Cooperation and Integration
Do we need them in Ubiquitous Computing Design?

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This thesis is submitted to the Department of Interaction and System Design, School of Engineering at Blekinge Institute of Technology in partial fulfillment of the requirements for the degree of Master of Science in Computer Science (Ubiquitous Computing). The thesis is equivalent to 20 weeks of full time studies.

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ABSTRACT

This thesis takes into account mainly the cooperative design and human factors from ubiquitous computing design perspective. Areas such as role of cooperative design in ubiquitous computing perspective, the changing attributes of society and the associated issues, the changing shape of public service delivery and need for a change in methodology in ubiquitous computing projects have been discussed.

The overall approach is taking advantage of Suchman’s idea of ‘design as an artful integration of different social as well as technical aspects'. The advantage of the technique has been taken by bringing together social and societal aspects, agenda of governments from IT perspective, human factors and purely designs methodology to frame up in which we need to re-assess ubiquitous computing design methodology.

The thesis work comprises literature review, and a case study to pick up on the role of cooperative and participatory design. The probe was specifically in the context of ubiquitous computing design requirements and ubiquitous computing vision.

Keywords: Cooperative Design, Information Society, E-government, Human Factors, Ubiquitous Computing.
ACKNOWLEDGEMENTS

I am very much thankful to my supervisor and program manager Mr. Marcus Sanchez Svensson who has been very helpful throughout the thesis work and the masters program as whole.

I am also thankful to Prof. Sara whose help enabled me building my focus around the idea.

Special thanks to my family and friends. Without their support it won’t have been possible.
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1 INTRODUCTION

1.1 Background

Ubiquitous computing has been on the technology horizon since 1991 when Mark Weiser put forward his ideas regarding a new form of computing technology that would reverse the design of how personal computing has come up over years [10]. And at the same time provided an ideological basis for how things should come up in 21st century when it comes to computing technologies.

Robin Milner recently reviewed [9] the understanding of ubiquitous computing over past years; highlighting some of the important associated questions. He started with the social part of ubiquitous computing phrasing it as, ‘what ubiquitous computing systems (UCSs) do people want or need, and how will they change people’s behaviour?’

The vision of ubiquitous computing has been highlighted as to keep human at centre of design and arrange the technology around human needs and his social setup and impact of design on humans and society [9]. Milner has further mentioned the holistic and dualistic views of ubiquitous computing systems. While the dualistic view takes humans and technology as two different entities; ignoring the human aspect so far and working more with the technological artefacts; the holistic view draws an overall picture taking humans as an integrated part of the system.

Both dualistic and holistic are helping researchers exploring new aspects of computing systems. But there has been a continuous debate over ubiquitous computing design methods over past years. Researchers have criticised some of the designs being a failure because user and its interaction with its environment had been missing [8]. As mentioned earlier the ubiquitous computing systems are supposed to be designed as per needs and desires of users; as against most of the conventional software systems that require users to be adaptive and flexible.

![Diagram]

Figure 1

For a successful ubiquitous computing design, designers need to consider the end user interactions in the context of use and the usability of the technology in its underlying infrastructure. In other words coming up with a desired ubiquitous computing design is
impossible without involving the users, domain experts, human factors, the work practices and work settings. This has made the participatory and cooperative design methods and practices an immense and highly desirable trait for ubiquitous computing.

Most of the reviews and case studies identifying the role of cooperative and participatory design in ubiquitous computing perspective revolve around technological prototypes; being dualistic in nature so to say. This works will discuss the role of cooperative and participatory design in a holistic perspective trying to trace out the need for change in over all practices.

Through this research I will try to find out whether it’s advantageous using cooperative design in the ubiquitous computing context. Further I will try to find out what role can Cooperative and participatory design play in e-government projects from ubiquitous computing design perspective. The designers have been discussing related issues and using cooperative and participatory design approaches in numerous e-government projects in recent years [2] [5] [7]. There are however, questions raised [4] regarding idea of participation that need to be addressed.

Furthermore as against the conventional personal computing technologies ubiquitous computing is going to come up with designs for a society that is undergoing a continuous and thorough change. This change is based upon information and communication technologies to a greater part. Governments are playing a very active role to support this change. The ‘National Information Infrastructure (NII)’ for the American society and the idea of an ‘Information Society’ hatched by European think tanks are a clear indicator of this fact. It is, therefore, quite hard to ignore overall direction of society in a holistic design context. In other words this research tries to trace the need for a holistic approach towards ubiquitous computing system design taking into account the technological directions of society involving all the actors that can affect the design and design process in any way.

