project. If there were a pool of knowledge (which has been forming cumulatively until that date), it will be possible to use it immediately in individual projects (Caplan, 1994).

3.1 UCD methods: Birds eye view

As user centered design is achieved through the collaboration of many departments in a firm; similarly, usability of products is attained through a collection of methods. There is no unique method for creating usable artifacts. Rather, usability methods are taken from an array of sciences and disciplines, and then tailored according to the needs of the profession. Of these various areas, several are psychology, anthropology, ergonomics, industrial and graphical design, marketing, and engineering sciences. Furthermore, the lines between usability methods per se are disappearing (Redish and Dumas, 1999). They also

point out that say that names are not important unless the necessary knowledge is elicited.

Nevertheless, an informal separation may be made between evaluation methods and the others, which are also methods for UCD, but do not "evaluate" usability of a given artifact. For the reason that the definition; "usability evaluation is any analysis or empirical study of the usability of a product or a system" (Rosson and Caroll 2002, p227); does not cover the methods applied when there is no product or system at all yet.

A generic classification of methods is as empirical and analytical usability methods. Jordan (1998) refers to these as empirical and non-empirical methods. Rosson and Caroll (2002) give the example of an axe to explain these two methods. How the usability of an axe is evaluated? An empirical method would be to give the axe to an axe man and study him as he uses it. On the other hand, an analytical method would be to study the axe per se, its center of gravity, its steel and so forth.

Empirical methods are said to provide solid facts and are very popular in usability engineering (Rosson and Caroll, 2002). Jordan (1998) lists these methods as: private camera conversations, co-discovery, focus groups, user workshop, think-aloud protocols, incident diaries, feature checklists, logging use, field observation, questionnaire, interviews, valuation method, and controlled experiments. As will be seen in the following sections, these are methods which users themselves are included in the study. Empirical methods are good for eliciting real users' behavior and/or thoughts.

The difference of analytical (non-empirical) usability methods is that they do not include the users in the study. They focus more on the rules and principles, and on the possible causes. For example, by conducting a usability inspection, the analyzer may decide whether the product works in compliance with certain principles and guidelines, and will detect potential problems. To return to the axe example, an

analytical method would find out why the cut is good or bad; that is, is it the steel, is it the center of gravity or something else (Rosson and Caroll, 2002). Rosson and Caroll also remind that the analysis is very much dependent on the analyzers' skills and knowledge.

Rosson and Caroll (2002) argue that conducting a study with real users will reveal what happens actually with real people in real usage. It is necessary to see the cut at first; otherwise it would be irrelevant to make assumptions for the causes of it. Therefore, it can be said that usability problems are better detected by empirical studies and the causes are by non-empirical ones.

The best is to use both of these methods, as each has its advantages in different product development stages. For example, Rosson and Caroll (2002) advise to start with analytical methods in early design phase; pinpoint problematic aspects, and then to focus on these areas by empirical methods. This empirical-analytical cycle may continue until the end of production process.

Jordan (1998) lists non-empirical methods as: task analyses, property checklist, expert appraisals and cognitive walkthrough. A generic name used is heuristic analyses and usability inspections.

A third general classification may be made as formative and summative usability evaluation methods. These terms are used frequently by software usability engineers. Their main aim is to find usability problems and to guide how they can be solved. After the problems are fixed, new evaluations are made and so on. Iterations go on until the production ramp-up. In addition to find and fix cycle, usability priorities are set by formative evaluations (Redish and bias 2002; Rosson and Caroll, 2002; Hartson, et. al., 2001). As the name suggests, formative methods are the ones used in the *forming* of products. Major part of usability evaluation methods are formative. A typical example for these methods is a think-aloud usability test (Rosson and Caroll, 2002; Hartson, et. al.; 2002).

As might be expected, formative evaluations are made in the absence of a finished product, since their aim is to have the major usability problems be detected and solved *before* the final design is reached. This is both the advantage and disadvantage of these methods. Advantage is that, because they are conducted in early stages in development cycle, late (and thus costly) alterations in would-be products are prevented (Rosson and Caroll, 2002). The disadvantage on the other hand, is just the point that formative evaluations are made when the product is at early stages of development (Rohn, et. al., 2002). The "product" at formation is actually a mock-up, a model, or at best, a prototype which represents the future product. This creates concern for the validity of formative evaluations. The causes of detected usability problems cannot be known exactly: is it because there is a wrong design or because users are confronted with an unfinished product? Besides, there is the question of validity of tests conducted in artificial laboratory environments (Rosson and Caroll, 2002). On the other hand, Rohn, et. al. (2002) claim that these methods cannot reveal the actual user tasks let alone user profile and use context. Field studies are used to cover these disadvantages, but of course, they too have their own drawbacks (Rosson and Caroll, 2002). On the whole, formative methods are necessary but not sufficient. Other methods are needed to complement these evaluations (Rohn et. al., 2002).

Those complementary methods are called "summative methods". These are the methods used mostly with finished products. They could be said to be used to give marks to products according to some pre-set (usability) criteria. The criteria are standards that can be measured quantitatively (Redish, et. al., 2002). The standards may be either the ones like ISO; or they may be the ones set by the product development team, for example, user should be able to program the oven in less than 10 actions. In this way, the "efficacy of the final design" is known (Hartson et. al., 2001).

At the same time, summative methods are used to compare product concepts or different design solutions, for example, a mouse or a ball? (Dumas and Redish, 1999). They are also used to determine how close the team has come to its goals and how much resources (time, money, human resources…) are needed further (Rosson and Caroll, 2002).

Another usage of summative methods is to compare the competitors' products (Rosson and Caroll 2002; Redish et. al. 2002; Hartson et. al. 2001). In this way limits for minimum are set for the new product.

Hence, summative methods are used both in the end and throughout the product development process, but they assess results, in contrast to formative methods, which find problems or solutions. The difference is shown in Figure 3.3.

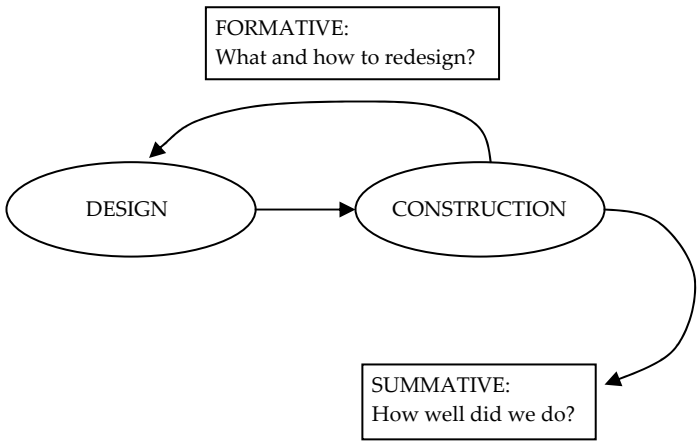


Figure 3.3. Formative and summative methods in development cycle.
Note. Reprinted from *Usability engineering: Scenario based development of human-component interaction* (p. 228), by M. B. Rosson and J. M. Caroll, 2002, San Diego, CA: Academic Press.

The examples for summative usability evaluation methods include usability inspections, participative design, surveys, cognitive walkthrough, storyboarding and so forth (Rohn et. al. 2002).

This is a concise description of methods for integrating users' interests in products. As it is seen, there is no shortage of user centered design methods. On the contrary, overwhelming variety of methods and their application styles may indeed be confusing for making strict classifications. For this matter, the generic new product development process shown by Ulrich and Eppinger (2000) is chosen as a guide, and relevant methods are explained at each development stage. This must be a functional separation, since, Dieli et. al. (1994) comments: "For usability activities to have any impact, it must provide information that is appropriate to the stage of product development." (p. 339).

It should be noted that, some methods are used several times throughout the development process; some are used exclusively in a certain stage. For example, field testing and field inquiry is done both in product planning and quality assurance steps in Microsoft (Dieli et. al., 1994).

3.2 Integrating UCD in product development

How user centered design can be reached in practice? The activities for ensuring usability are explained by Dumas and Redish (1999, p. 8) are as follows:

- Engineer usability into a product through iterative design and development process
- Involve users throughout the process
- Allow usability and users' needs to drive design decisions
- Work in teams that include usability specialists

- Set quantitative usability goals early in the process
- Be committed to make technology work for people
- Test products for usability and use other methods to ensure usability.

Ulrich and Eppinger (2000) model a generic new product development process. Stages of this model are as follows:

PRODUCT PLANNING >> CONCEPT DEVELOPMENT >> SYSTEM LEVEL DESIGN >> DETAIL DESIGN >> TESTING & REFINEMENT >> PRODUCTION RAMP-UP.

3.2.1 Product Planning

It is stated by Dumas and Redish (1999) that "Usability is affected by every decision in design and development, therefore it has to be built from the beginning." (p. 8).

Product planning is the first stage in new product development process; a crucial stage in which *what* to produce is decided. This is usually an area thought to be owned by marketing and top management but user centered design starts form this phase actually, or it should be so (Norman, 1999; Rubin 1994; Bonner, 1998; Kanis, 1999).

There are four categories of a product as defined by Ulrich and Eppinger (2000):

New product group 1: **a**. fundamentally new product.

b. improvement to an existing product.

New product group 2: **a**. new product platform.

b. derivatives of existing platform.

A product is a combination of these two groups. Product platform is defined as a system in which a product operates, for example cellular phones operate in GSM systems. In this case, the creation of the first GSM system was a new product platform. Connecting to internet by a cellular phone is a derivative of this platform, as it uses the present GSM technology. Similarly, cellular phone was a fundamentally new product but cellular phones with colored screens are improvements. A cross combination is Polaroid cameras; they were fundamentally new products. Simultaneously, they utilized an existing platform: they used the same technology with all other conventional cameras.

Whirlpool Company which is a consumer products firm engaged in white goods and selling under several different trademarks in the USA and Europe, can be given as an example from industry. Martel (1998) explains the activities in product planning stage of their firm as given below:

- Initially, what the consumers might need a product to do is found out. (Empirical research).
- Company learns how previous versions are perceived by the consumers. (Summative evaluation, empirical research).
- They decide on how to improve these versions. (Formative evaluation, empirical research).
- Simultaneously, they examine what their competitors are doing, that is they do benchmarking. (Summative evaluation, non-empirical methods).
- They investigate relevant ergonomic guidelines. (non-empirical research).

The activities at this stage are usually field studies. There are many techniques to conduct a field study. The point is that these are empirical studies, which include real users and real context. Field study techniques include surveys, focus groups, observations and interviews, which are frequently used in combination.

The advantage of surveys lies in their capability to reach large samples, so the results are representative, however, they do not provide in-depth information. In addition, the language must be very clear so that everyone understands the same thing (Rubin, 1994). Furthermore, Norman (1999) suggests that when users are asked about the features of a product, they say they want anything and everything. He also claims that users cannot make preferences for future products, they can only comment on existing ones. He adds however that, with observation, an experienced specialist would be able to see which need is necessary and which is not. Such problems are decreased if surveys are prepared through iterations and enough time is spared (Rubin, 1994).

The kind of information elicited by field studies can never be collected with heuristic evaluations or laboratory tests (Rosson and Caroll, 2002). The real context of users gives important information to the designers (Martel 1998). Rosson and Caroll point out that this information is very useful in requirements analysis as well as formative evaluations.

Bevan (1996) states that especially in soft design, the most important factor is to learn the requirements of users (or organizations) and this should be taken in conjunction with the contextual framework (INUSE, 1996). Dumas and Redish (1999) agree with this idea in that user profiles should be known at very early stages of product development. While developing profiles, cultural, physiological and psychological aspects of users should be described (Bonner, 1998). User characteristics, -both potential and actual- should be known (Dumas and Redish, 1999). Ethnographic research gives valuable information about user communities for example, which is useful for the designers' long-term product planning as well (Rosenbaum and Chisnell, 2000). Dumas and Redish (1999) recommend general market research, focus group studies, surveys, contextual interviews and observation of prospective users in order to understand the needs and skills of users.

One method of field study is making ethnographic observations. Jordan (1998) explains what he names as field observation as examination of users in their natural setting while they are using a product. Such methods provide the most natural setting for usability evaluations.

There are many variations of ethnographic observations. The traditional way is to give the product to users and observe them for a long time (for weeks or months) as they use it. In this way, information on product use in context is gathered (Dieli et. al, 1994).

In participatory analysis, people are observed while doing their work and then they come together with researchers/designers and discuss their actions (Rosson and Caroll, 2002). Dieli et. al. (1994) explain a technique called field inquiry, which is used in Microsoft. Observations are made in the real context of users. Here, the focus is not on how users use a product but is on the work and the (work) environment. With this technique, what the product should do and how it should do it is made clearer.

Rosson and Caroll (2002) show some compromising ways: retrospective interview and critical incident technique. In retrospective interview, the users are asked questions about their historical experiences. However, it is known that people "...reconstruct rather than recall experiences..." (Rosson and Caroll, 2002; p.240). Critical incidents are derived form the comments made by users after using a product. Jordan (1998) asks the users to keep critical incident diaries so that during using the product, they can note an incident when it is happened. This method is less dependent on memory than retrospective interviews, thus more reliable. Besides, by this technique, researchers have additional information about what incidents do the users perceive as important (Jordan, 1998; Rosson and Caroll, 2002).

Contextual inquiry is in between these two techniques. Users are simultaneously observed and interviewed when they are using a product in their natural environment (Redish and Dumas, 1999). Rosson and Caroll (2002) point out that, like simple observation, tacit knowledge is captured by contextual inquiry. They claim that sometimes people may not be aware of their actions. The advantage of this technique is that, in contrary to ethnographic research, it is possible to probe questions to users if it is needed. This technique is used iteratively throughout the design process as a supplementary to usability tests (Redish and Dumas, 1999).

Whirlpool Company uses a contextual inquiry to make home observations (Martel, 1998). They watch the users and simultaneously interview them about the situation. In this way, they can reveal "...latent or unconscious needs..." that the users themselves are not aware (Martel, 1998; p. 108). Similarly, Meera, manager for human factors in Compaq indicates that, "When you go into customers' environment, you pick up things people won't tell you in a survey or a focus group." (Roberts 2001, p90). For example, by seeing yellow Post-its, Compaq professionals understood that people need instant access to some information or by seeing a calculator near the computer, they understand that opening the calculator program in the computer is not considered practical (Roberts, 2001).

Every research method has its validity question. Validity of the observations are two-fold: If the users are aware that they are being observed, this creates a slightly artificial situation and naturalness of users' behavior might be affected (Jordan, 1998; Kanis, 1999). In some cases, companies observe users without notification. For example, Kodak observed and took over 500 photos of people while using or carrying their cameras in Walt Disney World and the Niagara Falls. As a result of this survey, they gained useful information about camera grip and carriage. They believe that, in this way they overcame the artificiality of other techniques (Caplan, 1994). Whether their behavior is ethical is doubtful though. On the other hand,

observing real users in real context has lower validity problems in comparison to other empirical findings (Rosson and Caroll, 2002).

In addition to validity, Jordan (1998) points out the problem of noise in field observations; for example a telephone might ring in the middle of a task the user is doing and the researcher cannot understand the efficiency of the product. Besides, because of the noise, the cause of a specific problem in usage cannot be easily determined whether it is the noise or a usability problem. In fact, field studies are not suitable to measure efficiency and effectiveness; these are better studied in controlled environments such as laboratories (Jordan, 1998). Conversely, knowing that the user will be interrupted frequently and has to start the task form the beginning might be crucial information in later efficiency investigations.

Ethnographic observation in field studies are time consuming and costly to conduct. Besides, the data obtained is so rich and multidimensional that analyzing them later on is laborious and hard to interpret (Martel, 1998; Rosenbaum and Chisnell, 2000; Rosson and Caroll, 2002).

For analysis of vast data, it is suggested that the data gathered can be rated according to its severity for product usability. An alternative is to make a content analysis by putting related data into categories, such as problem with buttons, with system layout and so forth (Rosson and Caroll, 2002).

3.2.2 Concept Development

Ulrich and Eppinger (2002) define a concept as description of form, function and features of a will-be product. They lay out the activities in a UCD process as follows: After the decision is made on what to produce, now several concepts are developed for a specific kind of product. Design and marketing departments come

together and apply various methods to find out needs. Customer needs are identified again, but in a more focused sense than the planning stage. For example, focus groups and interviews may be conducted with the designers participation. Of the several concepts generated by design department, one is selected by both the marketing and design departments.

There are many methods used in order to integrate users in the process. Some methods are participatory design (Rubin, 1994, Rohn et. al., 2002; Bonner 1998), focus group research (Dumas and Redish, 1999; Norman, 1999; Jordan 1998; Rubin, 1994), task analysis (Gillan, 1989; Dumas and Redish, 1999) and contextual inquiry (Vredenburg et. al., 2002).

Participatory design is defined by Muller (Rohn et. al. 2002) as:

> A set of methods, practices, theories and action programs…that enfranchise end-users as full and effective participants in the analysis, design and evaluation of products and services that affect their work or personal lives. (p. 893)

In practice, this is done by putting target user(s) in the design team (Rubin, 1994). As a member of team, users also participate actively in the design process. The interaction creates a bridge between the users and designers and the resulting product can fit to -in Norman's words- the mental model of the users (Bonner, 1998; Norman 1999; Rubin, 1994). Rubin (1994) claims that the disadvantage of this is that, in time, users become to think like the designers in the team and are not able to give appropriate feedback. Alternatively, they may hesitate to tell "bad" aspects in the team because of conformity.

Focus group research is popular both by marketers and designers. A discussion leader and optimally 5-6 users come together in a general discussion meeting. In a focus group, people trigger each other, and one subject leads to another, so much more is learned than a one to one interview (Jordan, 1998). In this way, people's

judgments and feeling are explored in depth (Rubin, 1994). Dumas and Redish (1999) argue that focus groups are not appropriate for verifying usability. A focus group is about people; their beliefs and attitudes, not about their actual behavior. What people do and what they say they do are not the same, so a focus group research never reveals actual behavior (Dumas and Redish, 1999; Norman, 1999).

In new product development, focus group is used in every stage, but a good discussion leader is the key point in obtaining useful results. Firs of all, s/he should make sure that there is no dominance in the group and everybody speaks. S/he should lead the discussion well, so that people do not fall into silence nor the talk does not lead to irrelevant points. The reality of the comments made should be evaluated carefully: did people bring up something naturally or did the leader probe a directing question? (Jordan, 1998). Similarly, there is always the doubt whether participants are telling their true feelings, or whether they are trying to be appropriate (Norman, 1998).

Lastly, Norman (1999) claims that it is hard for ordinary users to know what they will think about a non-existent product. They make only guesses unless they actually use it.

Task analysis has had a wide range of usages, since the times of its inventor, F. Taylor. Taylor's time and motion studies established the base for this method (Gillan, 2000). Product development is interested in which tasks the user wants to accomplish with a certain product. In addition, knowing which of these tasks are the most important for user is vital to have a user focused design (Dumas and Redish 1999).

In early development stages, task analysis is made to understand how the users do their work. On the other hand, for later design stages, it is used to see how users relate their work with certain aspects of a product such as menus, switches, dial and so forth (Dumas and Redish 1999).

A less formal tool is storyboarding. Having its origins in the movie industry, it is used to see the flow of interaction with a user interface (Gillan, 1989). In this method, explanations of parts of the product is presented on large sheets and put on the walls of a meeting room. The development team can see many aspects of product at once and discuss them (Barnum, 2002).

Contextual inquiry is explained in field research, in previous section. It is made by various techniques such as interviews, observation, and models created by the research team. According to Vredenburg et. al. (2002), the advantage is that it reveals how users work in their daily life. The main point is, by high interaction between users, designers and researchers, individual differences are minimized and consolidated models of users' needs are reached.

3.2.3 System Level Design and Detail Design

In concept development, most promising concepts are selected. Then the process of refining the selected concepts begin. Ulrich and Eppinger's (2000) model suggests that product architecture is made in system level design. This means that the product is divided into sub-systems and components, geometric layout is decided and specifications of functions of each part are made.

Ulrich and Eppinger (2000) state that detail design stage is the phase where a final concept is selected together with the marketing department. In this stage, the product design is made ready for manufacturing in every aspect: Geometries of parts are completely specified, materials decided, technical drawings for manufacture is completed, even the tools for manufacturing the parts are defined.

The usability assurance methods used in system level and detail design vary according to the type of the product. In addition, when to use these methods are

rather ambiguous, as in these two levels, development activities are sometimes simultaneous and has a transitory character. Therefore, the methods explained are for both of the stages.

The product is increasingly shaping and usability evaluation methods come into scene in these two stages. There is a vast variety of usability evaluations applied; as well as that, they are tailored differently by various firms, research institutes and other stakeholders. This causes difficulties in making clear distinctions between them. The major distinction can be made between user performance evaluations and usability inspections. The primary difference is usability test involve real users, whereas inspections are evaluations made by experts.

There are concerns about the validity of current usability evaluation methods. They are newly evolving and this brings disadvantages. It is claimed that the present methods are misleading (Hartson, et. al, 2001). Wichansky (2000) claims that their validity and reliability is not studied adequately. Bailey (2002) believes discount methods are not research based and thus, they are not valid enough. Hartson et. al (2001) argue that experimental methods used in usability evaluation do not have required power (of statistics).

3.2.3.1 Usability Inspections

Usability inspection is a generic term used to indicate methods where experts "inspect" the usability of a product (Barnum 2002). Heuristic evaluations, cognitive walkthrough, guidelines, usability walkthrough, formal usability inspection, heuristic walkthrough and expert evaluations are variations of inspection (Barnum, 2002; Hartson et. al., 2001). These evaluations are established in the 80s, after the need for feedback on early stages of design, when the designs are not suitable to

show and get feedback from users (Hartson, et.al., 2001). However, new methods enable early user feedback now, as seen in the previous sections.