In this thesis, being part of research in Europe, the society will be referred to as ‘the Information Society’. The idea of information society was first brought, back in the year 1999 through the European Commission's initiative ‘eEurope. An Information Society for All’[6]. This initiative set its 5 year objectives as follows [11]:

- Bringing every citizen, home and school, every business and administration, into the digital age and online.
- Creating a digitally literate Europe, supported by an entrepreneurial culture ready to finance and develop new ideas.
- Ensuring the whole process is socially inclusive, builds consumer trust and strengthens social cohesion.

The purpose to mention these socio-technical targets is to give a meek idea of the potential audience and infrastructural settings for ubiquitous computing solutions and systems. In information society where the technical infrastructure won’t be an issue; human factors will gain more weight in design than today. European Commission’s reports [12] [13] support the fact that most of these targets have already been achieved by the European governments and rest are on their way. More specific and advanced goals have been set for the next five years namely 2008-2013 (FP71).

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1 FP7, the European Union’s latest research programme
Figure 2

Above chart gives a brief idea of the direction that European Society is expected to follow in the years to come. The chart is based upon the figures given in European commission’s report ‘ICT in FP7 at A Glance - mid November, 2006 (Injecting over €9bn to boost European Information and Communication Technologies (ICTs))’ [13].

Figure 1 reflects upon the vision of European governments with a proportional investment in almost all the major infrastructural components that become the basis of information society. The initiatives by major leaders in the world namely Europe and America and the keenness of governments around the world to embrace information and communication technologies reflects upon the role that governments are playing to carve out future. Being ubiquitous computing system designers we cannot ignore the steps taken by governments that are bringing new design opportunities and challenges. Whereas changing face of society, diminishing resources and industrialization has introduced many new challenges; information society will have its own.

1.2 Challenge

The research work will comprise a review of cooperative and participatory design literature; finding its inherent relationship with ubiquitous computing.

The challenge further lies in identifying the potential role of cooperative and participatory design in reshaping the e-government/ e-services believing e-government as a means to achieve the goal of sustainable development in the information society.

The research will briefly highlight the challenges posed to and by ubiquitous computing in the technological and social change context.

The intentions of the research thus could be summarised being identifying the potential benefits drawn from the holistic design approach and cooperative design for e-government and ubiquitous computing.
1.3 Research Questions

The research will try to probe into the following areas:

- The role of cooperative design in ubiquitous computing perspective.
- The changing attributes of society and the associated issues.
- The changing shape of public service delivery.
- The need for a change in methodology in ubiquitous computing projects.
- How can the idea of artful integration be used with findings?

1.4 Research Methods

The overall approach will be taking advantage of Lucy Suchman’s idea of ‘design as an artful integration of different social as well as technical aspects’ [1]. Whereas the term design used wherever in the discussion means designing a ubiquitous system; the approach will be to take into consideration the social and technical constituents of the system. The thesis work will comprise literature review, case study and interviews to pick up on the role of cooperative and participatory design and documentation.

Working with research literature around ubiquitous computing participatory design and e-government; the experience of users while being part of system design process; figuring out the changing face of public service delivery and going through visionary political documents that mirror part of a current European discourse will help drawing a pathway for future work.
FROM PARTICIPATION TO COOPERATION

2.1 Design from nowhere

Conventional system design methods such as the waterfall method or the modified and recently developed design approaches such agile software engineering approach lack a lot to come up with a good design [1]. Hansson et al have highlighted same mentioning lack of thorough knowledge of users and use context of system on the part of developers. They have further mentioned the fact of customer being represented by a person who may or may not have sound understanding of users and use context of software [3].

My personal experience working brings me to same conclusions. The designer analysts are often hired from open market on project basis. Most of them come directly from universities or from software houses. There is a possibility that they might switch from another organization or firm. They hardly know anything about the inner procedures, work environment or the organizational culture of these firms that they have just joined. If consultants are hired it is more or less same situation. Yet they carry out system studies and come up with the requirements and design drafts that are used to develop software and implement solutions.

These analysts are provided most of the information by their counterparts in those departments who have been hired in the so-called IT sections of these organizations. These officials themselves have same background and are maintaining the networks and providing system support for the few stand alone computers in the department (especially in countries where automation and computerization is still on its way). Thus they themselves have very little idea of how people in the main stream are really working.