Some of the inspections are made with reference to design guidelines. These are usually for "soft" parts of interface and define basic principles in how a usable interface should be like, for example the terms should be consistent through out the interface. Bonner (1998) and Dumas and Redish (1999) argue that they are hard to apply to specific designs at hand, as they are too generic. Another argument is that guidelines are based on the individual writers' judgments and not on empirical data (Rohn et. al., 2002).

Cognitive walkthrough is done by experts of human cognition. They evaluate the products to see if they are in compliance with the cognitive processes of users (Barnum, 2002). It is argued that they find false problems and cannot find a portion of the real ones (Redish, et. al., 2002).

Heuristic analysis has its roots in cognitive research (Gillan, 2000). Several evaluators come together and inspect an interface to see to what degree does it comply with usability principles, called heuristics (Vredenburg et. al., 2002). These are cheaper methods than a usability test, that is why they are also called as "discount methods" (Vredenburg et. al., 2002). It is claimed that, heuristic evaluations are good at clarifying usability problems before a test is conducted. More complicated methods (like usability test) can be planned to focus on meaningful issues according to these preliminary findings (Nielsen and Mack, 1994; Rohn et. al., 2002).

Below are examples of heuristics explained by Jordan (1998):

Consistency: The way of doing different tasks with a product should be based on the same principles, they should be similar, so that once the user gets the move, s/he can continue with others.

Compatibility: The product should possess similar attributes with the outside world. For example, if red means *stop!* or *danger!,* then a red light on the product should NOT indicate *go!* The similar the working of a product with the others in the market, the easier will it be to use. This, of course seems to create a controversy for designers, something that tends to limit their creativity. In fact, Jordan argues here that there are many products in the market which needs improvement. It should be noted that basing the working principles of a product on widely recognized patterns is not copying other products.

User resources: The product should be designed in such a way that it shouldn't intrude with the users resources, that is, it should not demand already used "channels" of people. For example, when driving a car, it is not possible to watch television because the driver already uses her/his visual channels. On the contrary, listening to a radio is possible because "audio channels" are not occupied much. Hence, a car stereo system that communicates the user with a visual interface would create safety hazard.

Feedback: The product should acknowledge the user about her/his actions in an appropriate manner.

Error recovery and prevention: Humans do make errors. The point is that there should be an easy way to correct it. Besides, the product should be designed so that it minimizes the probability of making error.

User control: The user should have control over the functions and actions of the product. Certainly, in some cases, some functions are preferred to be preset by the product. For example a word processor having margins set as default, so that every time the user starts a document she/he won't have to set them all from the beginning. However, Jordan reminds that here, the user should be aware of the default settings and be able to change them easily. Jordan gives the example of an

adjustable chair too as a product which enables the users to control their sitting position.

Visual clarity: The interface of the product should be easily understood.

Prioritization of functionality and information: When there are many functions, it is more usable to prioritize the (exposure of) selected functions or information. For example, toolbar of a word processing program makes instant access to most frequently used functions of the product.

Appropriate transfer of technology: A technology developed in an area is frequently adapted to another area, like the Teflon pans. However, it should be a careful act, since every "area" has a different context. Jordan gives the example of window displays of an aircraft. These were usable in aircraft, because the pilot does not rely on what he sees out the window, he looks on the gauges. However, if this display is applied to automobiles, a traffic accident would be more likely instead of enhanced usability. The driver has to look through the windshield to drive: it would distract her/him if for example, the velocity gauge were located on the windshield.

Explicitness: The functions of a product should be recognized easily and it should be clear how it works. Norman calls this as "affordances", and gives the example of some doors: many people cannot understand whether to push or pull the doors of some corporate buildings.

The disadvantage of heuristics is the same with guidelines: "Heuristics are too general to be useful." (Rohn et. al. 2002, p892). Another disadvantage suggested by Bailey is that they find many problems, as well as that, it cannot be understood which of them are important. According to Bailey, 20% of the problems that users encounter are not found by heuristic analyses (Redish et. al., 2002)

When compared with usability tests, heuristic evaluations reveal more problems in number but they are minimal, local problems. Usability tests find out global problems which are related with the system level design. Dumas and Redish (1999) claim that local problems create little inconveniencies unless they are cumulative, however, global problems get in the way of users while they are trying to accomplish tasks. As a result, they advice both inspection and user performance methods.

3.2.3.2 User Performance Evaluation

When user performance is mentioned, the first thing which comes into the mind is usability tests, but there are other methods like verbal protocols, critical incident reporting (explained previously) and user satisfaction ratings (Hartson et. al., 2001) which are also in the scope of user performance evaluation.

Usability testing has become more and more informal since the 80s. Dumas and Redish (1999) believe this to be a consequence of trust in the merits of usability tests. Now the test methods or their results are justified among the stakeholders (Dumas and Redish, 1999).

3.2.3.3. Usability Testing

Rubin (1994) states that, for many years, usability evaluation is actually being done in the market itself with real customers! Today, there is a market demand for more usable products, therefore, firms consider evaluating their products before

releasing them. Usability testing is one of the techniques in user centered design process.

Industry and academy have different interests. Their goals, even if they are about the same subject, are different from each other, as well as the ways and means of achieving these. In contrast to the academy, time, resources and most importantly, the interest in forming and testing hypotheses are usually not present in the industry (Rubin 1994, Norman 1999). The pressure of releasing products as fast as possible forces the firms to skip detailed usability research of products (Norman, 1999).

In these circumstances, according to Wichansky (2000) and Norman (1999), all the corporate executives, developers, regulators and consumers want to learn is; can people use the product and how they like using it. Therefore, in industry, the most valued information is not the "bugs in the product"; the important point is whether the product is usable or not (Wichansky, 2000). Therefore, "quick and clean", reliable, comparable results accompanied with minimum cost is needed (Rubin 1994, Wichansky 2000, Norman 1999). From this point of view, Wichansky (2000) recommends that empirical techniques with users are the most credible methods that could be used in such an environment. As a result, he indicates that, usability testing is one of the preferred usability assessment methods in industry, especially in the sectors of software, computer, communications, media development and consumer products.

Usability testing defined:

Usability testing is an evaluation method, in which a person interacts with a product in a controlled environment with an applied scenario, by doing a goal oriented task. In the end, some behavioral data is extracted (Wichansky, 2000). Aim of the test is to measure specific usability criteria in the interaction of the users and

the product (Rubin, 1994). The distinctive part of usability testing is the inclusion of representative user(s) and the gathering of behavioral data (Rubin 1994, Wichansky 2000). Therefore, Rubin and Wichansky exclude methods such as expert evaluation, walk-through, focus group, competitive analysis and psychological experimentation from usability testing methods- they lack at least one of the elements- the user, task scenario, controlled conditions, or behavioral data.

Usability Testing Types:

Usability test methodology is originated from the classical approach for conducting a controlled experiment (Rubin, 1994). Rubin explains that usability testing may vary from large sampled, complex tests to one-user, informal tests. The choice is done according to the objectives of the testers: whether it is a firm in need of quick results or an academic study which tests a research hypothesis. Resources such as time, money, equipment and know-how are also significant factors.

Rubin (1994) groups usability tests which are conducted in industry into four categories. This grouping is paralleled to the product development life cycle and defined according to their aim:

- Exploratory;
- Assessment;
- Validation;
- Comparative usability tests.

Rubin's model is explained below:

Exploratory tests:

These are done with few participants in the earlier phases of the product development cycle, when there is a concept and barely a mock-up of it. At this stage, usage model (task analysis) and user profile should have been defined. The objective of exploratory usability test is to find out the effectiveness of design concepts with the users' mental model. Therefore, in these test, the focus is on the user rather than the product. Rubin explains the benefits of this type of tests by saying that if the design starts with wrong assumptions about the users, it is almost certain that there will be usability problems. In other words, the whole effort will be worthless even if the product turns out to be perfectly consistent in itself.

The difference between exploratory tests and other usability tests is the interaction of the participant and the test monitor, that is, representative user and person who guides the test, respectively. Participant gets help form the monitoring person or they discuss the problems and so forth. The monitoring person usually asks questions to lead the participant to express his/her thoughts.

In exploratory tests, there is usually a non-working model or a model with limited working parts. In this way, only the necessary features can be tested without giving the time and effort for making a complicated model. The emphasis here is on the high-level concepts as Rubin puts it.

The term exploratory usability test is also used by other researchers as being done after each of several iterative development cycles (Bias and Mayhew, 1994; Nielsen 1993, Rosenbaum and Chisnell, 2000).

Assessment tests:

After high level design is made, this time, the implementation of the concept is tested. The emphasis shifts from users' thought to their actual behavior. Therefore, the monitoring person does not intervene with the participant and lets the user to do the tasks. In exploratory tests, the product model was not complete, so user could only comment on the aspects without being able to use them.

Validation tests:

It is conducted late in the development life cycle, close to release of the product. This time, the objective is to see whether the product meets pre-determined usability criteria. These criteria might be derived from the standards, a competitor product or some historical standard. The advantage of conducting usability test is that they provide historical data so the firms do not repeat the mistakes in every new product (Bevan, 1999). Although the methods are similar to the assessment test, validation tests generate quantitative data, such as time-to-complete rates. This test is closer to scientific research- the results should be consistent and there are fewer places for intuitive results.

In validation tests, all the different parts of the product is now put together and tested simultaneously to see the product as a whole. Especially in software products, the parts are done by different people and tested separately in exploratory and assessment tests. Now all parts, help files, graphical user interface and so forth, are tested simultaneously. Norman (1999) also points out the problems arising from the integration of different parts in a product. He believes that this happens because the design teams do not work in coherence and this is reflected in the resulting product.

Rubin (1994) notes that with the validation test a crucial information is collected: whether there is a probability that the product will be recalled. A late release is undoubtedly preferable to a recall.

Comparison test:

This is rather a separate test than the previous three types. It can be conducted in every stage of product development. The objective is to compare different alternatives of the designs. Usually, the outcome will be a combination of the best parts of the alternatives. Rubin (1994) reminds that the benefit of these tests is that they force the design team to be more creative in order to come up with alternative designs. Besides, users will be clearer in their comments when they are comparing different alternatives.

Sampling:

The number of representative users in a test is usually 5 to 10. There is substantial research on sample size, and they *usually* agree on this number. With each additional user, detected problems reach a saturation point; no new problems are observed after that point. Therefore, the sample size is determined as saturation is reached. In fact, it is claimed that, 5-10 users detect 80% of the usability problems (in interface) provided that the probability of the users detecting usability problems are between 0.32 and 0.42 (Jacobsen, et.al, 1998). ISO 20282 (2003) requires that at in a usability test there should be least 20 representative users from all user groups.

Usability testing: Inadequacies, arguments:

Sole lab tests are not enough: In industry mainly two types of usability programs are used according to Rosenbaum and Chisnell (2000):

- The exploratory usability tests that are used iteratively.
- Heuristic evaluations, design revision and usability test.

The researchers argue that although it is cost-effective to use these methods, the industry limits itself by exclusively making laboratory tests and not using other usability evaluation methods in combination with these tests (Rosenbaum and Chisnell, 2000). Rubin states that testing is not always the best solution: sometimes other techniques such as expert evaluation might be more cost effective (Rubin, 1994). In addition; laboratory testing may lack some crucial information. In order to integrate human factors into product design, stakeholders should have the knowledge of the target user; their environment, their characteristics and so forth (Rosenbaum and Chisnell, 2000). In a study conducted for the evaluation of a clinical information system, Rosenbaum and Chisnell observed the staff while using the system and found out conditions that would not be revealed without seeing the real context of the users. For example, the users were continuously interrupted during usage, they could not have the time to concentrate on the product, and their focus was not on the product but on the patients. Besides, the errors could have fatal effects on patients. In sum, they recommend the combination of several methods, including contextual observations, should be chosen in product usability evaluations. "Testing does not guarantee the product works" (Rubin, 1994, p. 27).

Simulated environment disturbs natural behavior: A usability test, in spite of all the natural settings, is still an artificial situation (Rubin, 1994). Rubin argues that even the field studies can yield different results than real life, this is because a study is not real life, it is a study. Kanis (1999) indicates that when people know they are

observed, there is the "problem of obtrusiveness". Although in different levels, the subjects or the environment can effect the test results.

Problem of recruiting the representative user: Especially in new products, it is generally hard to know the prospective users. Frequently the products are used by others than the targeted consumers (Rubin, 1994). In the case of products that are already in the market, Rubin states that it is not easy to find representative users, even if the researchers happen to be able to define the target market! Jordan (1998) adds the factor of confidentiality - the firms may not be willing to reveal a new product to anybody, so they cannot use representative users.

Evaluator effect: Research findings point out that usability test results are variable according to the skills of the evaluators (Jacobsen, et. al, 1998). It is suggested that utilizing these test result as a basis for future evaluations should be questioned. The research of Jacobsen et. al. suggests that heuristic usability evaluation results differ according to evaluators as follows:

Novice evaluator finds out: 22%

Usability specialist finds out: 41%

Double-expert finds out: 60% of the total usability problems found by sum of all three.

Usability testing: Benefits

A usability test provides data not only for the product on hand, but also for the ones to be created in the future. In this way, repeating the same mistakes will be avoided, in addition, it minimizes the risk of releasing a product with bad usability (Rubin, 1994).

3.2.4 Testing and Refinement

According to Ulrich and Eppinger (2000) model, testing and refinement is the last stage before any changes can be possible. At this stage the prototype is developed and both user and engineering tests are conducted. Ulrich and Eppinger point out that a prototype is anything that resembles one or more aspects of a product, that means it might as well be a foam model to represent the form of the product. However, in this study, prototype is accepted as the last phase of a product, it might not be completely working but all industrial design decisions are made. What is left is related with manufacturing department.

The tests at this stage are more engineering tests, that is, alpha and beta tests. They are mostly related to the technical performance of product. Ulrich and Eppinger (2000) suggest that a beta test includes sending the prototype to customers' own environment and seeing if it fits the customers' needs. However, as it is stated in the previous parts of this study, if the UCD process has been successful, this test must give applause rather than a problem to the product team.

3.2.5 Production Ramp-up

At this stage, the product is started to be manufactured. The passage from ramp-up to full production is usually gradual- somewhere in between; product is launched and wide distribution starts. This is done to educate the workers of the firm (Ulrich and Eppinger, 2000). In some cases, product is sent to specific, known customers and asked them to use it for a while. Rubin (1994) claims that this is an opportunity to see the product's usability as whole; user, environment and product is now incorporated in natural setting. Of course, no changes are possible, but the information gathered can be used in future products. Constituted of observations,

surveys and interviews, these follow-up studies provide valuable information that sales figures can never give. Unfortunately, Rubin (1994) argues that in practice, this valuable knowledge is unstructured and uncontrolled, condemned to be lost.

By the last studies, development cycle is closed and a new product is started, hopefully with cumulated know-how of usability. Figure 3.4 shows the user centered methods used in the relevant stages of product development.

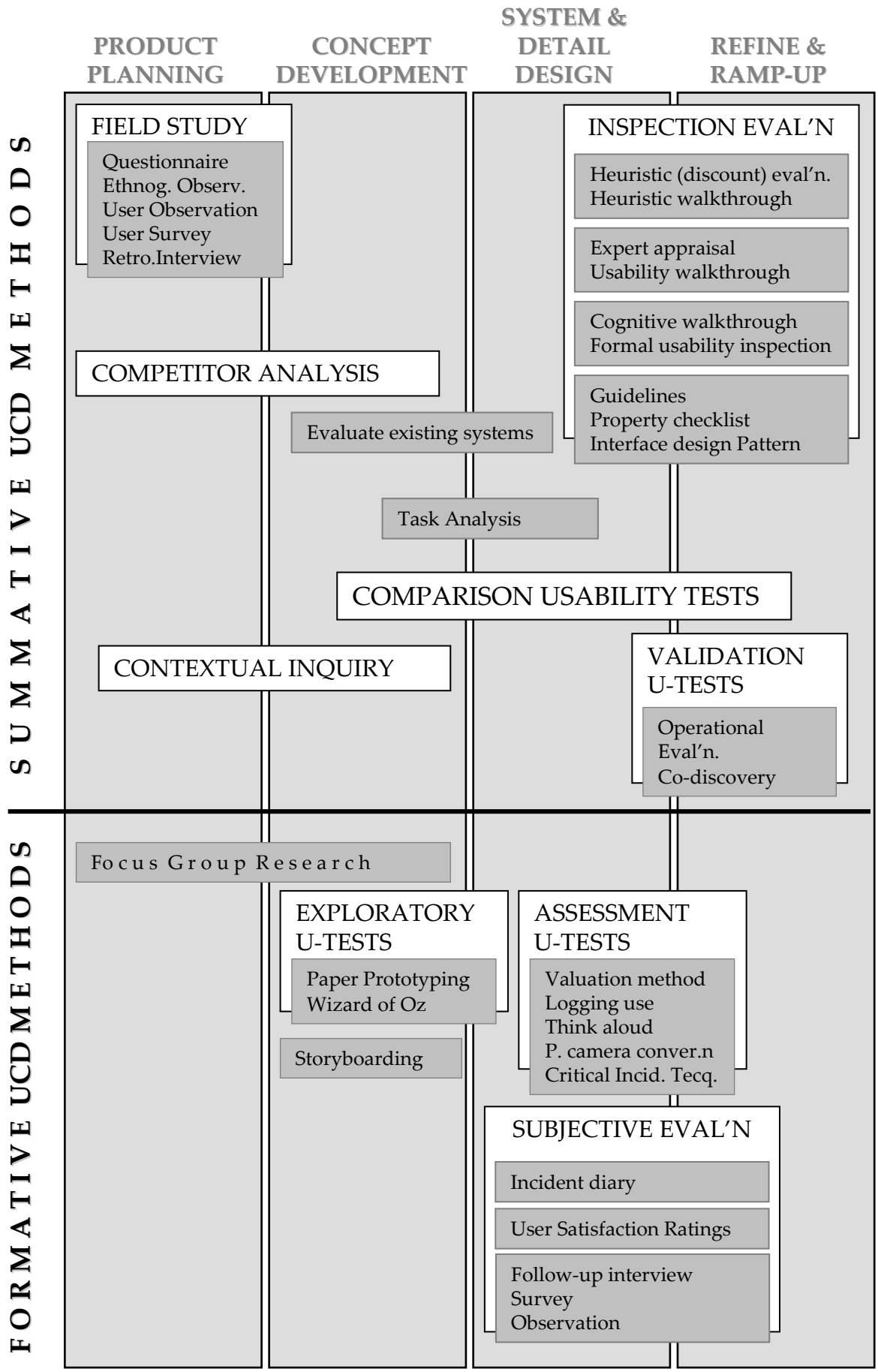


Figure 3.4 UCD Methods

CHAPTER IV

CONTEXTUAL DIFFERENCES

Context is the word used in literature to refer to the big picture in product usage. In this study, for the sake of simplicity, the word *context* is used to cover user characteristics (both psychological and physical), goals they want to achieve, and social and physical environment in which the product is used. Context of use is defined in ISO 9241-11 (1998) as: "Users, tasks, equipment (hardware, software and materials) and the physical and social environment in which a product is used." (Definition 3.5)

User centered design activities are shown in Figure 4.1. This chapter is about the first three steps; identifying a need for design, understanding and specifying the context of use.

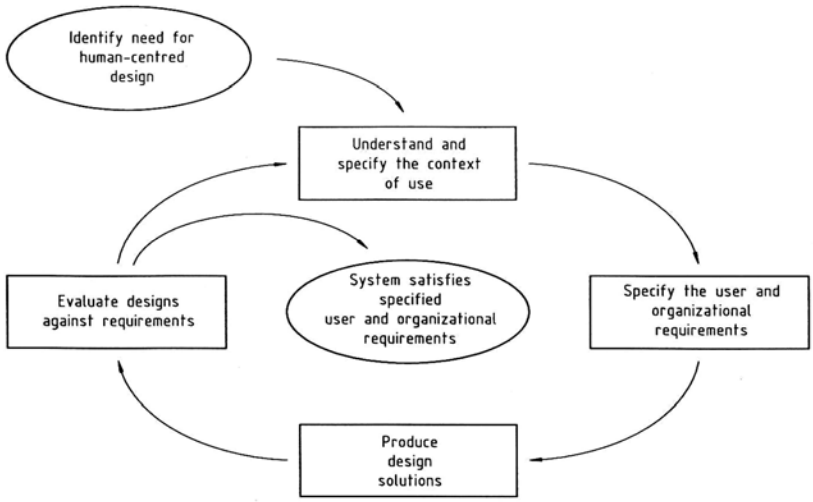


Figure 4.1 User centered design activities.
Note. Reprinted from ISO 13407:1999(E), *Human centered design processes for interactive systems,* Section 7: User centered design activities

It is interesting however; that the vital stage of a usable product development is when there is no product at all yet. In a user centered approach this is the critical moment just before a product idea is generated. Then the development process takes full speed by creation of several concepts based on that first spark. The (usability) success of the resulting product depends largely on how appropriate was the idea and how realistic were the concepts in terms of real life conditions. This duality in usability is put forth like a riddle by Wilson (2002) as:

Usability: building the right product.
Usability: building the product right. (p. 28)

Building the right product is the first half of the job. Building that product as usable as possible is the second half. In user centered design processes, product planning and concept development are the two critical stages on which the success of the product depends. Normally, design team is given information (usually by marketing department or top management) about what is needed (Ulrich and Eppinger, 2000).

According to Ulrich and Eppinger (2000) model, product planning and concept development are done with collaboration of marketing and design departments, or the development team is backed up by marketing and design knowledge. In product planning, some marketing opportunities are discovered and market segments are defined by marketing department (Ulrich and Eppinger, 2000). Marketing is thought to be about selling. However, the rising priority of user/consumer/customer satisfaction in the world changed the culture of firms. The concepts like total quality management, user centered design and marketing (rather than sales) are all linked to this trend.

Kottler (2000) indicates that today, marketers consider themselves as the agent which understands needs, wants and demands of users. He claims that selling is just the tip of the iceberg, "the aim of marketing is to know and understand the customer so well that the product fits him and sells itself." (p. 8). Therefore, in a generic production process, what the designers shall design is a decision made by the marketers.