2.1.1 Two examples

2.1.1.1 Technology drives the design

It was March 2007 when I started working with a project for a carpet company. We were 5 people in one group who was supposed to carry out ethnographic studies and come up with some technical solution for the problem. We were encouraged to come up with some RFID solution. It was so because the company was carrying out a technical feasibility study to implement RFID.

The company was facing some problems in its logistics. The carpets were picked up from the production lines and stored temporarily in the temporary storage areas before being sent to warehouse. This transition was needed because they needed to undergo a quality check. The quality check process was causing bottlenecks as the facilities for the purpose were not enough as compared with the production of the plant. This was making a large number of carpets stay in the temporary storage. But the temporary storage areas were not big enough to accommodate this large number of carpets.

So where would the carpets go that could not be stored in these areas? The fork lifters who were transporting these carpets from production till the warehouse and the dock had an answer. They said they would put these carpets anywhere around covered space in the
production area when the temporary storage areas had no more free space. Putting them under a roof was the only requirement. But this was giving birth to the problem of ‘missing carpets’. The temporary storage areas had their identification. The fork lifters were using loose papers to record which carpets were stored there. But the random spaces in production area meeting the mere requirement of being covered did not have any identification. Then the fork lifters were working in 4 shifts. The only artifact/source transferring information from one shift to next was the loose paper. The possibility and frequency of losing this paper based information was great. Moreover the mechanical nature of fork lifters’ work least helped them remember anything. One of the fork lifter who was helping us understanding how they worked told me, “(while working) sometimes I feel I have no head. I sleep and when I get up again I forget everything (about locations)”. This situation caused many of carpets remained unattended and unreachable for quite long times. These timely untraceable carpets were termed as missing carpets.

The technical team at the company who interacted with us included three people. They included one lady who was dealing with the SAP application in the warehouse and two guys who were explicitly hired for the project and were working with this problem. They had tried triangulation technique to encounter this problem and now, were trying to use RFID tags to trace the location of carpets. It was in itself very tedious and complicated task. When we started our studies and talked with these people and the fork lifters we came to know the fact that the technical staff had different perception of how things were being carried out than the factual position. They did not know the detailed procedures and yet they were trying to come up with some solution. This fact was revealed when we held combined meeting with fork lifter and the designer analysts. The designers for the prospective system were carrying out meetings with people from an RFID company who had offered them some solution.

On our side, RFID solution being one of the desired outcomes people in the team tried very little to look at things in a rational way. The problem was defined such that RFID tags could be used. And a solution was presented sticking the carpet rolls with RFID tags and suggesting storage of all related information in some centralized database. There was a suggestion that the location information should also be stored in the database. To trace them timely fork lifters would be given this information along with requisition for certain batch of the carpets. But there was no discussion or solution as how to identify the random locations in the production area. The report was submitted. Later the project was cancelled because the project manager left the company and joined some other organization.

2.1.1.2 Going with the trends

In one of the projects in Pakistan where I worked with technical feasibility for a decision support system in 2005 I came across almost same results as mentioned above. This organization is a financial organization dealing with setting up of industrial states and forwarding loans to small industrial entrepreneurs. There are 42 offices of the organizations all across one of major provinces of Pakistan namely Punjab. The offices deal with acquiring land for industrial estates, receiving applications from small industrialists, carrying out location surveys and forwarding the cases to central offices for approval of loans. Then forwarding loans and recovery of installments is also handled by regional offices at local level. All this process involves heavy finances. The record keeping being manual and the communication and coordination carried out through ordinary mail, telephone and faxes was very sluggish. Manual manipulation of records and application made it quite easy for personnel to mishandle cases. This provided very safe basis for most of the irregularities in the organization.

This was the operational problem in nature. But when it comes to control and coordination, the higher management was facing a tough situation. Most of the reports coming from
regions were reaching the head office late. Their credibility was not ensured. And another problem was the contingent requirement of data and information by the higher authorities. These queries were often given on short notices. With given big network of offices and insufficient coordination, control and communication facilities management would often find it hard to meet deadlines. Often old data was used to fill in the gaps.

When it comes to available computing facilities, each office had couple of computers that were mainly being used for text editing. In simple words these computers were being used in placed of the former typewriter machines. The personnel in the main functional stream of the organization were not at all using the computers for their operational requirements. At Regional offices the most computer literates were the people who could use Microsoft office package. Majority of these were steno typists. They too were using Microsoft Word and Power Point most of the times. None of the regional offices had any formal local area network setups.