Furthermore, marketer's role continue in concept development. In the concept stage, marketing collects customer needs, identify lead users and identify competitive products (Ulrich and Eppinger, 2000). American Marketing Association has a parallel definition for marketing: "Marketing is the process of

planning and executing the *conception*, pricing, promotion and distribution of ideas, goods, and services to create exchanges that satisfy individual and organizational goals." (Kotler, 2000, p. 8). Ulrich and Eppinger (2000) claim that marketing develop plans for product options and extended product family in system level product development stage. Kotler (2000) points out that marketers decide what product features are going to be designed into a new product.

What do the designers do then? Do they give forms to marketers' designs? Probably not. Beyer and Holtzblatt (1998) explain that marketing and design build on each other. There is a flow of knowledge from marketing to design, design is based on the information provided by marketing. Contextual information begins from marketing information. Marketers have many ways to frame *markets*, in other words, define the contextual factors that are believed to be effective in product use (and purchase). However, the 'contextual factors' defined by marketers are different from that of product developers.

Marketing provides 'what kind of a thing' will be produced for a certain market segment (Kotler 2000, Beyer and Holtzblatt, 1998). On the other hand, knowing *what kind of a thing* is to be produced is not the same as knowing *exactly what* will be produced (Beyer and Holtzblatt, 1998). Knowing the users, their environment, and their goals of usage has critical importance, since almost this knowledge defines what to produce in the first place during product planning. This contextual information is also crucial in succeeding stages, as seen in Chapter 3. Therefore, it is important that there is a fluent flow from marketing information to design information. Early decisions in product development should be based on detailed information about the context and future usability evaluations should be based on usability specifications derived from contextual information (INUSE, 1996).

It would be more efficient if the designer knew what the design priorities should be in a market segment which is targeted by the product development project.

What kind of *users* are there in specified lifestyles, sub-cultures, socio-economic groups, psychographic groups and other definitions used by marketing people? What are the factors that would be important in usability of products among these 'markets'?

This chapter focuses on contextual factors in usability and how these factors combine in real life.

4.1. Contextual Factors in Usability

Intensive research is being done to classify contextual factors so that unexpected situations can be avoided. Contextual factors are put in standards basing on the fact that usage is not isolated from context (Jordan, 1998). New ISO drafts for contextual issues are created as the research goes on.

ISO 13407 provides guidance on user needs and requirements (Maguire and Bevan, 2002). Similarly, ISO 20282 provides guidance for contextual issues in product usage of everyday products (ISO 20282 draft, 2003). In ISO 20282, usability in first use of everyday products is given much importance and is called as *ease of operation*. First use is especially important in public products, such as ticket wending machines or ATMs.

By everyday products, consumer products or equipments are meant, products which are used by general public and professional usage are excluded. The goal is defined as an intended outcome and task is the activities to achieve a goal (ISO 20282 draft, 2003).

It has been mentioned that "context" in this study refers to user characteristics, use environment and user goals. The following is a more detailed explanation of these components of context. Context as has been mentioned, is taken to be formed of three main areas: user characteristics use environment and user goals (tasks).

a. User characteristics:

Maguire (1997) lists user characteristics as knowledge, skill, experience, education, training (about product's usage), physical attributes of user, habits, motor and sensory abilities.

Jordan (1998) has a similar user characteristics list that influences usability as follows: experience, domain knowledge, cultural background, disability, age and gender. Recognizing the domain knowledge of users and designing accordingly is a factor that increases usability, for example, spreadsheet users and non-users: The product should not bore an experienced user but a novice user should be able to use it too. Cultural background of users is important for body dimensions, or conventions, for example switches are reverse in UK. Jordan (1998) indicates that some of the products used frequently, such as remote controls and ballpoint pens, were in fact designed for disabled users. Age becomes an important characteristic especially in high technology products. He also claimes that gender, apart from body dimensions and strength, is influential in preferences, for example, men generally love using technological products.

Thomas and Bevan (1996) point out that motivation in usage is important, that is whether the user has positive or negative attitudes towards the product. They suggest attitudes of users cover their attitudes towards the job in question or the tasks as well as towards the product.

Thomas and Bevan (1996) consider experience in both the usage of product and of other products which have similar main functions. Bevan (1995) adds that

experience in doing a certain task is also of interest. Jordan (1998) points out a dilemma here: if new products are designed so that users utilize their experience with conventional products for using new ones, then how can the innovations be made? He offers that there is abundance of unusable products in the market, these should be changed. On the other hand, correct experience gained by usable ones should be continued in new products. Consistency of ways in achieving the tasks within a single product is also a benefit for usability- this creates an experience in itself (Jordan, 1998).

Thomas and Bevan (1996) details skills and knowledge that affect usability as qualifications, relevant skills to use a product, linguistic ability and background knowledge. Qualifications may include degree or apprenticeship needed to be able to use a product. Relevant skills are the ones that are needed to use a product, such as typing skills. Background knowledge is the knowledge that is not directly related with product's usage but it is knowledge about general issues that affect work. These issues include social, organizational or regional issues, for example maintenance calls are taken until 1800hrs.

Thomas and Bevan (1996) recommend that, apart from the target users, a secondary user group who has interaction with the product should be defined. This is parallel to ISO 13407, in which it is reminded that different types of users should be defined too. These may be people with different roles like maintainers, installers, etc (ISO 13407, 1999). In household products, children can be said to form a secondary user group, even if the product is not targeted for their usage. A third group to be considered are people who are not normal users but still affected by the product's output. These people are the ones who use the output of the product as an input for their own work (Thomas and Bevan, 1996).

b. Environment of use:

Bonner (1998) divides environment into two as physiological and psychological environments. Physiological environmental factors are the ones like noise, illumination, climate and motion (e.g. in a car). Bevan (1995) adds workplace design (space and furniture, user posture, location) and workplace safety concerns (protective clothing, health hazards) to these factors. Psychological environment consists of stress, social interaction and mental workload (Bonner 1998). Social and cultural environment should be taken into account as work practices, attitudes and organizational structure (INUSE, 1996 ; ISO 13407,1999).

c. User goals and tasks:

User goals and tasks are defined in ISO 13407 as the tasks the users are to perform. The definition is as follows (ISO 13407:1999):

> …overall goals of use of the system. The characteristics of tasks that can influence usability should be described e.g. the frequency and the duration of performance. If there are implications for health and safety, e.g. controlling the behavior of a computer-controlled production machine…. The description should include the allocation of activities and operational steps between the human and technological resources. Tasks should not be described solely in terms of the functions or features provided by a product or system. (Definition 7.2.1).

Bevan (1995) explains that the risks resulting from error should be taken into account when investigating or analyzing tasks. He indicates that flexibility of tasks is also important in usability.

Apart from structuring the context, standards have further recommendations to be considered during design and development. These are given below according to ISO 20282 (draft, 2003):

- Obviousness of main goals of product
- Other equipment's influence on usage of product
- Relevant environmental factors (space, sunlight, temperature...)
- Privacy vs. social environment factors (here social environment means the presence of other people during usage, and the stressful situations)
- Influence of knowledge and experience on ease of use (high levels of education should not be relied on because under stress, it is seen that everybody may revert to old (pre-education) patterns of behavior)
- Cognitive abilities (e.g. interface should avoid need for memorizing data)
- Cultural differences
- Literacy (low level of reading ability is important as users may find it difficult to understand the instructions. Here pictograms may be helpful. It is said that for highly literate users, characters are more helpful than pictograms)
- Handedness
- Body dimensions
- Strength and bio-mechanical abilities
- Visual and auditory abilities
- Age and gender

Suri (2000), suggests that products have become more complex, although they aim to fit all kinds of people leading different lives. She indicates that technology has entered work, home and play. Even simple consumer products like radios or ovens have now many functions. In contrast, less users have any expertise in technology now, therefore it becomes more important to keep the products' usage easy for every user type (Honold, 2000).

Bonner (1998) state that every user has his own experience, so designers should consider differences in user-product interactions. Product design should consider diverse populations, which might be both from different cultures and different socio-economic levels.

The differences in contextual factors are the concern of product developers as well as marketers. Contextual factors are important for marketers in defining and understanding sub cultures, status groups or lifestyle. These areas were formerly only the concern of marketers and sociologists.

4.2 Contextual Factors in Market Definition

Firms define customer groups to increase their precision in what to produce, whom to produce and when to produce. In marketing jargon, this is called *market segmentation*. There are many ways of segmenting consumers; in addition, they are usually used in combination with each other. Kotler (2000) designates the main variables in market segmentation for consumer products as geographic, demographic, psychographic and behavioral. Table 4.1 gives a summary of these consumer market segments:

Table 4.1. Market segmentation variables. *Note*. Reprinted from *Marketing management* (p.264) by P. Kotler, 2000, New Jersey: Prentice Hall.

Geographic	Region, City size, Density (urban-rural), Climate.
Demographic	Age, gender, Family size, Family life cycle (young single, married, empty nesters…), Income, Occupation, Education, Religion, race, Generation (baby boomers, generation x…), Nationality, Social class.
Psychographic	Lifestyle (yuppies, longhairs…), Personality (ambitious, authoritarian…)
Behavioral	Occasions (special occasion, everyday), Benefits (quality, low fat…), User status (first-time user, non-user…), Usage rate, Loyalty status, Readiness (unaware, informed…), Attitude toward product (indifferent, positive…).

Using socio-economic levels to define user groups might as well serve as a realistic combination of contextual usability factors. A classification widely used by sociologists and economists, if applied to usability as well, would make life easier for contextual researchers. There is plenty of (what Bevan calls as*) secondary information* about these groups. How they live, what they like, their attitudes towards certain products are already known. For example, Sincovics et.al. (1991) suggests that, in technological products, success of market introduction is influenced by demographic variables (income, education, living standards).

4.2.1 Socio-economic level defined

Socio-economic level is also referred as social stratification (according to Weber) or as social class (Marx) (Solomon, 1999). There are many theories about differences in a society made by many theorists like Marx, Weber, Olin, Goldthorbe (Giddens, 2001). However, for the aims of this study, socio-economic level is used as a more general term, to indicate the division in the society between the "haves" and "have-nots" as Solomon (1999) puts it.

Solomon (1999) suggests that every society in the world has some type of stratification, a hierarchy between its members, even officially classless societies like former USSR or China. The relative standing of the members in the hierarchies defines their access to resources such as education, housing and consumer goods.

As well as access to resources, socio-economic level show itself in consumption and lifestyle (Giddens, 2001). People from the same levels "...work in similar occupations, they tend to have similar lifestyles by virtue of their income levels and common tastes. These people tend to socialize with one another and share

similar ideas and values regarding the way life should be lived." (Solomon 1999, p.410) Class is also what one does with one's money (Solomon, 1999).

Solomon (1999) claims that "a major motivation for the purchase and display of products are not to enjoy them. They are to let others know that we can afford them." (p. 419). Equally, satisfaction is a relative concept. Solomon (1999) points out that occupation serves as a status identifier as well: Turkey, Japan and Brazil share similar hierarchy of occupational prestige: Chief Executive Officer CEO, physician, college professor at the top; shoeshiner, ditchdigger, garbage collector at the bottom.

Measurement of socio-economic level is not easy. There are several factors that comprise level, but these may come in different combinations. For example, a high income 'higher s-e level' person may be a high school graduate, which implies a 'lower s-e level'. Besides, society has a dynamic character, measurements done in the past become invalid as values and economic structures change in time. There is also social mobility; someone whose family was from lower level may climb up in the social ladder to an upper level. In any case, marketers use two main measures; one developed for USA, the other for UK.

In the USA, a general structure is defined as (Kotler, 2000):

1. Upper upper
2. Lower upper
3. Upper middle
4. Middle
5. Working class
6. Upper lower
7. Lower lower.

Its UK version is: A, B, C1, C2, D, E.

According to a large market research company, Market & Opinion Research International (MORI, 2003), the definition of each of the letters are as follows:

A Professionals such as doctors, surgeons, solicitors or dentists; chartered people like architects; fully qualified people with a large degree of responsibility such as senior editors, senior civil servants, town clerks, senior business executives and managers, and high ranking grades of the Services.

B People with very responsible jobs such as university lecturers, heads of local government departments, middle management in business, qualified scientists, bank managers, police inspectors, and upper grades of the Services.

C1 All others doing non-manual jobs; nurses, technicians, pharmacists, salesmen, publicans, people in clerical positions, police sergeants/constables, and middle ranks of the Services.

C2 Skilled manual workers/craftsmen who have served apprenticeships; foremen, manual workers with special qualifications such as long distance lorry drivers, security officers, and lower grades of Services.

D Semi-skilled and unskilled manual workers, including labourers and mates of occupations in the C2 grade and people serving apprenticeships; machine minders, farm labourers, bus and railway conductors, laboratory assistants, postmen, door-to-door and van salesmen.

E Those on lowest levels of subsistence including pensioners, casual workers, and others with minimum levels of income.

The first three groups, A B C1s, are usually grouped under the heading "middle class" and the remainders, C2 D Es, are grouped as "working class".

There is research about the context in which these people experience product usage as well. There is a correlation between socio-economic level and certain consequences of product usage: accidents. Whether there is a correlation between usability problems and socio-economic level is not known, but based on this ground, seems highly possible.

4.2.2 Accidents versus Socio-economic level

Accidents are very much related with the contextual factors. For example, people under stress are more likely to have an accident because they "...tend to revert to stereotypical behavior." (Bonner, 1998; p. 250). He defines “a user in transitory state” (p. 250) as someone who is tired, fatigued or under influence of alcohol or drugs.

Sometimes, contextual factors can be a continuation of socio-economic level. The accidents resulting with death are seen more in low socio-economic user groups (DTI, 1999b). According to United States Statistics Institute, the probability of death from fires is 16 times higher in children from low socio economic level households (DTI 1999a). Similarly, people from C2, D and E consumer groups have 50% more burn and scald accidents than people in A, B and C1 (DTI, n.d.).

The reason behind the factors that increase the probability of accidents are also the ones related with use context, which are: Quality of housing, job type, lack of knowledge, inadequate education, different language and cultures, social isolation, poverty.

Similarly, the reasons for high probability of accidents in low socio-economic level households are as follows:

Usage of unsafe, lower quality products, inadequate infrastructure, higher population per meter square, inadequate supervision of children, inadequate financial resources to buy safer products for same goals (e.g. cannot but fryer, use frying pan instead; cannot buy cooker, use LPG burner) (DTI, n.d., p. 130).

It is noted in DTI (1999b) and in DTI (n.d.) that these conditions are neither extreme, nor seen occasionally. Products should not be designed exclusively for

large spaces and comfortable environments and nor for healthy people or well supervised children. The context that the users are in should be learned and designs should be made accordingly.

Socio-economic level has impacts on use environment of products, especially on the physical aspects mentioned in previous sections. It is also related with the education of users, which, as mentioned before, effects usability of products, or at least, perceived usability of products. Some other user characteristics may be resulting from socio-economic conditions, like attitudes and behaviors towards products.

Defining user groups or user profiles is strongly recommended in user centered design. When users are defined properly, it is easier to reach a structured, clean knowledge about them. This opens the door to more valid design input. For example, Vredenburg, et. al. (2002) categorizes potential users into user profiles:

> User profiles are detailed descriptions of the relevant characteristics of each user category. Characteristics include descriptions of users' prior knowledge and experience, physical characteristics, social and physical environment; jobs, tasks and requirements and cognitive characteristics. User profiles classify different types of users who will use the offering. (p. 132)

Common Industry Format for Usability Requirements (Bevan, 2003) suggests a definition of "user groups" in addition to individual users. User group is defined as follows:

> Subset of intended users that are differentiated from other intended users by factors such as age, culture, knowledge, skill, expertise, role or responsibility that is likely to influence usability.

Note: this may include current users, potential users, disabled users, expected future users, users of the task output and staff who support and maintain the product. (Definition 4.7)

ISO 20282 requires that knowledge about all potential user groups be considered in design. If there is inadequate information, investigations should be carried out to find any user characteristics that might be relevant to the usability of a product.

Intersection of contextual factors from the point of human factors with "holistic" concerns of designers may be giving birth to new combinations. Lifestyle and preferences of users are related to socio-economic level of users. (See Figure 4.2).

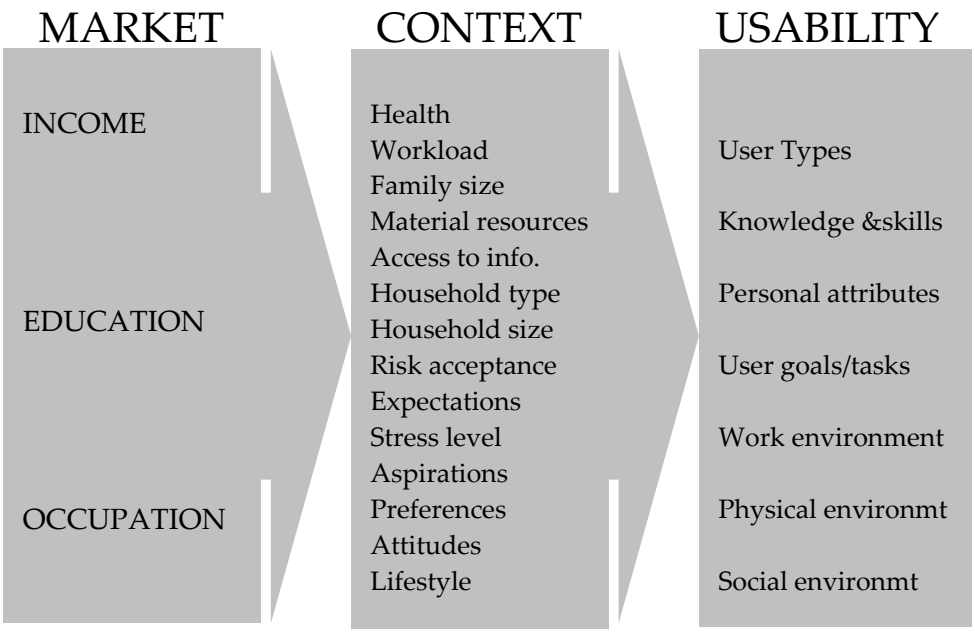


Figure 4.2 Transition from market characteristics to usability.

As a result, market segmentations can be used to establish a framework for specifications needed by designers and usability specialists. There are studies in literature which connects cultural factors with usability, however, connections between sub-user-groups in a country could not be found by the author.

4.3 Methods of Gathering Contextual Information

Identifying needs is not easy. Norman (1999) indicates that although what to produce is the most important decision, it is decided quickly and is not based on real world needs. When the designer is from the same community as the consumer, identifying exactly what is needed is not a problem. Beyer and Holtzblatt (1998) gives the example of the inventor of an accounting spreadsheet program: He did not have to bother about what is needed, because he was himself was once an accountant and his own experience told him what was needed, where was it needed and how was it needed. In this case, the designer shared the same characteristics as the user and there was no problem. Especially in consumer goods, this is just the opposite: designer is not the least like the users of the product.

Traditionally, designers came together and tried to make decisions by discussing among themselves or making guesses, without the real user data. This of course is not helpful, besides, much time was lost during discussions (Beyer and Holtzblatt, 1998). McLeod (1994) points out that one of the mistakes made in the 80s was employing inappropriate users to test the products. In addition to that, testing tasks were representing goals other than actual ones. These mistakes happen because of the lack of real world information. Usability evaluations cannot be done correctly, if no one knows what to evaluate.

Maguire and Bevan (2002) suggest the use of secondary market research as a supportive technique for gaining contextual information; research of published data (research reports, census data or demographic information) may throw light on certain markets and user groups in these markets. It is recommended in INUSE (1996) that before going into the field for contextual information, a meeting should be made with the participation of all stakeholders like marketing, engineering, human factors, development team and so forth. In this meeting, a definition should be reached about the different aspects of the context that the project aims to operate (INUSE, 1996). Similarly, Thomas and Bevan (1996) recommends stakeholder meeting to define user types, like for example, frequent user, occasional user. Other methods for understanding context of use are task analysis, pictures (sketch user actions), diary keeping, video recording of users on job, and other observational methods (Maguire and Bevan, 2002).

Rosenbaum and Chisnell (2000) claim that a combination of methods works better in contextual research rather than relying on just one. Beyer and Holtzblatt (1998) have developed a method which is a combination of major field study tools: observation, interview, think-aloud, incident diary (kept by the researcher if preferred) and video capturing. The findings are discussed afterwards by the stakeholders (both users and company members) to clear any misunderstanding.

4.3.1 Observational methods

Beyer and Holtzblatt (1998) argue that even the customers themselves cannot usually tell what they want exactly. They just know that they need something but they lack the understanding necessary in providing design information to the development team. It is the designers' job to discover details of the need in cooperation with the user. Beyer and Holtzblatt give an example from everyday life: Karen Holtzblatt would like a window to be constructed to her den. There are

many types of windows. The staff of the building company comes and talks to her, try to learn which window system is the best solution. They realize that, she needs more light into the den rather than a traditional window, through which she will watch the street or people on the street will be able to see the room. The builders gave the best solution after the context of the need for 'window' became clear.

A striking case about building wrong products is explained by Green and Klein (1999). They were to improve a product, "Keg Buggy", designed to carry beer tanks from the trucks into the bar cellars. It was a hand truck with a hook to attach the tanks. A good deal of time and money had already been spent in the development phase. The design team went to the field to see how the workers used the present product; they made user-trials with them. They continued contextual examinations by interviewing stakeholders, namely, workers, bar owners and beer companies. Questionnaires were given to workers from different companies to get retrospective data about accidents and their satisfaction with the usage. Finally, watching and talking to workers and capturing how they carry the beer tanks, to which places, etc. proved to be helpful in gathering contextual information. They realized that "the problems the product was supposed to solve were of quite a different nature than had always been presumed…(and) Keg Buggy was a solution to a non-existent problem" (Green and Klein 1999, p. 92, 101). "Keg Buggy" had to be thrown out and a new project was begun to satisfy the real needs.

When big corporations are concerned, Salasso et. al. (1994) claims that usability practitioners are creating the bridge between users and designers: They learn as much as they can; the jargon, the issues, needs and constraints. In this way, right questions may be asked and thus the right products may be created.

Importance of contextual factors still continue in concept development since, usable products are the result of an understanding of the larger picture. Jordan (1998) states that major importance in product usage should be who is using, what

his goal is and where he is using a product. In other words; “usability is affected not only by (a product’s) features but also by the characteristics of users, tasks they carry out and the environment in which the product is used.” (Thomas and Bevan, 1996; p. 1). It is suggested in INUSE (1996) that these variables affect the quality of use, as well as user health and safety.

Users are different than designers, that is, if a designer thinks a product is usable, it might not be applicable for real users out there in the world (Beyer and Holtzblatt, 1998). Laboratory tests do not always reveal usability problems that are result of contextual factors.

Rosenbaum and Chisnell (2000) give the example of a clinical information system for the hospitals. Although the new design was thought to be more usable, the hospital staff was conservative about any changes to information systems. The design team went to hospitals to see how doctors and other staff used their information systems. They saw how fast everything should be going, how everybody worked under stress and that they did not have a second to occupy themselves with the system, their attention was on the patients and medical emergencies. Usability tests were done in the hospital. Rosenbaum and Chisnell (2000) believe that, if the usability tests had been done traditionally (in a controlled environment) results would be misleading. In contrast, under the pressures of the hospital context, users were not able to do the tasks as easy as they would do in traditional usability tests. Therefore, usability is not a bunch of problems isolated from the background -they happen in situations where people “...live, work and play...” (Wilson, 2002; p. 28).

Brown and Perry (2000) claim that lab evaluations assume that users will behave according to generally accepted rules and in expected patterns. For example, a rule for phone is "when a phone rings, answer it". However, it is seen in real work environment that users do not always choose to answer it; furthermore, they may

not choose to be in a position of not answering. Brown and Perry observed that users have developed some Indian-like communications: in a company, office clerks did not answer phones when they have a more important job at hand. When it rang for a second time immediately after the first, this meant that the call was urgent and the clerk picked up the phone. People adapt to their situation and environment and can deviate from generally accepted rules. This situation can never be observed in a controlled usability test. When observed in real context, design for unanticipated use can be made (Brown and Perry, 2000). Unanticipated usage is an important factor in safety of products as well, because many accidents happen because of them (DTI, 1999b).

Contextual research in the users' own environment also serves to understand usability from the point of users themselves, along with the conditions in which interaction with a product takes place (Wilson, 2002). For example, Weimer (1995) suggests that a product's compatibility with other tools (or even the desk it is placed on) may be a big issue in usability.

Moore (1999) tells a case about the development of a radio production workstation. The general view was to put a mouse, keyboard and graphic display to the workstation in order to make it more usable. This was the ongoing convention among all the producers. The writer's team took another way and visited radios, watched and talked to them while they were preparing broadcasting spots. This is how Moore (1999) explains what he saw:

> …these people were under so much time pressure that they worked quickly and instinctively, despite using what we regarded as older and cruder tools...the energetic ways that they moved while working: rolling around from one machine to another on chairs with castors, jabbing buttons, grasping tape reels, and manipulating multiple faders. These visits led us to abandon a mouse and graphic screen as the primary interface we took what had been an optional dedicated work surface and made it a mandatory part of the system. I just couldn't imagine confining

> these production engineers behind a mouse, keyboard and graphics display…

Contextual research aims to understand the users' way of thinking and doing work in order to fit products to their way (Beyer and Holtzblatt, 1998). It should be noted that a complete fit to users' way of working may this time be a decrease in the utility of machines; machines automize tasks and increase efficiency. There should be a compromise between the users' way and machine's way of doing things. Beyer and Holtzblatt (1998) recommend a gradual shift from traditional ways to automated ways by giving the example of word processors: First there were typewriters. The first word processors were like typewriters, then cut and paste function was added which was also a task people did by hand. Now they say, word processors are far from resemblance to typewriters but they are easy to use because the need for changes in working ways happened in time. Numerous examples to similar cases can be given. It should be noted that being able to see design input from context is another issue per se (Beyer and Holtzblatt, 1998).

In industry, contextual analysis is not always clean cut, sometimes because of the speed of the development cycles, there is not much time to go and analyze user needs (Maguire and Bevan 2002). Beyer and Holtzblatt (1998) recommend storage of information as a solution. The information gathered will be used not just in the ongoing project but also stored to be used for future projects too. When the methods are applied properly, Beyer and Holtzblatt claim that development process including contextual research will be true and in optimum times, no delay in the projects will happen. They also claim that things will even move faster since real information takes place of long discussions and guesses about what is suitable for users.

4.3.2 Contextual inquiry

This method integrates many field study techniques such as interview, observation, video recording, etc. Beyer and Holtzblatt (1998) claim that this method is for finding new paths for design rather than iterating existing systems.

In contextual inquiry, researcher(s) go to users' natural context and watch them while they are doing their work and talk about it, ask questions when they need. Instead of creating an atmosphere of a researcher-interviewer encounter, they prefer to see the user as master and themselves as apprentices who try to learn a craft. In this way, Beyer and Holtzblatt (1998) believe that tension is decreased and users behave more natural. Users explain what they do now and then, but they do not have to make think-aloud all the time, so their attention is not disturbed. When they explain something, researchers understand that it is important for them. Everything happens in front of the researchers, this prevents the forgotten facts or generalization of problems, which are problems in diary keeping methods.

Beyer and Holtzblatt (1998) suggest that the advantage of this method is to reveal unarticulated needs or aspects of work. They believe they can observe habitual actions or invisible aspects of work by contextual inquiry. Focus groups and surveys cannot do this because people are usually not aware of their actions when they are doing a habitual work. 'How can you explain driving?' is the question they ask to explain the underlying assumptions. A driver cannot explain when to give the signal, when to start rotating the turning wheel and how much, exactly when to slow down, when to change gear etc. They believe that all these cannot be explained properly by the driver, unless there is someone asking questions in the next seat. Focus group research and surveys are asking drivers to explain driving after they get off the car. Furthermore, Kanis (1999) warns about the problem of social desirability and says that the best is to observe use-actions.

Contextual inquiry is an open-ended, qualitative approach (Beyer and Holtzblatt, 1998). This method goes in line with many writers in literature. For example Norman (1999) recommends that developers should observe and work with users. Kanis (1999) reminds that there is always some level of bias in observational research; the point is to decrease this as possible.

Kanis (1999) defends qualitative research by saying that such exploratory studies are important as they solve problems. He adds that to conduct a quantitative research, one should know what to quantify. Qualitative research gives the theoretical knowledge to serve as a base to quantitative measures.

When there is user data, it is also important to use it in a right way: to take general design tips from a few users, for example, bears the generalization problem (Kanis 1999, Beyer and Holtzblatt 1998). Suri (2000) believes that, seeing the extreme cases would help designers to overcome their stereotypes of users as "eccentric human behavior is not discontinuous with 'normal' behavior" (p. 898). Furthermore, generalizations should always be avoided in qualitative research (Kanis, 1999). In contextual studies, Thomas and Bevan (1996) recommend analyzing minimum 10 users from each group for statistical reliability. Kanis states that small samples are enough in qualitative research as the aim is to find problems, not to understand in what ratio they are seen in the population. Therefore, research is conducted until the chance of seeing a new finding decreases to a certain level.

How socio-economic factors influence usability? How these consumer groups can be represented in usability evaluations still remains a question. What are the priorities of the factors that influence usability in socio-economic level of users are needed to be investigated. For this reason, a case study is planned to examine these issues.

CHAPTER V

FIELD STUDY:
SOCIO ECONOMIC FACTORS IN USABILITY OF WASHING MACHINES

User centered design requires that product development process is based on real life context. For this purpose, questions like the following need to be answered: What do the prospective users need? How do they need it? Where are they going to use a product? How are they going to use it? For which purposes they use it? In the industries, such information is supplied by the collaboration of marketing and design departments (Ulrich and Eppinger, 2000). Marketing research provides general and quantitative information and design research provides detailed information (Beyer and Holtzblatt, 1998). Marketing is related with how people *buy*, rather than how people *use a product*. Design information complements marketing information by exploring how people use products. Both are interested in user satisfaction in the products. However, marketing focuses on how a product compares to others, that is, the competitors' similar products or products that serve the same need (Kotler, 2000). E.g. both an automobile and a train serve the need for

transportation. On the other hand, design is focused on satisfaction within a product, rather than between different products.

The information provided for each discipline is essential for usability. Establishing the connection between marketing and design seems to be beneficial for understanding the users and thus, creating better products. Usability is a context dependent factor; therefore the user characteristics, their goals and use environment should be major inputs in the design of consumer products. Besides, the context is framed mainly by the market information because of the prevalent design methods in the firms. A target market, that is, a definition of the consumer groups, frames a new product project initially (Kotler, 2000). Secondly, development team examines the context of people in a specified market segment (Beyer and Holtzblatt, 1998). Contextual information is important as the design is built on it. There is no data found in literature that reveals contextual factors critical for usability for specific market segments. Although possible contextual factors on usability are independently defined (ISO 20282 draft, Maguire 1997), they are not examined with respect to certain market segments, which act as the primary source of product development decisions in the industry. In practice, this means that, with every new project, the firm has to start a contextual research from scratch. In addition, deciding on what to search is another research per se. The design team has to extract contextual information for usability purposes whereas the sole information at hand is general information like the prospective users' education, income level, job, etc. Information in this format is not relevant for usability purposes; design team needs concrete details common to market segments. Which contextual factors become important in different market segments is not known yet.

In fact, if market definitions can be used to presume certain usability considerations is not clear. For example, whether socio-economic status of users affect usability of household products is not found in the usability literature. There

are studies about the effects of national cultures on usability; such as works made by De Souza and De Jean (2000); Beu et. al. (2000); Nielsen and Del Galdo (1996) to name a few. Nevertheless, differences within a single nation are not studied. As mentioned in chapter four, some contextual factors critical in usability are the result of socio-economic level of users.

It is recommended that the participants in a usability test be representative users (Dumas and Redish, 1999). Who are the representative users for example, for washing machine market? Or, how the context should be assumed for A group consumers of washing machines? Do they do the washing themselves or hire others to do it for them? Who are those others? What is expected from them? Do they work under stress? Do they have access to machine's user manual? Should the participants be gathered from illiterate people in this case? Literacy is said to be influential in usability (ISO 20282 draft, 2003). To what degree would educational level be important in usability? Do primary school graduates and academic professors experience different usability problems with certain products? These questions may continue. How these factors should be represented in the usability studies is not known. Knowing critical contextual factors in pre-defined target markets would lead to reliable contextual representations for usability studies.

An overall depiction of markets that are used for consumer products are made in chapter four. This chapter focuses on one of those classifications, the socio-economic groupings in consumer markets. The literature does not provide a deep understanding of socio-economic levels from the point of usability concerns, thus a field study is conducted. In the field study, effects of context, which is defined by socio-economic level, is explored. How socio-economic groups should be represented in usability studies is searched. The priorities for usability are tried to be revealed.

5.1 Method of the Field Study

5.1.1 Product selection

Most of the usability research is made in software products, or 'soft' features of products. However, three-dimensional products have their own usability problems. Therefore, focus on a three-dimensional product would be meaningful as a contribution to researches in usability.

Among all the consumer products, white goods have the largest user population as they are being considered among the basic needs, almost a survival tool by people. Potential problems in such products would be influencing the quality of life of many people, as they have no choice but to use them. The problems encountered in white goods would influence a considerable number of users.

A singe product is chosen as an example to frame the field study and to enable a deeper analysis. Brand and model of the product are not constrained as the focus of the study is on the contextual factors in different socio-economic levels rather than the usability problems of specific product.

The most promising product to be chosen as example for the purposes of the field study was washing machine. Usability problems could be more obvious in washing machines, as laundry cleaning is a relatively complicated task and the machines have become complex with the added functions and programs in the last 10 years.

Washing machine was chosen for feasibility purposes as well, for washing machine ownership diffuses to lower socio-economic groups so that creation of contrasting samples became possible. Table 5.1 shows that washing machine is one of the most widely used household products in Turkey, along with TV, refrigerator, cooker, vacuum cleaner and freezer (Euromonitor, 2003).

There are approximately 1,300,000 washing machine units in use today, in Turkey. The number is increasing and the forecast for the year 2006 is 1.5 million units (Euromonitor, 2003). Washing machines include automatic washing machines (automatic washing machines are pre-programmable and incorporate a spin-dryer and sometimes a tumble-dryer), semi–automatic and non-automatic washing machines (Euromonitor, 2003).

Table 5.1 Ownership of household products in Turkey.

Note. Retrieved in May, 2003 from www.euromonitor.com.

White Goods	**no. in every 100 households**
Refrigerator	88,5
TV b&w	16,1
TV color	67,3
Vacuum cleaner	49,6
Washing machine	26
Freezer	25,2
Dishwasher	14,3
Tumble drier	5,7
Microwave oven	7

5.1.2 Sampling

Sampling was based on the criteria in Socio-Economic Status Index created by ACNielsen ZET for Turkey (Çağlı, 2004). The index is comprised of the indicators of social welfare such as possession of specified household products, job of household head, and education of household head. Six different socio-economic levels are classified by the index: A, B, C1, C2, D, E. Group A represents the highest and group E represents the lowest socio-economic level of population. The Socio-Economic Status Index is given in Appendix C.

Two user groups from extreme ends of user population were chosen as the sample to be observed. The advantage of using extreme ends is in the diversity and richness of the contextual factors they provide. Comparing the usability problems in these two ends provided a clearer understanding of relationship between socio-economic level of users and usability problems. Therefore, the first group was of socio-economic level A, second was of socio-economic level C2 and D. Group E was not considered because of low possession of automatic washing machines in E group households.

Snowball technique was used to create the sample. However, a maximum of three chains were attained. When the last participant could not recommend another user, preceding participant was returned until a new chain started. Participants were chosen from users who satisfied the group definitions. Once the chain was started, the previous interviewee was asked to recommend an acquaintance in a similar income level. When the visit was conducted to the recommended participant, her socio-economic level was captured through observation and asking questions. In the socio-economic level index in Appendix C, negative, positive and zero points are given to listed household products, to job groups and education level. These points were added, and the score of user indicated a group. For example, if the user had a dishwasher, she got 11 points but if she did not have

one, she got 0. On the other hand, she got 0 points if she had a refrigerator but if she has no refrigerators, she got minus 13 points.

There were seven participants in Higher socio economic and six in lower socio economic group. The aim was to trace as many factors as possible; therefore an in-depth analysis was made in a small sample.

Females were exclusively present in both samples in this study, since male users of washing machines is not a frequent case in Turkey. Besides, white products are marketed to female users mainly. In the second level, availability was a major factor in becoming a participant.

Experience in laundry washing was a requirement in choosing participants. The knowledge of laundry washing as a task was considered to be an important variable in usability of washing machines. Setting experience level to a minimum of 3 years, worked as a controlling factor in determining skills and knowledge of users about their washing machine.

5.1.3 Home visits

A combination of methods was used to elicit data in the study. Participant observation and interviews were made in context. In this method, the observer becomes a kind of a member in the observed group, which leads the method to be named as *participant observation* (Robson, 2002). According to Robson, the focus of this kind of observation is on 'hows": how the user programs the machine. The why's were elicited by the interview.

Observation was used as a supportive method to enrich and also to control the validity of the information gathered through interview and testing. Observations in this study were focused on pre-structured factors; the ones defined in the

contextual factors model (see Table 5.2, 5.3, 5.4). From this aspect, observations re *formal observations*, where non-specified factors were considered irrelevant (Robson, 2002). For example, usability problems caused by the individual design of the washing machine interface were not focused unless contextual factors had impacts on these problems.

This method had the strength of providing in-depth information. It gave the opportunity to discuss with users, learn their actual behavior and reveal many factors related with context.

Participants were visited in their home for a period of approximately two hours. The stay in some of the houses lasted longer than two hours because traditional courtesy was followed such as having tea. The visit enabled observation of environmental factors as well as providing important clues about user characteristics.

The interview was made in front of the washing machine (see Appendix A). The interview was a semi-structured interview, where the talk was lead by the participant mainly. The focus was on understanding the problems related with contextual factors that are listed in Table 5.1. Permission was asked to record the interview to a tape which was in a bag, in order to minimize the distraction of participant.

After the interview, the participant was requested to play a scenario of washing a wool blanket. Loading and programming the washing machine was filmed by using a digital camera. Questions were probed about her actions, e.g. why she chose a particular program.

Some of the participants found it hard to carry and load such a heavy piece, but they did the programming as if there was a wool blanket in the machine. The scenario revealed clearance problems, illumination problems, and posture of user

in addition to cues about her knowledge of programs. Finally, the washing machine panel and its environment were photographed.

It is seen that some of the answers given during the interview contradict with the comments made during tea-talk. This is taken as the desire to be socially correct. For example, during tea-talk participant said that her curtains "become purple" but in the interview she said that her washing machine cleans very well. In cases of contradicting comments, other clues were searched about the subject to justify one of the comments. Comments were omitted when justification could not be made.

5.1.4 Analysis method

Raw data collected by observation and interview was translated into structured contextual variables by following the guide prepared by Thomas and Bevan (1996) and ISO20282 draft (2003). Tables 5.2, 5.3 and 5.4 below present the critical contextual factors from which usability of products might be affected. Some of the items are modified or cancelled to retrieve specific knowledge about washing machines.

Table 5.2 User Characteristics. Note.Modified from ISO 20282 draft (2003); Thomas and Bevan (1996).

USER CHARACTERISTICS	
Attitude in purchase	how chose that model
Satisfaction of user	
User Types	primary user:
	secondary user(s)
Skills & Knowledge	task experience: laundry cleaning
	product experience: this washing machine
	other product experience: washing machines used
	level of training: reading instruction manual
	knowledge of icons on washing machine
	knowledge of terminology on washing machine
	knowledge of programs on washing machine
	detergents used maintenance and service
Personal Attributes	age
	visual abilities
	attitude to task
	attitude to product
	attitude to programmable household products

Table 5.3 Use Environment. Note. Modified from ISO 20282 draft (2003); Thomas and Bevan (1996).

USE ENVIRONMENT	
Physical Environment	**Location Conditions**
	location of washing machine
	infrastructure illumination level obstruction on washing machine panel
	Location Design
	space and furniture
	user posture
	Location Safety
	health hazards
Social/work Environment	**"Organizational Environment"**
	group working: any helpers?
	assistance in case of problem

Table 5.4 User Goals/Tasks. Note. Modified from ISO 20282 draft (2003); Thomas and Bevan (1996).

USER GOALS/TASKS	
Task 1: loading/emptying	task frequency
	user posture
	side effects
	physical factors that make task demanding
	health hazards
Task 2: Programming	wash cycle duration
	task frequency per wash
	programming habits (used/not used)
	factors that make programming physically demanding

5.2 Findings of the field study

Below is the contextual factors observed in home visits*. Tables show the observations of the related contextual factor for each participant separately. Participants from higher Socio Economic Group (SEG) are represented in the left column and participants from lower SEG are represented in the right column.

5.2.1 Factors of User Characteristics

Attitude in Purchase

Higher Socio Economic Group (SEG) saw washing machine as a tool and sought simpler and cheaper models. In contrast, washing machine was a status symbol in Lower SEG and the latest models with highest number of features were purchased. Brand loyalty was observed to be stronger in Lower SEG. From the point of usability, the learnability and effectiveness, as well as level of capacity utilization decreased as the number of features in washing machines increased. Apart from specific design properties of the products, the user characteristics played an important role in this problem. Lower SEG users never acquired expertise in their machines, independent from their experience level.

The difference in purchaser was also clear in the two SEGs: Higher group users chose their washing machine themselves and Lower group users were given the washing machine as a gift by their male family members (son or husband). This factor might be an interesting input for the marketing agents. As well as that, it

* Some of the factors are grouped in slightly different combinations in order to attain coherence in analysis. Sub-headings are kept the same with the ones in the *contextual factors model* presented by the above table to ensure resemblance.

might contribute to the ignorance in washing machine observed in Lower SEG, since actual user had little or no connection to the primary or formal source of information, the seller, and in most cases the deliverer, the servicemen.

Skills and Knowledge: level of training

Level of training indicates the method users applied to learn the operation of washing machine when it was delivered.

Table 5.5 Level of training

HIGHER SEG	LOWER SEG
U1, U2, U4, U5: manual U6, U3, U7: manual, hot-line	U12, U9: relatives, neighbors U8, U10, U11: servicemen U13: husband read manual

It was observed that learning method did not vary in relation to the level of experience in automatic washing machines. Lower Socio Economic Group (SEG) learned to use their washing machine from acquaintances that already owned a similar washing machine. Whether the acquaintances were expert users is not known. Although an initial training were given by the selling firm to these users, they still searched for assistance from social network in learning.

All users in Higher group read manual to learn how to use the washing machine, 3 users proceeded further and telephoned the seller to clear points that were not understood in the manual. Another 3 users said they had to study the manual for several days before they could fully understand the working system of washing machine. Reliance in social network was not seen in higher SEG.

Education level of users might be playing a role in the usage-learning methods of the two groups. Literacy, is vital for user's access to information about the product, however, the methods in learning did not seem to bee related with literacy of user. Nevertheless, higher SEG never consulted informal help, which may be indicating that it is the level of education rather than the literacy that determines the preferred method of learning. There may be other factors like lifestyle of users in choice of learning methods, but these are outside of the scope of this study. In spite of this, the clear differences in learning style of the two groups give important clues to usability.

Another result is that Lower Socio Economic Group (SEG) started to use the washing machine with inadequate knowledge. As the manual was rarely read, only source of formal training (assistance from social network is considered as informal training) was the self-evidence character of the interface. Therefore the usability of the panel seemed to assume a critical role in Lower SEG for learning the usage.