The head office was however an exception. Here they had a small computer section where they had 3 people working with a payroll application. This application was developed in FoxPro. The number of high rank officials being greater, the number of computers was also large in the head office. The technical staff at head office was trouble shooting and maintaining these computers in addition to the payroll report generation. These people had same problem. They were not aware of the functions and procedures of different sections in the organization.

The top most management was however keen in setting up a solution that could help them regulate the information flow and increased control. Hence a feasibility report was prepared. The problem was defined by the management and all of the information regarding sections’ working was provided by the section heads. A solution was suggested linking all the 42 offices. With backups at regional offices a central database was supposed to run at the head office. There was a web based interface for those among general public who would apply for loans. They were supposed to submit their applications and check status of their applications; check their payables and balances and launch any complains if needed.

Each of the regional offices was to be provided with 4 computers. One of them would serve as servers taking local backups of data and maintaining connectivity with the central database at head office. The other 3 were given to operational functionaries. It was suggested that in-house trainings should be conducted to train the officials working in these positions. However management was of the view that new people had to be hired because government wants creation of more job vacancies with these setups. However some funds were requisitioned to hold trainings in general to mentally prepare people for a different working environment. With the start of this initial report rumors spread in department regarding downsizing.

The initial report was approved after being reviewed by three different departments. They demanded some changes and explanations. The changes were made and report was submitted again that was approved approximately after 4 months. After that a more formal report was prepared in an official template. Interesting fact is that all the project proposals whether of economic, social, construction or technical nature had to be submitted in same format. The project proposal was approved after 9 months finally.

In the implementation phase different people took over as technical consultants. They prepared a requirement document based upon the information given by higher management/section heads and the 3 technical personnel in the head office. The software development was outsourced and a third party worked with development based upon the software requirement specifications prepared by consultants. New employees were hired to manage the proposed solution and hardware was purchased. The trainings for existing employees
were skipped. And the most significant event was transfer of the head of department, who was acting as a driving force to carry out the project.

The situations were odd after that. All the equipment was in place, personnel were hired, software development was delayed, and the operational functionaries tried their best to make the system a failure.

2.1.1.3 Some Comments

The above examples are interesting in many ways. One of the studies was carried out in Sweden and the other one comes from Pakistan. But the design seems to have same kind of weaknesses. In both cases the designers were not part of the organization. The designers had only little knowledge about the working that they got to know from their counterparts in the organization. In both cases the functionaries were ignored. In both cases major information source were the people who had little to do with the problem itself. In first case however there were brief field studies. Though they were termed as ethnographic studies, I won’t use the term because it was just couple of guided tours to the production area, temporary storage and warehouse. In both cases the moving out of key personnel caused loss to the projects.

The major difference was that in case of carpet-company, the designers were ubiquitous computing students. But in the given circumstances they acted like any other designer highly fascinated by technology. However it was the limited cooperation in first case that helped me understanding shortfalls of the design approach. If fully exploited the cooperation could have helped with a better overall system design.

2.2 Ubiquitous Computing Design Requirements

Does ubiquitous computing differ in its design requirements? Which methods and approaches suit these requirements? How have the ubiquitous computing scientists and researchers been dealing with design issues? And what are merits and demerits of different methods used these days by these people. These and such questions automatically come to our mind when we look forward to make a design approach choice or when we need to bring people to a comparatively narrower area so as to develop a consensus.

Ubiquitous computing has been trying to come up with a totally different overall ideological and technological framework and using existing facilities. Weiser’s ideas regarding ubiquitous computing being a new form of technology that sets the PCs in their proper place [18] were not merely meant to bombard the living and workplace with countless embedded devices. He had explicitly mentioned that, “the challenge is to create a new kind of relationship of people to computers, one in which the computer would have to take the lead in becoming vastly better at getting out of the way so people could just go about their lives”[2].

Designers and researchers have been trying to redefine this relationship. But it is a complicated link that involves a variety of factors. Carefully speaking from the perspective of computing environment, information and computing system comprises quite a lot of components. It includes the hardware, software, networks, data, information, knowledge, workflows, work settings, checks and controls, organizational constructs and culture and the humans. But unfortunately the emphasis has to large extent been around hardware, software and communication facilities. It has so far just the hardware that has been tried to make ubiquitous most often. There is a long way towards reaching where we find ourselves implementing Weiser’s vision [4].
Humans and their problems in accommodating themselves with in these systems have often been ignored in the traditional design approaches. These systems are sometimes totally alien for the users and the users are expected to change their work practices and norms completely. They are expected to learn extra skills for this new technology enabled work space. Weiser says, “(we want computer to be) Machines that fit the human environment, instead of forcing humans to enter theirs, will make using a computer as refreshing as taking a walk in the woods” [18].

2.3 Ubiquitous Computing Vision

As mentioned earlier Robin Milner recently reviewed the understanding of ubiquitous computing over past years. He highlighted some of the important associated questions [17] such as:

- “What ubiquitous computing systems (UCSs) do people want or need, and how will they change people’s behaviour?” And
- “How will the hardware entities—the sensors and effectors whose cooperation represent such a system—acquire power, and by what medium do they communicate?” And
- “For the populations and subpopulations—including software agents—that make up a system, what design principles should be adopted at each order of magnitude, to ensure dependable performance?” And
- “What concepts are needed to specify and describe pervasive systems, their subsystems and their interaction?”

From Weiser to Milner all the ubiquitous computing scientists and researchers show the same concerns. The ubiquitous computing design has to take into consideration the real needs of the people. The people who are part of a system that is presently subject to change. We need to take into account as to how much human behavior and practices will be affected by the design. We need computers to suffer and frustrate not the humans [18]. Ubiquitous computing needs the design methodologies that take into social, technical, and engineering aspects providing foundational basis for future practices. Ubiquitous computing can not serve its purpose with approaches termed dualistic by Milner. The dualistic view takes humans and technology as two different entities; ignoring the human aspect so far and working more with the technological artifacts. Researchers have criticized some of the designs being a failure because user and its interaction with its environment had been missing [8].

An alternative is the holistic view that takes humans as an integrated part of the system. It takes into account the human factors, human needs, work practices, organizational culture etc. As mentioned earlier the ubiquitous computing systems are supposed to be designed as per needs and desires of users; as against most of the conventional software systems that require users to be adaptive and flexible. For a successful ubiquitous computing design, designers need to consider the end user interactions in the context of use and the usability of the technology in its underlying infrastructure. Hence the holistic design approach is both preferable and desirable.

Coming up with a desired ubiquitous computing design is impossible without involving the users, the work practices and work settings. This has made the participatory and cooperative design methods and practices an immense and highly desirable trait for ubiquitous computing.
2.4 Participation or Cooperation

2.4.1 Participatory design
Participatory design is thought to find its roots in the Scandinavian principles of promoting democracy at the work place back in 1970s. The initial purpose of establishing these norms was to make organizational change more of a democratic nature through consent and participation of those who will undergo the change and to use the skills of these people ending up with a more acceptable and desirable design [1]. But the approach has under gone number of changes in all the past years since its inception. Initially it was more a politicized approach [5] but in more recent years it has emerged as a discipline than a political agenda. And it is recognition of its success that user participation has been more and more popular with product design, work place analysis, designing multimodal interaction\(^1\), building distributed design spaces and better understanding of customer needs and usability issues [5][19] [6][7].

The participatory design not only helps designers understanding user needs and grabbing requirements but also the functional, personal and social contexts [8]. It is about how the user acts in the given work settings, which artifacts he is using to accomplish his routine tasks. It is further a probe into how the user is going to use the product, which way and how the design will affect the user, the social and the work settings.

![Participatory Design](image)

Figure 3 Participatory Design

2.4.2 Issues
There have been questions raised like how much can we depend on the user and to what extent [16] can we rely on his perception? This has been a point of great concern. The users are not supposed to know and inherently accept the need for emerging technologies and services. They are not most of the time aware of the technological possibilities. They have limited technical knowledge and hence their perception is limited as against the domain experts [9]. So designers have devised some alternative approaches categorized as ethnomethodologically informed approaches to IT design [10]. The participants need to be informed with the underlying technologies and their capabilities. They should also be taught enough to make their participation meaningful [11].

Other the other hand there has been discussion on whether designers can come up with a real innovative design if they are too much under the influence of choice and opinion of users [16].