Skills and Knowledge: Icon recognition

Icons on washing machine may be thought to be a substitute for manual or helpful for illiterate users. This aspect is not clear because of the differences in washing machine.

One of the participant's case shows that icon usage on washing machine might be worth further studies: This washing machine had color coding and its user found it very easy to program, though she did not made distinction between the programs in "the same color" and turned the knob arbitrarily to some letter as long as it is in that color. It is worth pointing that none of the Higher group users remembered icons when there is written definition.

Table 5.6 Icon recognition

HIGHER SEG	LOWER SEG
Icons: U5: not use icons U7, U2, U4, U3: not use icons, remember if there is no word U6: not applicable to washing machine U1: not use icons, memorized letters	**Icons:** U11: not use washing machine U12: only curtain U8, U10: not applicable to washing machine U9: only spin, not use icons U13: uses color coding and some icons

Skills and Knowledge: washing machine terminology

Terminology is the program definitions written on the washing machine panels. As users explained the programs; their wording and the terminology on the washing machine are compared.

Table 5.7 Terminology recognition

HIGHER SEG	LOWER SEG
Unclear terminology: U3: "hassas" (delicate) U6: "narin" (delicate), "mini 30" U2: "easy care"	**Unclear terminology**: U9: "narin" (delicate)

It was seen that panel tables are a source of guidance. Terminology used on washing machine affected users' understanding. The more the terminology was close to users' wording, the easier they understood the functions and programs. It is interesting that the non-understood program name was consistent among users. This could have been a relevant feedback to the producer if this was a pre-design contextual research for a firm.

The terminology on the panel is an explicit indication that there exists a washing program. User can see it by looking at the machine's panel. Therefore, non-used programs are due to the usability problems in interface rather than the choice made by users. The lack of information about terminology indicates to the level in ease of learning provided by the machine interface. The interface does not encourage further investigation by the users. This usability problem changed shape between Higher and Lower groups. Higher group overcame the problem by investigating the washing machine where Lower group left it unknown and used a few programs for years.

Skills and Knowledge: wash-programs

Knowledge of different wash programs is considered to be an important factor in decreasing errors like shrinkage, unintentional dying or inadequate cleaning of laundry.

All Higher group users were aware of all programs present in their washing machine, even if they did not use all. In addition, they were aware of their level of knowledge and consulted formal sources when needed to learn more about their machine. This enabled them to tailor the programs according to their specific needs. They had the expertise to mix-and-match the programs in their machine. For example, they could wash hand-washed, delicate clothes with their machines.

They were able to use the machine in full capacity or take alternative routes in programming. For example, when users were in a hurry, they could speed up the wash-cycle without a loss in cleaning. They knew the working principle of the machine, which increased the effective usage. Interestingly, these users showed least satisfaction about their machines. Moreover, the comments made by these users were pointing to complicated architecture in program architecture and unnecessary functions. Their expertise in usage did not contribute to their satisfaction.

Table 5.8 Recognition of wash-programs

HIGHER SEG	LOWER SEG
U3, U1, U7, U2: defined all U6: defined all except 1 U4: defined 2, read others from manual table U5: defined 0 read all from manual table (confuses washing machines with each other)	U11: defined 0 U8: defined 1 U12: defined 2 U13: defined 3 U10: defined 3 read others from panel table U9: defined all except 1 (works as cleaning lady, taught by her employer)

On the other hand, Lower group users seemed to be ignorant about the potential of their washing machine. It was revealed that users in Lower SEG had serious difficulties in grasping the programs of their washing machine even after several years of experience. Although they had complaints about ineffective or harmful washing, they could not find the cause. The cause of this ineffectiveness was selection of wrong programs. Users were frustrated when they had to wash by hand in order to protect the clothes from harmful washing. If there was no harm, they did not show dissatisfaction about their washing machines although they

were not able to use many of the programs. Contrastingly, they were highly satisfied with their machines. The cause of this factor may be related to the socio economic level of users. Washing machine saved these users from hand washing, even if it was not always fully efficient. Lower group had lower expectations from washing machine.

From the point of view of socio-economic factors, knowledge of washing machine programs considerably differed between the two groups. The difference may be resulting from the learning sources of the users: Higher group users preferred formal sources like manual and customer service whereas Lower group users preferred word of mouth or trial and error. It was also observed that Lower SEG quit trying after a time and used only a few functions for basic tasks in laundry. It seemed necessary that Lower SEG needed a different approach in interfaces, mainly in the explanation of program architecture. This contextual factor needs to be integrated into the usability studies in washing machines.

Skills and Knowledge: Maintenance and service

Maintenance and service heading includes the general maintenance like cleaning filters, using appropriate detergent, getting out stuck objects as well as searching consultancy from official repairmen in case of a problem in the washing machine.

Lint filter prevents unwanted objects (hair pins, socks, buttons, etc) and lint from entering evacuation pump. It is recommended in manual to clean it every 40 washes. Detergent drawer gets stuck because of the residual detergent and softener accumulation. Users are recommended to take it out and wash it regularly. Producers also recommend that filters in the faucet connections be taken out and

cleaned every 40 washes. *Assistance in case of problem* is framed with unexpected working of washing machine.

Table 5.9 Maintenance and service

HIGHER SEG	LOWER SEG
Cleaning lint filter: U1, U2, U6, U7, U5, U3, U4: yes	**Cleaning lint filter:** U13, U12: no, not aware U9, U10, U8, U11: yes
Cleaning detergent drawer: U6, U5, U1: yes U7, U4: yes, but hard to take it out, call husband U3: yes, but hard to take out because toilette-paper-holder on wall U2: no, use detergent ball to avoid cleaning it	**Cleaning detergent drawer:** U12: yes, but hard to take out, already broken U9, U13, U10, U11: yes U8: no, hard to take out
Assistance in case of problem: U5, U6, U2, U1, U7, U4, U3: service	**Assistance in case of problem**: U13, U12, U11: avoid service, man of house looks first U8, U9, U10: service

All users in Higher group cleaned lint filters, whereas only 4 users knew its existence in the Lower group. The lack of knowledge may be causing discreet behavior in Lower SEG towards washing machine.

In spite of discreet behavior, Lower SEG users exhibited higher attention to the maintenance of their washing machines. They used scale-preventing solutions to

extend the life of their machines. Higher SEG, in contrast, did not believe in the necessity of these solutions and it were Higher group users who mentioned the expensiveness of these product for not using them. The care given by Lower SEG users to their machines can be related to the scarcity of their resources. The washing machine was a precious object in the house of a Lower SEG user. Another cause may be lying in the education level of these users that they believed in the advertisements without questioning.

Higher group users called servicemen in case of unexpected situations, even if they were not sure if the problem was technical. On the other hand, Lower group users avoided calling the service and men of the household took the chance in repairing it on their own. Lower SEG users demonstrated untrusting attitude towards service provided by selling firms. The second reason for not avoiding the service was the financial constraints experienced by the lower SEG. The information that lower SEG attempt to repair machines is probably present in the marketing data collected by firms, and its implications provide important clues for design. The design of the machines may be done in such a way that users cannot reach hazardous parts.

Usability problems in maintenance are closely related with the design of the specific product, although problems were present in most of the washing machines. Contextual research revealed these clearly. For example, seeing a broken detergent drawer in context reveals important clues for the design of washing machines.

Personal attributes: attitude to task and attitude to product

This item in the study is to have supportive information about users' satisfaction levels and usage habits.

Table 5.10 Attitude to task and attitude to product

HIGHER SEG	LOWER SEG
Attitude to Task: U7, U2, U6: nuisance U4, U3: neutral U5, U1: like clean feeling after washing **Attitude to Product:** U5, U2, U7, U1: enough that it functions U6, U3: like it U4: automatic washing machine was a revolution	**Attitude to Task:** U13, U10, U12, U9: neutral U11, U8: like clean feeling **Attitude to Product:** U10, U13, U12, U8, U9: precious item U11 : afraid to break down, precious

It is seen that attitude to task of laundry washing was similar in both groups except that three Higher group users saw washing as a nuisance in their daily life. For lower group other tasks were harder than laundry work, so it was not seen as nuisance. All Higher group users claimed that they hire helpers for housework, whereas, none of the lower group users had this opportunity.

The Higher SEG users who left washing activity to cleaning lady, programmed washing machine themselves, especially if valuable clothes are to be washed. They saw laundry washing as a detailed and complicated task. They thought using automatic washing machine would be complicated for the cleaning lady because of her inadequate knowledge. This contextual factor is exemplary for the users' perception about learnability and easy usage of washing machine.

On the other hand, attitude to product changed in the two groups. Higher group users saw washing machine rather as a tool. In Lower SEG, washing machine was considered as the most important item in the house. The washing machines in Lower SEG households were acquired with great effort and the work it brought about a big alteration in the life standard of user.

Personal attitudes to task of laundry washing and to users' own washing machine provides an input about the place of washing machine in users life. From the point of usability, a user who sees the task as a nuisance and sees her washing machine as a tool may become frustrated by a complicated washing machine. All she wants is to set the washing machine and continue her life as soon as possible. In fact, this was the exact comment of participants U2 and U7. Especially Higher SEG users spent little time in front of the machine. This contextual factor is determining in the design of usability evaluations. Efficiency in programming becomes especially important in washing machines. Besides, the users cannot see the result of their actions before the washing cycle of washing machine is finished. Therefore, errors done in programming may lead to uncorrectable results, like shrunk clothes. For usability purposes, this factor reveals the need for specific emphasis in efficiency of programming in washing machine.

5.2.2 Factors of Use Environment

Use environment is divided into *physical environment* and *social environment*.

Social environment includes helpers during washing activities, causes of interruption if any and source of assistance in case of problem. Last item is examined under the heading *maintenance and service*.

Interruptions during work could not be observed, as this needed longer periods of observation and a role of observer as marginal participant. Therefore, absence of this information is traded off with the advantages of interview and a shorter stay in the visited households.

Physical: Infrastructure and illumination level

Infrastructure is rather an important factor, as variations in voltage and water pressure gives harm to washing machines.

Table 5.11 Infrastructure and illumination level

HIGHER SEG	LOWER SEG
Infrastructure: U7, U3: use extension cable for electricity U2, U6, U5, U1, U4: specialized faucets **Illumination level on panel:** U5: 73 U6: 33 U2: 20 U7: 16 U1: 13 U4: 12 U3: 2	**Infrastructure:** U13, U10, U11: hole in wall to bring water U12, U8: voltage variation, water freeze U9: sand in water **Illumination level on panel:** U10: 30 U12: 35 U13: 6 U11: 6 U9: 12 U8: 2

Likewise, illumination level is important in ensuring users' posture and ability in learning the machine. According to Schiler (1992), IES Lighting Handbook

recommendations for illumination level in residences are as follows: The illumination range comfortable for the task of laundry washing with washers is 200-300lux. If the user is under age 40, 200 lux is enough, if the user is over age 55, then 300lux is needed to attain equivalent comfort. Illuminance for washers is recommended to be on the area of task, rather than as general lighting.

One of the fundamental differences between socio-economic groups was the housing conditions. Three of the Lower SEG users dug a hole in the wall to connect washing machine to water source, because the washing machine was not in a room with water source. This might have negative effects on water pressure. Furthermore, same houses were subject to voltage variations which is a fatal contextual factor for electrical products. Three users who lived in squatter housing pointed to freezing waters in winter. Water freeze had the contingency of stopping all laundry activities or result in carrying the laundry to an acquaintance and using their washing machine until the weather got warmer. Water cuts in summer have a similar effect. Although Higher group users were also subject to water cuts, most had a water tank in their building. Apart from the direct results of infrastructure problems, the observations revealed an indirect usage pattern in Lower SEG. They shared washing machines, which in turn leads to new usability considerations for producers. A case was that, the guest user changed the setting of the washing machine and owners could not start it for several days. Usage of washing machines by inexperienced users is a common situation in Lower SEG.

Illumination levels in both groups were similar. When low illumination levels are combined with low contrast, small fonts and inappropriate angles of washing machine panels, users are forced to bend down to be able to see the controls. Furthermore, the possibility of error increases when the users are over 40 years of age: they develop farsightedness (hypermetropia). Users over age 40 were observed to bend backwards during program selection and some complained that they could not see the letters on washing machine anymore. If the washing

machine was a new one, low levels of illumination might have had negative effects on learning the washing machine by the users. Low illumination levels in use environment could be an important input to laboratory usability evaluations.

Physical: Location design and location safety

Usage location as well as space and furniture are vital to comfortable usage of many products, if not for safety. Details of location of washing machine are given with photographs in the 'user cards' in Appendix B.

Table 5.12 Location design and location safety

HIGHER SEG	LOWER SEG
Location of washing machine: U6, U3: WC U5, U2, U4: main bathroom U1, U7: cupboard **Space and furniture:** U3, U6, U4, U7, U1: obstruction U5, U2: no obstruction	**Location of washing machine:** U10: bedroom U12, U8: kitchen U9: Turkish toilette U11, U13: corridor to bathroom **Space and furniture:** U9, U10, U8 : obstruction U12, U13, U11: no obstruction

In both of the groups, washing machine was not always in suitable locations. In Lower group users, washing machines were used in inappropriate areas because of space constraints. On the contrary, Higher group users seemed to have made a choice about the place of washing machine. Three Higher SEG users experienced

uncomfortable usage as a consequence of their aesthetic preferences. As a result, size of washing machines created considerable inconveniencies especially in Lower SEG households. The effects of location are unsafe usage and uncomfortable loading postures.

Furniture and carpets that are close to washing machine create safety hazard too. Carpets cause the washing machine to overheat. It was observed that Lower group users had carpets under or in front of washing machine, which can easily ignite in case of fire. Fire risk was also present for Higher SEG, as washing machines were put in cabinets. Fire may spread more easily and people may not put it out easily since they will not be able to reach the back of washing machine. Extension cable usage in wet spaces was another fire hazard, as well as electrocution.

As for the obstructions, inadequate clearances were observed in both of the SEGs. The analysis for each user is made in user cards in Appendix B. Here it would be worth to point to the fact that contextual research provided valuable insight into actual clearances a washing machine is subject to and it is observed that they do not permit comfortable or safe loading.

When users' health conditions are added to location design, the situation gets worse: Two users had temporary neck and back problems; they could not bend over to read the instructions or the letters on washing machine panel and knobs. Another two users mentioned that they felt back pain after loading or emptying the washing machine, which should be considered seriously by the design team. The problems showed no considerable difference between user groups. In spite of these problems, most of the users did not show dissatisfaction, possibly because they were not aware of them.

Social/work environment: Helpers in washing activities

Washing activities include separation of laundry, loading to washing machine, program selection and setting, emptying washing machine, drying clothes and ironing them. Participants' usage of product might be influenced by the amount of help they are able to get.

Table 5.13 Helpers in washing activities

HIGHER SEG	LOWER SEG
Sorting laundry: U6, U3, U5, U1: user U7, U2: cleaning lady or user U4: owner of clothes; whites in washing machine, others to box **Program selection:** U7, U2: cleaning lady or user U6, U3, U5, U1: user U4: daughter or user **Ironing:** U5, U2, U7, U3: cleaning lady U4, U6, U1: user	**Sorting laundry:** U10, U12, U8: store in washing machine, so owner of clothes U9, U11, U13: user **Program selection:** U13, U10, U12, U8, U9: user U11: neighbors, relatives **Ironing:** U10, U12, U8: daughter or user U13, U11, U9: user

It was seen that help was provided by cleaning ladies in Higher group users, whereas the helpers became female family members in Lower group users. The help in washing activities were in ironing in Higher SEG. In Higher SEG, the cleaning lady hand washed some of the laundry if the lady of the house found it

necessary. This factor may be decreasing the vitality of the washing machine for Higher SEG users. They were not as affected as Lower SEG in case of the inefficiency in washing machines, as they got their laundry cleaned in any case. The same was true for ineffective working of machine or errors in programming. For example, if the wools shrunk in machine, cleaning lady washed them by hand. This might turn out to be an influential contextual factor in perception of usability level and satisfaction of Higher SEG.

One of the participants from Lower SEG, could not use her washing machine herself. She got help from a neighbor or a relative. Two other users mentioned this problem for their people in the village. The access to help in usage may be causing the Lower SEG users to pay less attention in learning their machines.

Social/work environment: Task timing, interruptions

Timing of washing activities was directly related with socio economic factors. Lower SEG usually washed at night because electricity is cheaper at night. Concern for economical washing also influenced the frequency of washing in the two SEGs. Whether they looked for low-electricity consumption during purchase is not clear, as men of the household chose the washing machine in Lower SEG.

The type of help in Higher group affected the timing of washing machine usage. Users washed in night hours to prepare the laundry for the cleaning lady to iron in the next morning. Another reason was the factor that in Higher SEG, most of the women worked and came home late, so they preferred to wash at night.

As a result, noise in washing machines was considerably important in both groups, both for the family members and neighbors in the building. The timing of usage was directly related with contextual factors as seen in the field study. The

similarity in wash timing of the two groups was based on completely different concerns though.

5.2.3 Factors of User Goals/Tasks

Programming: programming habits (used/not used)

Participants are requested to explain the programs/functions they use in daily life. Although the number of programs used has little variation between users, the way of usage and the purpose differs with socio-economic levels.

Table 5.14 Programming habits

HIGHER SEG	LOWER SEG
Used programs: U2, U1, U6: 4 U7, U5, U3: 3 U4: 2	**Used programs**: U13, U9, U10: 3 U12: 2 U8: 1 U11: 0

Higher group users preferred short cycles since clothes are washed frequently before they get too dirty. Usage of gentle programs (named as "wool" or "delicates" by the washing machine) was also common, as possession of 'delicate' clothes increased in this sample. In addition, Higher SEG users applied sub-partitions because of hygienic reasons. For example, pillowcases, towels and

tablecloths were not washed with underwear, socks and dirty trousers. Therefore, they used more programs in comparison with Lower SEG users.

In Lower group, users mainly separated laundry between whites, coloreds and curtains. These rough separations led to errors in washing and resulted in shrinkage in two users. It was observed that their selection were based on memorization and not on comparison of programs offered by the washing machine.

Usage of additional functions varied between the two SEGs. Usage of at least one of the optional functions such as low speed spinning, ½ capacity wash, economy mode, extra rinse, anti-wrinkle, etc. was observed in Higher group users. Conversely, Lower group users generally named optional functions as "buttons", where four of the users said that they do not "touch them" and one pressed arbitrarily. The reason for the difference does not seem to be resulting from the difference in washing machine models in the two samples, because washing machine models were not simpler or older in Lower socio-economic groups. They were observed to have little knowledge about optional functions of washing machine as illustrated under heading; *general knowledge: wash-programs*.

A critical factor in Lower group was the arbitrary usage of programs. This is most probably a factor closely related with the level of use-knowledge. For example, three users interchanged between 'close' programs, that is, programs represented next to each other on the program selection knob, for example D-F, A-B, etc. Side effects of arbitrary program selection were non-disappearing stains, shrinkage, color-fade and "purple whites" as expressed by users.

Interviewing users in their own context enabled in-depth information about usage in their own washing machine. When asked, most of the users gave confident and definite answers about their program selection. Continuing the interview in front

of their machine revealed actual usage patterns. As well as that, seeing the washing machine helped the interviewer to probe in necessary points.

5.3 Analysis of findings

Contextual factors that are structured by the studies of Thomas and Bevan (1996) and the ISO 20282 standards are examined through the example of washing machines. The research in the field showed differences in the two groups but also interesting similarities. Findings that are thought to be critical in usability of washing machines are discussed in this section.

A major difference in the two socio economic groups is observed in the level of knowledge about the washing machine. Low socio-economic groups clearly lacked information about the product. They did not use the formal information provided by the selling firm. Low socio-economic groups adopted a learning style based on observation of usage by someone else or on word of mouth. Furthermore, their attitude to product resulted in discreet behavior; preventing the user from exploring the machine. Learnability aspect of the washing machines was in pessimistic levels in Lower SEG users.

The differences in the level of knowledge led to different usability problems in the two groups. Inadequate knowledge of Lower SEG resulted in ineffective usage with high rates of error in program selection. Incorrect usage is seen solely in this group. Among the causes there might be education level, differences in the attitude to products or access to official service support. This is a factor that reveals the worthiness in considering various market segments by usability specialists, when a new product is developed.

Secondly, despite the years of experience, the experienced user performance was low in Lower SEG. As noted in Chapter II, usability is achieved when potential utility becomes actual utility (Wilson, 2002). In the case of Lower SEG, potential utility of washing machines were far from actual utility reached by the users. 'Shallow' usage is heavily recorded in Lower SEG. Users did not utilize most of the features in the products, although the need was apparent.

On the other hand, for Higher SEG users, there was little or no learnability problem in washing machines. The usability problem is observed in the coverage of system potential in this group. There were many non-used functions although the need for them was revealed. Some users made the cleaning lady to wash by hand as they were not satisfied with the machine.

Another difference in usability aspect in the groups was observed in higher SEG was in the re-usability of washing machine. Users who had more than one washing machine experienced problems in remembering the usage of an individual machine and had to look up the manual. This usability problem resulted from the lifestyle of users; they had periodic visits or vacations and stopped using their washing machine for some time.

The differences in usability problems in the two SEGs result from their differences of context. Education level might be a major cause in the knowledge level-related problems. Contextual observation seems to have been the most effective in eliciting knowledge difference in lower socio-economic group, because they were not aware of their usage style. On the contrary, higher socio-economic group mentioned that there were non-used features because they did not need them. They were highly aware of the capacity of their machines. It seems appropriate to design the interface of the washing machine in a way that it is self evident to both types of users. Lower SEG users do not seem to be accustomed to analyzing the abstract representations in presenting the information of do not think about the working

principles of washing machines. However, cognitive studies would provide answer to this assumption. Nevertheless, it can be said that Norman's (1999) theory about the discrepancy between users' model and designers' model about functions of a product, perfectly fits to the situation observed in Lower SEG.

As for access to help by users, the difference between the problem solving mannerss are observed to be directly related with socio-economic level. Higher socio-economic level users get formal help from seller firm, whereas lower socio-economic group tend to avoid this because of financial constraints. Although the result is the increased costs of repair, lower income groups feel the need to take the risk in self-servicing their machines. In practice, the tendency to self-repairs can be directly understood just by looking at the socio economic level of users. Preventive measures may be taken in new designs.

In laboratory usability tests, experience in various products or period of usage is considered to be an indicator of expertise in products. It is assumed that an experienced user is able to use a product in highest level of effectiveness and efficiency. The problems that are revealed in usability evaluations are then attributed to the interface design. In this study, none of the users showed dissatisfaction about their knowledge level, they were even confident in their expertise. However, as seen from the examples in section 5.2.1, the quality of experience seems to be more important than the quantity of it. Many problems associated with washing machines are in fact resulting from users' inadequate knowledge. Usability evaluation would be biased if this factor is not known. Level of expertise was lower in Lower SEG, this can be an input for usable product development.

Undoubtedly, the role of the interface is equally crucial in usability of the product. However, the problems in individual interfaces are not in the scope of this study, as the focus in on the contextual factors. Including the individual interfaces of

selected products would complete the triangle of user-environment-product and can be a valuable contribution as a further study.

Problems in infrastructure vary between the two user groups. Related inconveniences are connected to socio-economic level of users. When Lower SEG are considered, the design team should keep in mind that washing machine is used in tough conditions. The conditions vary greatly between squatter housing and apartment homes.

Contextual factors like the infrastructure in Lower SEG, generated the necessity of sharing washing machines with acquaintances in times of water freezes or water cuts. This factor made the guessability aspect of washing machine a priority. One of the cases provided an educative example for this: A guest user (first time user) who used the washing machine unintentionally changed the settings of it and the owner had serious problems when she wanted to use her machine afterwards.

On the other hand, clearance problems were present in both groups. The causes of the problems also differed among higher and lower socio-economic groups. In higher group households, the machines which were subject to clearance problems were the result of a choice made by the owner. They aimed to put the machine out of sight, to non-used areas or inside cabinets. Lower socio-economic groups used machines in the best possible areas; they did not have specialized space or infrastructure in their home. The clearance problems were mostly unavoidable because of the housing conditions. Therefore, the two groups experience the same problem although the cause is different. The solution that will be provided to seemingly same problem in lower and higher socio-economic groups need different approaches. For example, pleasurability aspect can come into scene in Lower SEG.

Illumination level, location of washing machine, space and furniture all observed to affect usability of the product. In laboratories, product stands usually large,

well-lighted rooms to assure good image recording. However, as seen in the previous findings, this is not how the product is used in real life. The washng machines were used in dark, cluttered and usually small spaces. Taking these contextual factors into account would enhance the usability of products.

Level of satisfaction varied with income, the higher the socio-economic level, the unimportant washing machines became in users priorities and expectation of efficiency increased. Satisfaction level is related with expectancies of users. Higher socio-economic level group tended to perceive washing machine as a tool. For lower socio-economic group, washing machine seemed to assume a role of status symbol. In the tea-talks, it appeared that the 'latest' and most expensive models were preferred in lower socio-economic groups. This might be why Lower SEG expressed higher satisfaction than Higher SEG, although Lower SEG users were experiencing serious usability problems.

Brand loyalty is also seen to be a dominating factor in purchase decisions in this group. However, this is a subject that needs further inquiry if generalization to population is to be achieved.

In laboratory tests, effectiveness and efficiency is measured according to the success level of users in applying a given scenario of usage. Most of the time, scenarios are prepared according to the assumptions in the use-frequency or preference of certain functions. Throughout the study, it is seen that the frequently used programs changed according to SEG. For example, delicate programs are preferred more by Higher SEG, whereas intensive programs are more popular among lower socio-economic group. Usability evaluations may lead to biased results when the differences in use habits are not taken into consideration. As well as that, this might be a clue for creation of features in washing machines. It would be helpful in tailoring the architecture of interface and thus increase the learnability and guessability aspects.

CHAPTER VI

CONCLUSION

In this study, the concept of usability is aimed to be examined in a detailed fashion. The pursuit of one answer released other questions and following them lead the present author into an area which is not fully covered in the academic literature on usability yet.

In the beginning of the study, causes lying beneath the problems encountered by ordinary users in usage of everyday products are investigated. The concept of usability is explained and advantages of usable products are noted. Focusing on the various aspects of usability in related academic literature revealed that problem is rooted in the prevailing production ways and means of industry. A change in the priorities of manufacturers in accordance with the interest of consumers is needed in order to improve the problems encountered in the resulting products. It is

revealed that usability in products is achieved by employing a user-centered-design process.

The question of how to employ user centered design is tried to be answered through the examination of a typical new product development process in firms. From this point of view, methods in usability research are inquired in successive stages of new product development process.

The main requirement of user centered design is found to be lying in the quality of research into use contexts. It is assumed by contemporary researchers that usability is not exclusively a result of the design of products. It emerges through interaction of many variables in use context and product. Therefore, it is seen that usability is a dynamic attribute, which changes as the contexts differ. In addition, it is neither universal, a usable product in a certain use context may turn out to be unusable in a different one. As a result, acquisition of contextual information is confirmed to be a fundamental factor in achieving usability.

Researching the context of use revealed the academic studies which aim to structure the use context into pre-defined factors, so that applicable theories may be produced in the future.

Simultaneously, when looked from the point of firms, contextual considerations start by definition of prospective customers made by the marketing. The product design team builds the product on this definition of customers. However, during the product development process, usability professionals apply a different definition about customers; because they seek information about 'users'. Hence, it seems that there are two different approaches for defining the same users. Production starts from the definitions created from the point of view of marketing and continues with the definitions made from the point of usability. The essence of information sought by the two agents is the same, though in a different format. They both aim to make classifications of users in order to tailor the products.

It is observed that the studies in usability and marketing are intersecting neither in professional life nor in academic literature. For this reason, the information expected from marketing people to apply UCD during the manufacturing process, does not focus on the requirements of usability experts. The reasons are as follows:

1. Arbitrary information inflow to usability
2. Language (terminology) differences between the two important branches in product development
3. Unstructured information about the 'users'.

As a result, the relationship between usability and market definitions appeared as a question worth examining. In pursuit of this aim, usability and marketing literature are surveyed separately to analyze intersecting concepts. One of the widely applied definitions in marketing, the socio-economic level definition, is chosen for inquiry to frame the analysis. Usability literature is scanned to find definitions which might have a relation with socio-economic factors.

A field study is designed in order to examine the question in real world. In the field study, it is believed that inquiry into usage of a specific product in two different socio-economic contexts would reveal different usability problems. Basing the variables to be observed on the usability literature, the sample is chosen from a marketing perspective.

The field study exposed some differences between use-contexts of socio-economic groups. The study is based on a single product as example, within this frame, it pointed to the importance of contextual research as well as the relationship between use-context and one of the classifications made by marketing department in firms. The two samples are tried to be of extreme ends to have a stronger light on the studied factors.

In this way, the context defined by marketing literature is intersected with the one in usability literature. In this case, it became possible to conduct further studies which might take the challenge to define socio-economic context from the point of product usability.

6.1 Further Studies:

This study does not provide information to generalize the findings, as there is yet inadequate information for making assumptions about the population. In spite of the rich information it provided, the sample size is not large enough to reach to generalizations. Conducting the study with a large sample can be promising. Likewise, cooperation with the industry might be sought to have a more focused view in impacts of socio economic factors. Fixing the product to a specific model can be controlling in the field study. In this way, usability problems may be elicited from two points simultaneously: the ones exclusively related to socio economic factors and the ones exclusively related to product interface.

Socio economic classification of users is just one method in structuring context related usability problems. If integration of successive stages in product development process is to be studied, other marketing definitions should be investigated too.

Finally, a method can be developed for integration of idea generation and context decision stages in firms with concept development and design stages. Further studies aiming to create a structured knowledge base about contextual factors would contribute creation of usable products.

The mentioned field study aims to find questions that should be investigated in further studies.

APPENDIX A

INTERVIEW QUESTIONS

Merhaba, ben ODTÜ Endüstri Ürünleri Tasarımı bölümünde yüksek lisans yapıyorum. Tez konum tüketici ürünlerinde kullanılabilirlik üzerine. Tezimin bir bölümünde çamaşır makinelerindeki kullanım problemlerini araştırıyorum. Uzun vadede ürünlerin daha iyi tasarlanmasına yarayacak yaptığım iş. Eğer kabul ederseniz makinenizle ilgili sorular sormak ve konuşmamızı kaydetmek istiyorum.

Çamaşır Makinesi:

Makinenin yaşı:

Markası:

Modeli:

Kullanıcılar:

1. Asıl kullanıcı:
2. Yaşı: 20-30 30-40 40-50 50-60 60+
3. İşi: 4. Eğitimi:

5. Diğer kullanıcılar: 6. Size yardım edenler:

7a. Kaç yıldır otomatik makine kullanıyorsunuz? 7b. Kaç yıldır bu makineyi kullanıyorsunuz? 7c. Başka makine kullandınız mı/kullanıyor musunuz?

8. Bu makine nasıl çalışıyor anlatır mısınız? Nesi var, neler yapıyor? Nasıl yapıyor?

9. Bir tül bu makinede nasıl yıkanıyor gösterir misiniz? Bir de yünlü?

10. Şu işaretler ne anlatıyor, tek tek üzerinden gidebilir miyiz? Faydalı buluyor musunuz bunların burda yazmasını, işinize yarıyor mu?

11. Bu makineyi kullanmayı nasıl öğrendiniz?

12. Hangi deterjanı kullanıyorsunuz?

13. Makine bozuldu mu hiç? Ne oldu? Kim onardı?(servisçi ne dedi?)

14. Başka problemle karşılaştınız mı (programlarken şaşırdı mı, mesela), kim yardım etti?

15. Kendiniz herhangi bir bakım yapıyor musunuz makineye?

16. Çamaşır yıkamak konusunda ne düşünüyorsunuz? Diğer ev işlerine göre nasıl bir iş sizce?

17. Çamaşırları nasıl yıkıyorsunuz, kirliler nerde duruyor, nerde seçiyorsunuz, yıkanırken napıyorsunuz, bitince noluyor...bir çamaşır yıkama gününüzü anlatır mısınız, o sırada yanınızda kimler oluyor, işinize karışıyorlar mı, yardım ediyorlar mı?

18a. Çamaşırlar yıkanırken ne yapıyorsunuz? 18b. Çalışırken bitmesine ne kadar kaldığını nasıl anlıyorsunuz?

19. Bir çamaşır makinesinde en çok neler önemlidir, bunu alırken fiyat dışında nesine baktınız?

20. Makinenizi değiştirmeyi düşünüyor musunuz? (Hayır ise: Yeni bir makine alacak olsanız nasıl bir tane seçerdiniz?) (Evet ise): Nasıl birşey almayı düşünüyorsunuz? Bu makine sizce hangi açıdan iyi, hangi açıdan kötü?

21a. Arkadaşlarınızdaki/akrabalarınızdaki veya başka bir makineyle karşılaştırdığınızda bunun nesi daha iyi/kötü? 21b. Tanıdığınız kişilerden duydugunuz şikayetler var mı makineleriyle ilgili? Sıkıntılar ne olabilir?

22. Sizce ev aletlerinin çok programlı olması daha kolay kullanmaya mı yarıyor yoksa işi komplikeleştiriyor mu? Mesela herşeyde tek bi düğme olsa daha kolay mı olurdu çalıştırmak?

23a. Buranın bir fotoğrafını çekebilir miyim? 23b. Sizi yün bir battaniyeyi yıkarken çekebilir miyim? Makineye yükleyip programlar mısınız, başlatmaya gerek yok.

Çok teşekkür ederim...

APPENDIX B

CONTEXTUAL DATA CARDS

Social group: High
User: U1
Secondary Users: none
Age: 50+
Education: Higher education
Job: ISCO 2310: College, university and higher education teaching professionals
Location of residence: Çankaya
Machine: Bosch V468 economic, age 10.
Satisfaction of user: neutral. It is OK unless it functions. Said it is just a washing machine.
Attitude in purchase: These were in market in the time of purchase.

USE ENVIRONMENT

Physical Environment

Location of washing machine: In the corridor leading to bathroom. Detergents and basins are on shelves.
Infrastructure: There is water tank in the building.
Space and furniture: Washing machine is hidden in cabinet. Doors touch the user during loading.

Visual Environment
Illumination level on panel: 13lux
Any obstruction on washing machine panel: -

Safety hazards: Not able to clean accumulated lint from dryer, which should be done on a yearly basis: Fire hazard. If there is a fire, it may spread quickly to house as the machines are surrounded by flammable materials (wooden cabinet) .

Social environment
Helpers: None during washing but cleaning lady irons big pieces.
Assistance in case of problem: She calls servicemen.
Interruptions during work: None

USER TASKS

1. Laundry loading

Task frequency: 4-5 times a week, after returning from work
Physical factors that make loading demanding: User has to bend forward.
User posture: (see photo) User loads machine from the side, using left hand only, because she holds machine with right hand to attain balance and gain power. She claimed this posture is more comfortable than kneeling.

Safety:
Side effects: Unhealthy posture

2. Programming

Usage of programs:
Washes gentles in 4 seperate groups (because of hygienic reasons) (K short program, 30°):
Group 1: shirts and table clothes. Uses starch instead of softener.
group 2 : light coloreds and night suits.
group 3: dark coloreds
group 4: curtains
wools: N, P (pump out the water)
Washes towels and underwear in two degrees in B (long program)
Group 5: whites in 80°
Group 6: coloreds in 60°

Not used: pre-wash programmes (A, G, H) as clothes are washed frequently.
economy mode not used- not believe in it
½ mode not used: washing machine is filled quickly

Side effects:
Task frequency per wash: Pumps out the water after washing wools.
Wash duration: Does not know, she's home when washing machine works, so checks once in a while.
Factors that make programming physically demanding: low illumination.

USER CHARACTERISTICS

Skills and Knowledge

Task experience: 20+ years
Product experience: 10 years
Other product experience: She uses 2 washing machine.s at the moment
Training level: She read the manual only. Does not use the table on the machine's panel.
Icons on washing machine: Does not remember all, she used to look at them but now does not use as she has memorised all.
Terminology on washing machine: There is no terminology on washing machine, just icons.
Programs: She defines all but does not use pre-wash programs: A, G, H. Does not believe in e (economy) mode and does not use ½ mode as washing machine is always full.
Detergents used: Matic detergent, softener, starch. No scale preventor.
Maintenance & service:
- immediately calls service, never bothers to solve a problem herself. Does not inquire much after they repair it; its their job.
- She cleans detergent drawer, picks out stuck objects from the bottom filter , but does not clean filter regularly.

Personal Attributes

Attitude to task: she likes washing, ironing and cooking. Does not like cleaning the house. These things relaxes her after a long day at work. She claimed she likes washing and ironing because she gets feedback: "the dirty, wrinkled things are converted into clean smelling, nice clothes. I like to see this result. On the other hand, if you clean the house the result is not so obvious even after hours of working. In laundry, the result is clearly appereant".
Attitude to product: Neutral. It is just a washing machine, enough that it functions properly.
Attitude to programmable products: She does not like them much. She can attain the task with simplest products. She said " the sophistication brings along a higher price and this increase is not worth the increased utility that these products claim to have. I cook as easily and as good with a simple oven and wash the same with a simple washing machine. " If she changed her washing machine, she would not pay more for digital or many-programmes washing machines.

ANALYSIS OF CONTEXTUAL FACTORS

1. Washing machine is hidden behind a cabinet.
2. Cabinet door does not permit full opening of washing machine door.
3. Safety hazard: inflammable material near tumble dryer and washing machine.
4. She bends down when loading – not a healty posture (does this 10 times a week).
5. Contrast of table on washing machine panel is low and there are no definitions, only sysmbols.
6. User does not believe in some functions: economy mode.
7. Pre-wash programs are not needed because of life style.
8. User said she does not want to pay more for programs and other sophistications which she won't use.
9. User likes the task of washing but neutral to washing machine- enough that it functions well.

Social group: High
User: U2
Secondary Users: Cleaning lady
Age: 50+
Education: University
Job: ISCO 2146 Chemical engineers
Location of residence: Oran
Machine: Bosch V965, age 8
Satisfaction of user: Neutral. She does not want to spend time on washing machine. She wished that she could add forgotten clothes in the middle of a cycle. Prefer non-spin option as clothes wrinkle if they stay in machine for some time. Building has hot water but this machine cannot use it, why heat water twice. She prefers a smaller washing machine.
Attitude in purchase: Bought it from customs for a very cheap price. Believed non-domestic products are of higher quality.

USE ENVIRONMENT

Physical Environment

Location of wm: In main bathroom.
Infrastructure: There is water tank and electric generator in building,
Space and furniture: Washing machine stands next to covered bathtub. Bathroom is large.
Visual Environment
Illumination level: 20lux
Any obstruction on wm panel: The bathrobe hanging above obstructs table on the machine's panel. (She said she never looks at the table.)
Note: User said she cannot read/see the letters on the turning knob as she has developed farsightedness.
Safety hazards: Floor slips if gets wet

Social environment

Helpers: Cleaning lady
Assistance in case of problem: She calls servicemen.
Interruptions during work: She used to load the washing machine when rushing for work so that the cleaning lady can dry and iron them during the day.

USER TASKS

1. Laundry loading

Task frequency: 3-4 times a week
Physical factors that make loading demanding:
- said her back and now arm aches after loading.
User posture: see photo.
Safety: -
Side effects: back ache, arm ache.

2. Programming

Usage of programs:
She said table on machine panel was not detailed enough for her task goals, so she used to look up at the manual.

Most used:
½ function as washes laundry frequently and washes in different color groups.
B (whites/coloreds), F (gentle), J (wool). Sometimes rinses two times.
Pre-wash programs A and G used rarely.
Spin-dry function: She dries bathrobes in winter and her son's sports uniform when it is urgent. Also dries to soften towels because spouse is allergic to softeners. Dryer has to be used less load, so she has to move half of the laundry out after washing. She said she wish she did not have to go and interact with the machine for the second time.

Not used:
extra gentle function (makes each cycle gentler when a button is pressed)

Side effects:
Task frequency per wash: 2, washes then rinses for the second time.
Wash duration: She does not know, starts the machine and leaves home.
Factors that make programming physically demanding:
- Low contrast on panel
- Inlaid knob
- Gray translucent cover
- Unclear definitions of panel table
- Her farsighted eyes

USER CHARACTERISTICS

Skills and Knowledge

Task experience: 20+ years
Product experience: 15+ years
Other product experience: She uses 2 washing machines.
Training level: She read manual.
Icons on wm: She defines the icons on buttons, she does not use programming icons.
Terminology on wm: She defines all, with technical detail. Misinterpreted "easy care" for delicate, gentle program.
Programs: Studied the manual for 3 days when she fitst got the machine. She said manual was very complicated. She defines all programs in a detailed fashion.
Confused with activation of non-spin function (IVS): this machine spins when IVS button is pressed, her other machine spins when it is not pressed.
Detergents used: Matic detergent, softener (changes the brands frequently as spouse is allergic to them. No scale preventor. She said "changing the resistance is cheaper than using scale preventor (Kalgon)."
Maintenance & service: She cleans lint filter. She puts detergent in a ball to avoid cleaning the detergent drawer.

Personal Attributes
Attitude to task: She does not like laundry cleaning job.
Attitude to product: Neutral. She does not want to spend time with it.
Attitude to programmable products: She not interested in them. However, she does not want to set washing machine more than once. If it was possible to set the machine for wash, second rinse and dry in a single interaction, would prefer it.

ANALYSIS OF CONTEXTUAL FACTORS

1. **Letters on the machine panel are in low contrast and they are covered with gray plastic.**
2. **User feels physical pain after loading the machine.**
3. **She has farsightedness, it is hard for her to see the letters on the knob.**
4. **Used to forget the meaning of icons and looked up at the manual all the time.**
5. **User is confused about working of a button (IVS) if it spins when it is pressed or not pressed.**
6. **Manual was hard to understand.**

7. **Table on the panel is found inadequate.**
8. **It is hard to memorize the meaning of program letters.**
9. **User loads and starts washing machine in a rush and with little care.**
10. **User forgets clothes and wants to add them later in the middle of a wash cycle.**
11. **Does not want to set washing machine more than once for the same laundry.**
12. **Washes in a detailed manner and wants the washing machine to support this, does not like having to change the settings 2 times for a single laundry group.**
13. **Does not want to clean detergent drawer all the time, so uses a detergent ball.**

Social group: High
User: U3
Secondary Users: none
Age: 25-30
Education: University
Job: ISCO 2310 College, university and higher education teaching professionals
Machine: Siemens Siwamat XL54060
Satisfaction of user: Satisfied but does not care much. After all, washing machines are all similar. Realised that anti-wrinkle programme is not critical 'as you iron them anyway'
Attitude in purchase: Saw a commercial about its anti-wrinkle function. Consulted acquaintances who used Siemens. Did not buy Arçelik because plastics and interface seemed of low quality. Would still prefer digital and many-programmed washing machines, even though now she knows "you won't use all of the programmes".

USE ENVIRONMENT

Physical Environment:

Location of wm: WC. Turkish toilet is moved out to put wm. İn the room.
Infrastructure: There is no plug in room. She uses the plug in kitchen wall, an extension cable passes through entrance lobby to WC.
Visual Environment
llumination level: 1.5 lux
Any obstruction on wm panel: none
Space and furniture:
- washbasin is on the way. Obstructs her during loading and especially carrying laundry as she cannot turn around without lifting the full basket over the basin. Therefore she walks backwards to get out of the room.
-soap dish on the wall obstructs detergent drawer when she takes it out for cleaning residual dertergent and softener (see photo).

-cleaning tools (mop, bucket) and shoes in the room.
Safety hazards:
- extension cable accross the room, might trip over it.
-may hit to washbasin
-she put plug on cleaning bucket in case of water leakage from machine.
- family may trip over the extension cable, as it lies in high traffic areas (kitchen and entrance lobby)

Social environment

Helpers: domestic lady (do not use machine, do the ironing)
Assistance in case of problem: 1. Reads manual. 2. consults spouse 3. calls service
Interruptions during work: none

USER TASKS

1. Laundry loading

Task frequency: 2 times a week, preferably at night
User posture: (see photo)
Here she is kneeling because she did not have the laundry basket in front of her. Normally she bends down while loading. Said she experiences backache after emptying the machine.

Physical factors that make loading demanding:
-Has to bend forward, cannot move comfortably because of little space.
Safety: cable, may hit head to washbasin, Back ache after emptying
Side effects: backache

2. Programming

Side effects: ?
Task frequency per wash: set and leave (1)
Programming habits:
Uses only 3 prog.s:
Colored/whites: for colored (30˚)/whites (60˚)
"delicates" for curtain
wool program
Additional functions: Anti-wrinkle (her favorite), spin speed: jeans at 900, others at 800.
Not used: synthetic, heating more than 60˚ (detergents work well today), pump out water, extra rinse, spin.

Wash duration: Does not know, gets feedback from noise
Factors that make programming physically demanding: low illumination

USER CHARACTERISTICS

Skills and Knowledge

Task experience: 3.5years (since marriage).
Product experience: 3.5years.
Other product experience: the machine in mother's home (Arçelik 2100). She used that rarely.
Training level: Read manual.
Icons on wm: Knows if used frequently. Did not recognize 2 of the icons, but immediately consulted the manual and gave correct answer.
Terminology on wm: She consulted manual to clarify the term "hassas" in initial usage. Said others are presented clearly by the table on the panel.
Programs: Defines all. Said panel table is easy to understand and defines the programs well.
Detergents used: matik detergent, softener. No scale preventor (does not believe in its utility).
Maintenance & service:
-Cleans detergent drawer
- gets out stuck objects from the bottom filter , but does not clean it regularly. Sock got in washing machine, dyed clothes for sometime, she remebered the machine at mother's home so opened the bottom cap and got the sock out. Tried to solvethe problem herself first before calling service.

Personal Attributes

Attitude to task: Washing laundry is not a problem but neither a pleasurable task. Just a thing to be done.
Attitude to product: Likes her machine because it is silent. She washes usually late at night. No special attachment to her machine it seems.
Attitude to prog. products: Neutral to positive. Prefers many programs and digital interface in washing machines. Digital interfaces look aesthetic.

ANALYSIS OF CONTEXTUAL FACTORS

1. Loading position is uncomfortable because of inadequate space in WC.
2. Safety hazard: Risk of electrocution resulting from usage of extension cable in wet spaces (plug lies on floor in WC).
3. Safety hazard: people may trip over extension cable.
4. Low illumination level makes it harder to read from panel.
5. Angle of panel requires user to bend to be able to read from the panel.
6. Washing machine door cannot be opened fully, so does not permit comfortable loading.
7. Detergent drawer cannot be taken out easily because of soap dish on the wall.
8. There are unused programs and functions.
9. There are shoes on the floor, but water comes out from washing machne when bottom filter is opened.
10. User prefers to wash at night, so silence of machine is important.

Social group: High
User: U4
Secondary Users: Daughter
Age: 50+
Education: High school
Job: ISCO 4190 Other office clerks
Location of residence: Konutkent
Machine: Bosch V468 economic
Satisfaction of user: Automatic washing machines turned a tedious work into a simple task. This washing machine has too much programs, no need for them.
Attitude in purchase: Imported washing machines are of higher quality. She used to like the variable spin speed function but now thinks that it is useless.

USE ENVIRONMENT

Physical Environment

Location of washing machine: In bathroom
Infrastructure:
Space and furniture: She moves the laundry box when loading the washing machine, in order to have more space. Washing machine door opens to left, it would be more comfortable if it opened to the opposite side.
Visual Environment
Illumination level on panel: 12 lux
Any obstruction on washing machine panel: -

Safety hazards: -
User posture: see photo

Social environment

Helpers: daughter
Assistance in case of problem: 1. manual 2.husband
Interruptions during work: none

USER TASKS

1. Laundry loading

Task frequency: 1-2 times a week. Heavy usage during seasonal changes (washes clothes and piles them to wardrobe for the next season).
Physical factors that make loading demanding: Washing machine door does not open fully and the opening direction is not fit for the room.
Safety: - **Side effects**: -

2. Programming

Programming habits:
Uses 2 programs: Curtains with G; all other laundry with D, short program: whites at 40º, coloreds at 30º. Clothes are washed frequently, they do not need long, intensive cycles.
Not used: None of the programs except D and G.
High/low speed spin button, economy mode.

Side effects:
Task frequency per wash: 1
Wash duration: She thinks it as a half-day process. If she washes at night, irons in the following morning. If washes in the morning, irons in afternoon.
Factors that make programming physically demanding: The table on machine panel is not in Turkish, she looks to table she hung on the wall. She uses glasses and light is low, so it is hard to see. But rarely looks at it, as uses only one program for everything except curtains.

USER CHARACTERISTICS

Skills and Knowledge

Task experience: 25+ years
Product experience: 10+
Other product experience: None
Training level: Read manual, detailed table hung on the wall, they still look at it if needed.
Icons on washing machine: Icons of buttons are useful as reminder. She never looks at others because she uses the table hung on the wall.
Terminology on washing machine: In German, so never looks at washing machine panel, uses table hung on the wall.
Programs: Learned them in detail but does not use them now, because D program handles everything. Has not memorised anything, when asked, reads it form the table on the wall.
Detergents used: Matic detergent, softener. No scale preventor (used it for some time, then lost confidence in it).
Maintenance & service: cleans detergent drawer and the bottom lint filter. Detergent drawer is hard to move out, calls husbad for help.

Personal Attributes

Attitude to task: Neutral
Attitude to product: Neutral to positive. Automatic washing machine is very comfortable, she turns the knob and goes away.
Attitude to prog. products: Does not like them. Bought a programmable dishwasher which she could not succed in learning to use yet. Washes many pieces by hand because it is more practical.

ANALYSIS OF CONTEXTUAL FACTORS

1. **User does not like many-programs machines, thinks they create too much complexity for simple tasks. Today she would buy a washing machine with less programs.**
2. **Only 2 programs are used, one for curtains and one for all others.**
3. **Automatic washing machine is a big change in laundry cleaning work.**
4. **User piles whites in the washing machine, coloreds in the laundry box.**
5. **Laundry box is moved everytime washing machine is loaded in order to increase space.**
6. **When user was working, she used to do the washing on Friday nights so that she was able to iron them ("ütüyü kaldırmak") on Saturday mornings. Therefore she prefers a low noise washing machine.**

Social group: High
User: U5
Secondary Users: Cleaning lady
Age: 50-60
Education: University
Job: ISCO 13 GENERAL MANAGERS (This group is intended to include persons who manage enterprises, or in some cases organizations, on their own behalf or….)
Location of residence: Çankaya
Machine: Arçelik 4850
Satisfaction of user: Neutral. Wants to use hot water in the building, why heat twice? Mixes up all 3 washing machines she uses, so she has to look up at the manual for each use.
Attitude in purchase: When the previous washing machine was 'irreparably worn out', she phoned an Arçelik shop, the manager was her friend, asked them to send her a washing machine immediately, the one in the commercials. The washing machine in the commercial had additional functions such as wool washing program. She did not bother to go to the shop and examine all the washing machines. After two years, she realized that her washing machine was indeed an expensive model. She was pentinent at first but decided finally that "this machine washes even the cashmere pullovers, so it seems it is worth the price".

USE ENVIRONMENT

Physical Environment

Location of washing machine: In main bathroom
Infrastructure:
Space and furniture: Washing machine stands next to dryer. There is enough space for loading. Detergents are stored on the washing machine.
Visual Environment
Illumination level on panel: 73
Any obstruction on washing machine panel: -
Safety hazards: -

Social environment

Helpers: Cleaning lady
Assistance in case of problem: Calls service
Interruptions during work: None

USER TASKS

1. Laundry loading

Task frequency: It used to be every 2 days when children were living at home, now once a week.
Physical factors that make loading demanding: -
User posture: She injured her back, so now pays attention to her posture. Never carries heavy load (pulls the laundry basket near washing machine instead of lifting it). Never bends down; instead, she kneels.
Safety: - **Side effects**: back pain

2. Programming

Programming habits:
Selects laundry according to colors only (no seperation between socks and pillowcases, etc.)
Uses only short (fast) programs, starts the washing machine in the morning and goes out, gets bored if it is not finished when she is back home. Says that she washes frequently, so there is no need for high heat and long cycles. Uses "shorten the cycle" button sometimes, gets bored easily, fast washing is very important for her.
Uses tap water option (no heating) in summer (in winter, tap water is cold, will not clean oil stains).
Washes nylon socks and precious blouses by hand. Nylon socks need to be put in a washbag, not practical, so washes by hand. Does not trust to washing machine in precious blouses.
Not used: Spinning speed control, long programs

Side effects: Interface is not learnable, looks up to the manual every time she uses the washing machine.
Task frequency per wash: 1-2 (pushes shorten cycle button).
Wash duration: Too long!
Factors that make programming physically demanding: Control knob is hard to read: program indicators are embedded in the panel and covered with a dark grey plastic. She has to bend to be able to see the letters. She cannot bend because of her back, so after loading, she gets up to take the manual from its place on water hoses, looks at the manual to select a program, then kneels again to turn the program selection knob.

USER CHARACTERISTICS

Skills and Knowledge

Task experience: 35 years
Product experience: 3-5 years
Other product experience: 20+ years
Training level: Reads manual every time she uses the washing machine. Never able to learn as interfaces of all her 3 washing machine is mingled in her memory.
Icons on washing machine: looks at manual
Terminology on washing machine: looks at manual. Knows what can the washing machine do, and what she requires but does not know how which letter is for which program.
Programs: knows what can the washing machine do, but does not memorize the mappings in interface, looks up the manual to see which letter is for which program)
Detergents used: does not use softener (instead uses soda) and scale preventor ("scale preventor is so expensive that you can buy gold with that amount!")
Maintenance & service: immediately calls service "if hears a creek, etc."

Personal Attributes

Attitude to task: She likes "to work with water". Likes laundry washing too, likes the feeing of cleanliness.
Attitude to product: Neutral. Important that it functions well and washes fast. Never bothered to talk about these things with friends (when asked if there she had heard any problems happened to her acquaintances…)
Attitude to programmable products: Neutral, not afraid. Learned many functions on cellphone.

ANALYSIS OF CONTEXTUAL FACTORS

1. **User easily gets bored, wants washing machine to wash fast.**
2. **Does not use long cycle programs because washes frequently.**
3. **Washes in 6 in the morning (so that cleaning lady will iron when she arrives) so noise is important.**
4. **Control knob is hard to read: program indicators are embedded in the panel and covered with a dark grey plastic.**
5. **She has to bend a little to be able to see the letters. She cannot bend because of her injured back, so after loading, she gets up to take the manual from its place on water hoses, looks at the manual to select a program, then kneels again to turn the program selection knob.**
6. **Uses 3 washing machines, all have same programs but have different interfaces. She mixes all, so looks up the manual every time she uses washing machine. Never bothers to learn such things such as interface of a washing machine.**
7. **Every time she uses the washing machine, she looks at manual. Knows what can the washing machine do, and what she requires but does not know how which letter is for which program. Washing machine interface is not learnable for her.**
8. **Thinks washing machine is just a tool, not bothered to go to the shop and examine models even during purchase. She telephoned and asked for a model seen in commercials.**

Social group: High
User: U6
Secondary Users: None
Age: 25-30
Education: University
Job: ISCO 2310 College, university and higher education teaching professionals
Location of residence: Konutkent
Machine: Beko 2313CE, 3 months old
Satisfaction of user: high. Now she does not have to hand wash anything as this washing machine has that function too.
Attitude in purchase: Additional functions played an important role, especially anti-wrinkle and hand-washing. Bought the one with highest number of programs.

USE ENVIRONMENT

Physical Environment

Location of washing machine: In WC
Infrastructure: There is water outlet and space for washing machine is included in the room plan.
Space and furniture: Small space. Wall and closet leaves a tight area for the user to load the washing machine. In addition, laundry box is in the same room and on the way to washing machine. It also prevents the door from full opening. Detergent box and softener stand on the floor, in front of the washing machine.
Visual Environment
Illumination level on panel: 33lux
Any obstruction on washing machine panel: -

Safety hazards: May hit to door when lifting up from loading, if in a hurry
User posture: User puts a basin in front of washing machine door and bends down in order to load, as it feels too tight when she kneels.

Social environment

Helpers: None
Assistance in case of problem: 1. manual 2. service hot-line 3. calls service
Interruptions during work: None

USER TASKS

1. Laundry loading

Task frequency: every 2 days
Physical factors that make loading demanding: has to bend in an uncomfortable posture as closet is in her right hand side and hits it if she kneels.
Safety: - **Side effects**: back pain

2. Programming

Programming habits:
Wool program, Cotton program.
Hand washing function, Anti-wrinkle button.
Not used:
Mini 30, Delicate program, Fast program, Spinning speed control, Extra rinse, Extra spin, Water pump.

Side effects: -
Task frequency per wash: 1

Wash duration: does not know. Understands from noise if she is at home.
Factors that make programming physically demanding: low contrast on panel, thin fonts in letters

USER CHARACTERISTICS

Skills and Knowledge

Task experience: 5+ years
Product experience: 3 months
Other product experience: 5+ years
Training level: Read manual very carefully, telephoned service and asked questions about spinning function as it was not clear enough in the manual.
Icons on washing machine: Not much icon on washing machine, all are written
Terminology on washing machine: Terminology is very similar to the user's terminology. Defined programs are parallel to washing task. User feels very much in control. Additional functions are seperated instead of integrated into programs. In this way, user makes her own combination.

Programs: User defines the programs in detail, as she studied the manual in detail. Programs are similar to her old washing machine, but the definition and structuring is made to fit the users model of washing. She feels in control.
Detergents used: matic detergent, softener
Maintenance & service: Immediately calls service

Personal Attributes

Attitude to task: Washing is nuisance in daily life. She starts the washing machine and leaves, closes the door behind (noise).
Attitude to product: She moved to her own house and bought new white goods. Enthusiastic about them for the moment. Likes this washing machine as saves her from washing hand washed clothes- of which she has plenty. She said it was almost a joy to wash with this washing machine. She thinks this washing machine has more functions than her old washing machine. (when compared to old washing machine, she uses hand-washing function additionally). She finds this washing machine of high technology, she believes the higher the better and more efficient. Old washing machine did not have much options.
Attitude to prog. products: Likes to use high technology products.

ANALYSIS OF CONTEXTUAL FACTORS

1. **User studied manual in detail and phoned service for unclear points.**
2. **Inadequate space for comfortable loading, user has to bend down instead of kneeling.**
3. **Terminology of washing machine fits with the one of the user so she feels in control.**
4. **Frequent use and small amount of clothes in a single wash.**
5. **Shuts the door behind her because of noise.**
6. **Liked anti-wrinkle function but she irons clothes in any case, so this function did not prove to be useful.**
7. **Sets and leaves the washing machine. Washing is a task done in-between other things although she likes her washing machine.**
8. **Bought the one with the most functions, though she does not use all.**

Social group: High
User: U7
Secondary Users: Rarely child
Age: 50-60
Education: University
Job: ISCO 13 GENERAL MANAGERS (This group is intended to include persons who manage enterprises, or in some cases organizations, on their own behalf or….)
Location of residence: Çankaya
Machine: Beko 2314BP
Satisfaction of user: Low. It shrinks wools. Salesperson said this model used less energy and water but it is not true, because it has a small drum, so washes less laundry. Softener leaks out during washing, so she has to wait until washing is finished and then add softener and rinse again. Detergent drawer easily gets dirty but it is hard to take it out to clean.
Attitude in purchase: Looked for the lowest price. Wanted wool washing function. Did not want many programs, wanted it simple. Thinks that complicated, programmable products wear out more easily.

USE ENVIRONMENT

Physical Environment

Location of washing machine: Main bathroom
Infrastructure: Specialized faucets.
Space and furniture: Hidden in bathroom cupboards.
Visual Environment
Illumination level on panel: 16
Any obstruction on washing machine panel: -
Safety hazards: Electricity is carried with extension cable form the next wall which may create hazard. User cannot reach the back of washing machine.

Social environment

Helpers: Cleaning lady
Assistance in case of problem: 1.husband 2. service
Interruptions during work: Usually uses the washing machine in-between other activities and hurries during usage.

USER TASKS

1. Laundry loading

Task frequency: Before, when children were at home, washed every day or every 2 days. Now spend much time in a country house where there is no washing machine. Brings the laundry when comes to Ankara. Therefore washing machine works continuously for 1-2 days, then it is not used for 2-3 weeks.
Physical factors that make loading demanding: Cabinet doors.
User posture:
Safety: She may hit the cupboard doors when she is in a hurry.
Side effects:

2. Programming

Programming habits:
Laundry is not very dirty, so uses short programs.
Underwear is washed for 2 times, first cold, then hot.
Uses starch, so rinses 2 times.
Not used: Long programs (A, B).
Side effects: Wools are shrunken, softener gets lost if put in the beginning.
Task frequency per wash: 2. Adds softener or starch and rinse again because softener leaks out of the drawer. Washes underwear 2 times.
Wash duration: She does not know. Starts and goes away, opens when she's back home. But if she's home, listens to sound of washing machine to understand if finished- adds starch when finished.
Factors that make programming physically demanding:

USER CHARACTERISTICS

Skills and Knowledge

Task experience: 20 years
Product experience: 3 years
Other product experience: 1 in other house. Uses automatic washing machine for 20+ years.
Training level: Read manual
Icons on washing machine: Does not look at them, reads from the sticker-table on panel
Terminology on washing machine: Defines all.
Programs: Learned them all at first, every washing machine works on the same principles, anyway. Now uses several programs and uses them from memory.
Detergents used: Matic detergent, starch, softener, matic bleach. No scale remover.

Maintenance & service: Calls husband to take out the detergent drawer; it is hard to take it out.

Personal Attributes

Attitude to task: Tries to spend as little time on laundry as possible. Does not want laundry to interfere with daily life.

Attitude to product: Enough that is functions- but this washing machine does not function properly! Does not like this washing machine.

Attitude to programmable products: She would like a programmable oven but for washing machines, they are simple machines, no need for them to be programmable. She has no interest in programmable things.

ANALYSIS OF CONTEXTUAL FACTORS

1. **User wanted washing machine to be as simple as possible, no need for many programs, washing is a simple task anyway.**
2. **Listens to the sound to see if washing cycle is finished.**
3. **Washing machine is hidden behind cupboard.**
4. **Extension cable is used but it is not on the way.**
5. **Cannot reach the back of washing machine.**
6. **Hard to take out detergent drawer, calls husband for help.**
7. **Does not use long programs. If too dirty, washes 2 times in a short program.**
8. **Does not recognize icons, reads the sticker-table on washing machine. In time, that sticker will be worn out. Maybe the producers think user will memorize all programs until that time.**
9. **Does not like to wash laundry or spend time in front of the washing machine.**

Social group: Low
User: U8
Secondary Users: Daughter
Age: 40-45
Education: No school
Job: Housewife (head of household: ISCO 9132 Helpers and cleaners in offices, hotels and other establishments)
Location of residence: Altındağ
Machine: Beko 800Devir, age 15
Satisfaction of user: Positive. Automatic washing machine is very important. Of course there will be some problems, but this works well, will not change until it wears out. (It seems washing machine had problems: hose got out of place, water got in motor).
Attitude in purchase: Husband gave his entire wage to washing machine payments for 5 months, so he worked as a porter of furniture in weekends. They bought the best washing machine present in those days (she said this has a spin speed of 800 turns and washes 6 kg. She bought her son a 1000 spin speed one).

USE ENVIRONMENT

Physical Environment

Location of washing machine: In kitchen
Infrastructure: The squatter house had no water outlet for washing machine, so they dig the wall and brought an additional pipe from faucet.
Space and furniture: LPG tube stands in front of washing machine, near the wall. Hose stretches over the washing machine. Floor is covered with carpets
Visual Environment
Illumination level on panel: 2
Any obstruction on washing machine panel: LPG hose
Safety hazards: LPG tube and hose.

Social environment

Helpers: Daughter
Assistance in case of problem: Calls service- washing machine is worth the money paid to servicemen.
Interruptions during work: None

USER TASKS

1. Laundry loading

Task frequency: said 3 times a day sometimes (??)
Physical factors that make loading demanding: LPG and washing machine door obstructs comfortable loading.
User posture: She loads from the side, bending over the washing machine door. Puts basin in front of washing machine, so no place is left for her because of LPG.
Safety: Unhealthy posture
Side effects:

2. Programming

Programming habits:
Uses 1 pre-wash program (A) and 3 heating levels: coloreds 30, whites 75 (there is no 75 written on knob!!), "solmayanlar" at 95. If there are too much shirts, then, at 70 because ironing is easier if washed in lower heat.
Arbitrarily "turns to" B, arbitrarily presses ½. Someone said it is for washing curtains.
Not used: Programs except A and B.
Side effects: Shrinkage and fading seems to be experienced. Curtains might not be cleaned well if presses ½ button.
Task frequency per wash: 1
Wash duration:
Factors that make programming physically demanding: Low illumination.

USER CHARACTERISTICS

Skills and Knowledge

Task experience: 20+ years
Product experience: 15 years
Other product experience: none
Training level: Servicemen explained how to use it when they installed the machine.
Icons on washing machine: She does not understand them.
Terminology on washing machine: She is illiterate.
Programs: She memorized 1 program. Uses heat control. Does not know others. Can read letters on knob.
Detergents used: Matic detergent, softener, matic soda and scale preventor.
Maintenance & service: Takes out stuck pieces from bottom lint filter. Never cleaned detergent drawer as it is hard to take out. When she washes carpets, the drum slows down.

Personal Attributes

Attitude to task: She liked laundry work after they bought an automatic washing machine.
Attitude to product: Positive. Takes care of it as best as she can. Seems that she likes to use it. Might be a status symbol.
Attitude to programmable products: She does not possess any.

ANALYSIS OF CONTEXTUAL FACTORS

1. **Husband worked as porter in weekends for 5 months to pay for washing machine. Very important possession.**
2. **Never took out detergent drawer, it is hard to do it.**
3. **User is illiterate but recognizes letters.**
4. **Does not know programs. Memorized 1 and uses it in various heat settings.**
5. **Calls service, worth the money for washing machine.**
6. **Uses softener, scale remover, soda matic, matic detergent.**
7. **Overloads with carpets sometimes.**
8. **Arbitrary or wrong usage of functions and programs.**
9. **Husband chose the model.**
10. **LPG tube and hose create safety hazard and uncomfortable loading.**
11. **Carpets on the floor may get wet.**
12. **Loading made from side bending over washing machine door.**
13. **Washing machine door does not fully open and open to unsuitable side**
14. **There are voltage variations in the area.**
15. **Water freezes in winter.**
16. **Water hose got out once.**

Social group: Low
User: U9
Secondary Users: Husband
Age: 40-50
Education: Primary school
Job: ISCO 9131 Domestic helpers and cleaners + ISCO 9141 Building caretakers
Location of residence: A. Ayrancı
Machine: Arçelik Full Automatic 2200
Satisfaction of user: High, especially after non-automatic machine. "emektar". Cleans well. Has bought a new washing machine which is digital. She cannot manage to use it, too complex for her she said. Her 15 year old son learned it immediately, he tires to teach her now. This old one is easy to use.
Attitude in purchase: Brand loyal, latest model at the time of purchase. Said "most expensive is the best, isn't it?" She has bought a digital, many programmed washing machine recently; "of course " it is an Arçelik.

USE ENVIRONMENT

Physical Environment

Location of wm: In bathroom & Turkish WC, next to WC
Infrastructure: Sand in water, so cleans the water hose.
Space and furniture:
- bath is washed frequently, water spill to machine. Rust developed. User has made a concrete set on her own in order to prevent water spills to machine.
- door obstructs passage and loading
- space in front of wm is inadequate, she loads from side

Visual Environment
Illumination level:
Any obstruction on wm panel: hard to see the letters and icons on the turning knob as they are inlaid and covered with gray plastic. User said she cannot read anything as she has developed farsightedness.
Safety hazards:
-may hurt herself when lifting the filled basin up, over the machine.
-may trip over the set between WC and machine.

Social environment

Helpers: Daughter
Assistance in case of problem: 1. husband, sister 2. service (avoids calling servicemen, because believes they will not cure washing machine although they charge a high price. They change parts instead of finding and solving the problem).
Interruptions during work: Her two children when they were small.

USER TASKS

1. Laundry loading

Task frequency:
Physical factors that make loading demanding:
User posture: There is room door and wall behind her. Has to pull the clothes from left side of washing machine when loading, she cannot pass with basin in hand, so lifts it higher and over the machine, steps to other side, opens the door with her foot.
Safety: Might trip over the concrete set, might hit head to wash basin or door handle.
Side effects: back ache, arm ache.

2. Programming

Usage of programs:
Uses 3 programs:
A or B for whites/coloreds, whites at 90°
D or F for curtains (does not know the difference, uses arbitrarly).
J for wool
Not used: economy mode, ½ mode, non-spin button. Delicates program.

Side effects: husband broke the knob because applied to much force at the end point
Task frequency per wash:-
Wash duration: does not know, starts the wm and leaves. Listens to its noise to understand if it is finished washing.
Factors that make programming physically demanding:
-Low contrast on panel
- Inlaid knob
- Gray translucent cover

USER CHARACTERISTICS

Skills and Knowledge

Task experience: 20+ years
Product experience: 15+ years
Other product experience: She has 2 washing machines and uses the ones in households where she works, under guidance.
Training level: Did not read manual. Her sister had the same washing machine, she taught the participant basic usage. Said it was hard to learn at first. Then started to read table on panel and learned the rest herself from that table.
Icons on wm: Does not use, does not know.
Terminology on wm: Defines all, except "narin"(gentle).

Programs: She cannot define the non-used programs and additional functions such as economy mode, ½ full mode and non-spin. Cannot define delicates program. Does not know the difference between D and F.
Detergents used: matic detergent, softener, scale preventor.
Maintenance & service: Cleans detergent drawer, the lint filter and filter of the water hose.

Personal Attributes
Attitude to task: Easiest house work.
Attitude to product: Likes it now, a bit emotional "emektar".
Attitude to programmable products: She is not interested in them. Bought the new washing machine digital wm because it was the most expensive one. Does not use cellphone.

ANALYSIS OF CONTEXTUAL FACTORS

1. Clearances are not met for comfortable loading.
2. Water spillage on wm, there is rust on wm.
3. Safety hazard: concrete set on floor.
4. Dirty water.
5. It was hard to learn to use the washing machine. User did not read manual, asked relatives, who do not know much either.
6. User does not trust one of the functions-economy mode. Thinks will not clean enough.
7. User cannot understand the icons.
8. User cannot read the panel, has farsightedness and there is low contrast.
9. Avoids calling service does not trust them and too expensive for her.
10. Unused programs.
11. User's terminology for the task does not match with the terminology of the interface.
11. Secondary user, husband, broke the knob.

Social group: Low
User: U10
Secondary Users: Daughter, son, husband
Age: 30-40
Education: Primary school
Job: ISCO 9131 Domestic helpers and cleaners + ISCO 9141 Building caretakers
Location of residence: Çankaya
Machine: Arçelik full automatic
Satisfaction of user: Highly satisfied about washing machine and its brand.
Attitude in purchase: Brand loyal. Neighbor advice. Husband chose the model.

USE ENVIRONMENT

Physical Environment

Location of washing machine: In the bedroom.
Infrastructure:
Space and furniture:
- Water brought to washing machine through a hole in the wall.
- Washing machine stands on carpet.
- Small area. Bed next to washing machine. Keeps laundry in it because there is no other place. Can open washing machine door only 90°

Visual Environment
Illumination level on panel: 30 lux
Any obstruction on washing machine panel: -
Safety hazards: Water leakage may create big problems as the floor is covered with carpet; carpet may cause overheating or create risk of fire in a small spark.

Social environment

Helpers: Daughter, son.
Assistance in case of problem: Calls service. No problem until today. Her people in the village cannot leave washing machine unattended because of frequent water cuts.
Interruptions during work: None.

USER TASKS

1. Laundry loading

Task frequency: 10 years. Before, every 2 days, now 1 a week (building requires that they pay for the electriciy now).
Physical factors that make loading demanding: Small area. Bed next to washing machine prevents comfortable loading of washing machine.
User posture:
Safety:
Side effects:

2. Programming

Programming habits:
She memorized 3 programs, one for coloreds, one for whites and one for curtains.
Not used: Short programs, functions with buttons
Side effects: coloring of whites
Task frequency per wash: 1
Wash duration: whites 2.5 hours, coloreds 1.5 hours
Factors that make programming physically demanding: Low contrast on knob and table on panel.

USER CHARACTERISTICS

Skills and Knowledge

Task experience: 20+ years
Product experience: 10 years
Other product experience: Household where she works
Training level: Servicemen explained when they brought the washing machine. Reads the table on panel but mostly learned from neighbors and relatives.
Icons on washing machine: Defines none but reads program letters (A,X, J, G..).
Terminology on washing machine: Memorized a few programs, so programs the washing machine from memory. When asked, reads definitions on panel.
Programs: Memorized two: A for whites, B for coloreds.
Detergents used: Matik detergent. Scale preventor is too expensive, she stopped using it.
Maintenance & service:

Personal Attributes

Attitude to task: Her job.
Attitude to product: Automatic washing machine saved life, loves it
Attitude to prog. products: She said she cannot use even the TV remote control. Does not want digital washing machine, you turn a knob with this one, very easy.

ANALYSIS OF CONTEXTUAL FACTORS

1. **Washing machine is in bedroom, water brought through a hole in wall. There is no space in bathroom.**
2. **Bed next to washing machine prevents comfortable loading.**
3. **Safety hazard: washing machine stands on carpet.**
4. **Does not know programs well, memorized a few and uses them. Thinks she is a expert user though.**
5. **Wants simple washing machine.**
6. **Learned to use from acquaintances.**
7. **Said people in village wait in front of washing machine in case of a water cut, because they are afraid of motor burns.**
8. **There is water scarcity in village, here they are comfortable in city.**

Social group: Low
User: U11
Secondary Users: Son, daughter-in-law, relatives.
Age: 50+
Education: No school
Job ISCO 9131 Domestic helpers and cleaners
Location of residence: Seyranbağları
Machine: Arçelik 3800FT, 3 months old
Satisfaction of user: Not satisfied, almost regrets. Cannot use it! Washing used to be her job, as son and daughter-in-law works. Now she has to leave that job to them. She said "I sit vacant all day at home without doing anything like a disabled person".
Attitude in purchase: Brand loyal. Bought the best brand and newest model.

USE ENVIRONMENT

Physical Environment

Location of wm: In front of bathroom. Water comes from bathroom through a hole in the wall. This part of the house used to be a seperate squatter house. Washing machine stands in a former room, which is used as a passage and storage now.
Infrastructure: water freezes in winter + water cuts.
Space and furniture: Plenty of space, but carpets in front of washing machine.

Visual Environment
Illumination level on panel: 6 lux (in day, curtains are always shut)
Any obstruction on wm panel: -
Safety hazards:
User posture:

Social environment

Helpers: Son helps daughter-in-law in using the washing machine, daughter in law helps user in washing. She needed no help with her previous machine, an Arçelik Lavamat.
Assistance in case of problem: 1. relatives 2. service
Interruptions during work: None.

USER TASKS

1. Laundry loading

Task frequency: 3 times a week, in daytime (now at night, after her son is back from work)
Physical factors that make loading demanding:
Safety: A pin cut the plastic seal in which the washng machine door closes.
Side effects:

2. Programming

Usage of programs:
A relative came to their house to wash his laundry 2.5 months ago. He changed the washing machine settings, they could not make it start again. Her son studied the manual and did tiral and error for 3 days to correct the settings and make it wash again. Now they do not change anything, do not touch any button. They only choose whites/coloreds by turning the knob.

Side effects: Frustration
Task frequency per wash:
Wash duration: "too long" 2.5 hours for whites.
Factors that make programming physically demanding: low illumination.

USER CHARACTERISTICS

Skills and Knowledge

Task experience: 30+ years
Product experience: 3 months
Other product experience: 20+ years
Training level: None. Serviceman explained but they did not understand anything.
Icons on wm: Defines none except that digital screen shows left time.
Terminology on washing machine: none
Programs: none
Detergents used: matic detergent, softener, Kalgon
Maintenance & service: She does not touch anything on washing machine.

Personal Attributes

Attitude to task: She likes washing with automatic washing machine very much. Likes when the perfume of softener fills the house.

Attitude to product: Almost afraid to touch.

Attitude to prog. products: Discreet, does not understand them, afraid to cause damage.

ANALYSIS OF CONTEXTUAL FACTORS

1. Tap water freezes in winter, or cuts in summer. They gather their laundry and carry to relatives' house and wash there.

2. Low illumination.

3. Outside users may give harm to washing machine, or change settings.

4. Main user cannot learn washing machine, feels herself useless.

5. Other users too are frustrated with washing machine because of its complexity.

6. Manual is not helpful enough.

Social group: Low
User: U12
Secondary Users: Mother in law
Age: 30-35
Education: Primary school
Job: ISCO
Location of residence: Altındağ
Machine: Arçelik 3340, age 5
Satisfaction of user: Low. Clothes shrink, machine does not clean well. Detergent drawer and program selection knob is broken. Still, washing machine is a vital element in house, said "pass everything, washing machine is very important" . Also husband cares much for washing machine.
Attitude in purchase: Husband brought as dowry.

USE ENVIRONMENT

Physical Environment

Location of washing machine: In the kitchen
Infrastructure: voltage variations harm machines, she unplugs it when there is electricity cut (their radio-tape broke down because of this) water might be freezing in winter.
Space and furniture: carpet in front of washing machine. Coverd with decorative (synthetic) cloth. There is no obstruction
Visual Environment
Illumination level on panel: 35 lux
Any obstruction on washing machine panel: decorative cloth covers the panel when washing machine is not in use
Safety hazards: Voltage variations might create risk of fire. Cover cloth and plastic rack (stands next to washing machine) can ignite in case of fire.

Social environment

Helpers: mother in law, sister
Assistance in case of problem: 1. neighbors, husband,relatives 2. service
Interruptions during work: two children younger than 5.

USER TASKS

1. Laundry loading

Task frequency: every 2 days because of children
Physical factors that make loading demanding: None. She piles laundry in the washing machine.
Safety: **Side effects**:

2. Programming

Programming habits:
All clothes: Uses only pre-wash program (A) whites at 90°,coloreds at 30-40. (pullovers shrink, so she washes them by hand). Curtains: curtain program (F) at 60°.
Not used: Programs except A and F; functions operated with buttons (1/2, water pump, spin speed).
Side effects: Unclean clothes (especially baby's because there is saliva on them), shrinkage
Task frequency per wash: 1
Wash duration: Washes at night because electricity is cheaper then.
Factors that make programming physically demanding: Low contrast and small fonts, has to bend over to see them.

USER CHARACTERISTICS

Skills and Knowledge

Task experience: 5 years
Product experience: 5 years
Other product experience: none
Training level: Servicemen "did not explain well", so they learned to use from neighbors (who gave wrong instructions: wash wools at B) or relatives (sister told her to wash coloreds at 40° after 5 years of usage).
Icons on washing machine: Curtains are clear, does not know others.
Terminology on washing machine: There is no terminology on washing machine, only icons.
Programs: She does not know any of the programs except curtains (curtain icon is clear because she looked at the panel and read from there). Memorised A, washes everything with it at 90°. Pullovers shrink, so she hand-washes them. Clothes are not cleaned well. After 5 years of usage, a relative newly taught her to wash clothes at 30-40°. Detergent is left in the third compartment, acquaintances said it is a useless compartment.
Detergents used: Matic detergent. Does not use scale preventor but not confident, asked interwiever if she is doing right because washing machine is very important.
Maintenance & service: Servicemen got out a sock from the bottom lint filter (she does not know). Had noise in the first days now it does not happen (did not call service). Washes detergent drawer but broke it because it is hard to take out.

Personal Attributes
Attitude to task: Neutral.
Attitude to product: She likes her washing machine though it is an alien to them, she is afraid to break it down.
Attitude to prog. products: Does not possess any.

ANALYSIS OF CONTEXTUAL FACTORS

1. **Servicemen did not explaiend well, so user depends on relatives and neighbors advice (which are usually uncorrect).**
2. **Inadequate knowledge of washing machine causes shrinkage and unclean clothes.**
3. **Washing machine is the most important item in the house but they are alien to it.**
4. **User does not chose, husband brings as dowry.**
5. **Third compatment in detergent drawer is thought to be useless.**
6. **None of the programs or functions are used except A (pre-wash long) and F (curtain).**
7. **Detergent drawer is hard to take out.**
8. **Detergent drawer and program knob is broken.**
9. **Voltage variation breaks down machines ("neighbors' are all gone").**
10. **Piles dirty clothes in the washing machine.**
11. **Does not use scale preventor (cannot afford) but afraid to give harm to washing machine by not using it.**
12. **Carpet in front of washing machine.**
13. **Uses washing machine at night to utilise electricity discount.**
14. **Voltage variations broke down their radio-tape.**

Social group: Low
User: U13
Secondary Users: None
Age: 30-40
Education: Middle school
Job: ISCO 9131 Domestic helpers and cleaners, ISCO9141 Building caretakers professionals
Machine: Arçelik 5700 Super, age 6-7
Satisfaction of user: Low. Makes too much noise. Tears the clothes.
Attitude in purchase: Brand loyal. Everything at home is Arçelik. Bought the newest model in the market. "now there are digtal ones, these are out of fashion" she said. They all decided together with husband's brother's family; bought the same washing machine.

USE ENVIRONMENT

Physical Environment:

Location of washing machine: Previously washing machine was in the kithcen. When they bought a dishwasher, they moved it here: In the corridor leading to bathroom. There is no place in bathroom. They carry water hoses through a hole in the wall.
Infrastructure:
Visual Environment: llumination level: 5.5 lux
Any obstruction on washing machine panel: none
Space and furniture: washing machine is on carpets.
Safety hazards: Washing machine may get overheated because of carpets; dirty water hose crosses the bathroom to reach washbasin. Risk of tripping to it.

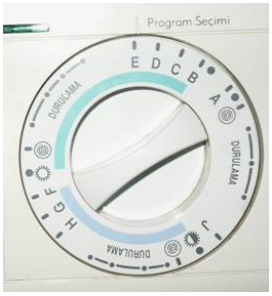
Social environment
Helpers: none, daughter strings them up sometimes
Assistance in case of problem: 1. husband opens the back and tries to repair. Avoid calling service, they do not trust them; said "they change everything to charge more money, they do not solve the problem. Or, they do nothing and still charge a visit price". Husband takes a chance, if he can repair, they save money, if he cannot, then they will call service anyway.
Interruptions during work: none.

USER TASKS

1. Laundry loading

Task frequency: 1-2 times a week, preferably when she is at home. If she leaves laundry in washing machine, they wrinkle, she wants to hang them immediately after washing.
Physical factors that make loading demanding: She puts one knee on floor, but it is soft.
Safety: **Side effects**:

2. Programming



Side effects: Shrinkage.
Task frequency per wash: set and leave
Programming habits:
Uses 3 prog.s: Curtains (blue side, J); Whites/coloreds, wools in short program (green side, E or D) If whites are "purple" after D or E, then C (program for cottons, 95°); sometimes pre-wash (A).
Drying function.
Not used: Button controlled functions (spin level, non-spin, etc.).

Wash duration: Too long, so uses the shortest programs.
Factors that make programming physically demanding: Color coding is very useful it seems.

USER CHARACTERISTICS

Skills and Knowledge

Task experience: 10+ yrs. (since marriage)
Product experience: 6-7yrs.
Other product experience: The washing machine in the household she works, but uses under guidance.
Training level: Husband read manual and taught her.
Icons on washing machine: She uses color coding on knob: blue for curtains, green for clothes. Thinks table and knob are different, said "don't look there, all is here" by pointing to the knob. Recognises icons in drying mode and the spinning icon.
Terminology on washing machine: Never reads table on panel. No relationship is recognised between the programs (letters on the knob) and the table.
Programs: Does not know the programs in detail. She memorised 3 programs by trial and error. Now uses them. Memorised the letters, uses similar ones arbitrarily. Does not read table or manual, she washes wool in non-delicate programs too. Does not know the functions of buttons. Defines drying "fast" and "slow" (synthetics- cottons).
Detergents used: matik detergent, sometimes softener. No scale preventor- not aware.
Maintenance & service: Cleans detergent drawer; husband gets out stuck objects from the back. (does not know the bottom lint filter).

Personal Attributes
Attitude to task: Washing laundry is not a problem. The simplest task among housework.
Attitude to product: Automatic washing machine is wonderful. It does the work for her, she just turns the knob. However, this washing machine has many technical problems at the moment (tears clothes, water leakage, too much noise).
Attitude to prog. products: Buys "in vogue" tools, the highest technology if possible, but not able to use them.

ANALYSIS OF CONTEXTUAL FACTORS

1. **User cannot use washing machine effectively. Does not know programs, uses arbitrarly.**
2. **Does not read the table on panel, just uses color coding on the knob so makes mistakes.**
3. **Cannot make connection between table and program selection knob.**
4. **Avoids calling service although the washing machine has problems. Does not trust repairmen and calling service is too expensive for them.**
5. **Bought the latest technology although cannot use it.**
6. **Washes when at home as clothes wrinkle too much if they stay in the washing machine.**
7. **Safety hazard: water hose crosses the bathroom.**
8. **Washing machine stays on the carpet, in the corridor.**
9. **Water is connected through a hole in the wall.**
10. **Water leakes and carpets get wet.**

APPENDIX C

INDICATOR POINTS			PARTICIPANTS												
			AA	**TE**	**LA**	**CE**	**DI**	**PE**	**AN**	**FA**	**DO**	**SU**	**MU**	**AY**	**GU**
Possesion of products															
if present	video	**12**	12	12	12		12	12	12			12			
	microwave	**11**	11			11			11						
	dishwasher	**11**	11	11	11	11	11	11	11					11	11
	car	**10**	10	10	10	10	10	10	10					10	10
	camera	**9**	9	9	9	9	9	9	9						
if absent	automatic wm	**-10**													
	oven	**-11**													
	normal/auto wm	**-11**													
	refrigerator	**-13**													
Job- Head of HH															
qualified proffesional		**23**													
employer 5+ emp.ee		**20**													
director 5+ emp.ee		**19**	19						19						
director <5 emp.ee		**16**													
employer <5 emp.ee		**10**													
white collar (memur)		**9**				9		9							
farmer -has 1+ workers		**8**													
retired		**1**		1	1		1								
self-employed		**-1**													
blue collar (işçi)		**-3**								-3	-3	-3	-3	-3	-3
farmer -has <1worker		**-11**													
Education-Head of HH															
university		**18**	18	18	18	18	18	18	18						
high school		**9**										9			
middle school		**3**											3	3	3
primary school		**-2**								-2	-2				
no school		**-14**													
total points per participant			*91*	*61*	*61*	*68*	*61*	*69*	*90*	*-5*	*-5*	*18*	*0*	*21*	*21*
socio-economic group per participant			**A**	**A**	**A**	**A**	**A**	**A**	**A**	**D**	**D**	**C2**	**D**	**C2**	**C2**

HIGHER GROUP			**LOWER GROUP**		
A	points	53+	**C2**	points	2...13
B	points	35....52	**D**	points	1... -31
C1	points	14....34	**E**	points	-32

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