\(^1\) Multimodal interaction provides the user with multiple modes of interfacing with a system beyond the traditional keyboard and mouse input/output (Wikipedia).
The question of ‘who will drive the cart’ is obviously critical. As mentioned earlier if the designers depend upon the feedback, opinion and choice of users it’s hard to come up with something worthy. But on the other hand there can be situations that the users are not taking interest in the design process and act dormant or passive; merely providing feedback to the designers. It is more of a traditional nature and users accommodate it more readily. It is easy, time saving and hence appealing on the part of users. The designers should help users develop the overall understanding of the process and involve them to more creative side of design [12].

To bring things in balance and to resolve the tensions of who should participate which way, transformations have been made. Different techniques are used such as workshops, studies of work, mock-ups, prototyping and scenario building [5].

Moreover if we try to map the visions of participatory design and ubiquitous computing we find certain amount of gap. And we need modified and enhanced participatory design practices to fill up the gap. In other words participatory design itself is not ubiquitous in its nature but helps implementing the ubiquitous agenda while applied with ubiquitous computing vision in mind [6].

2.5 Weiser’s Vision

Weiser explicitly mentioned about ubiquitous computing approach, “A key part of this evaluation is using the analyses of psychologists, anthropologists, application writers, artists, marketers, and customers. We believe they will find some things right; we know they will find some things wrong. Thus we will begin again the cycle of cross-disciplinary fertilization and learning.” [2]. It could mean including the domain experts in the process of designing along with the users.

Weiser indicated the chances of mistakes being made but he also highlighted the possibility of cross-discipline learning. If we try to map Weiser’s vision with cooperative design; we find them accommodating and supportive in nature. The terms ‘participatory design’ and ‘cooperative design’ is being used synonymously. But if interrogated thoroughly, cooperative design is more a refined form of participatory design and is more ubiquitous in nature.

2.6 Cooperation on its way

Susanne Bødker et al tried to find out means (tools) for promoting cooperation in participatory design in year 2000 to enhance creativity and innovation in design process [13]. The considerations were a more informed design and inclusion of multiple voices.

Another major step emphasizing need for ‘cooperation’ is the advent of ‘Tango arena’ where researchers have used cooperative design for egovernment co-construction. The idea of co-construction not merely consists of participatory design practices and principles. It has in addition to its basis in participatory design and a blend of certain methods and models from across disciplines [14]. Yvonne Dittrich et al continued on the same line following same practices and explored related issues [2] [15]. More recently we can find examples where same approach is being used involving end users, technical experts, design experts, developers and domain experts [7].
2.7 Some Final Remarks

In the preceding pages I have tried to figure out the journey starting at ‘design from nowhere’ to more hot and popular participatory and cooperative design approaches. The probe was specifically in the context of ubiquitous computing design requirements and ubiquitous computing vision. The literature both from ubiquitous computing and participatory design domain researchers has mentioned use of participatory design practices and techniques. It is however obvious that the traditional participatory design methods are questionable at times and act handicapped. The situation has often made researchers introduce modifications and enhancements to the traditional participatory design approach.

Whereas participatory design is a mature design approach dating back to 1970s, more recently researchers have started using the term cooperative design. The term ‘cooperative design’ has continuously been used in literature with the term ‘participatory design’, more often synonymously. However careful literary review shows that it is hardly used with/for ‘participatory design’ while used in a crude or conventional form. The term ‘cooperative design’ is only used when ‘inter-disciplinary’ domain experts are involved in the design process along with user and ‘designer’. In addition use of non-conventional methods and innovative techniques also makes it a modified form of participatory design.

Further a review of ubiquitous computing vision has made it clear that the modified form of participatory design or in other words the cooperative design approach is more ubiquitous in nature.

Now that we have developed an idea of cooperative design we can understand that it can play an effective role as we follow holistic approach for ubiquitous computing system design. In the coming chapter I have tried to broaden the canvas by including the society and its technical directions in the discussion.

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1 The term has been used in conventional meanings. In cooperative design all the parties involved will be acting as designers in their place.
3 INFORMATION SOCIETY: POTENTIAL AND THREATS FOR DESIGN

Having been through with a brief overview of design practices in ubiquitous computing and identifying cooperative design as one of the options for ubiquitous computing designers and practitioners, we need to identify societal directions as well. Social pressures built up by the living style, expectations and awareness of the general public indirectly influences the designers and their approach to design. As designers we need to take into consideration what people expect from technology. On the other hand the designers can be powerful enough to control the expectations of the people. Cooperative design helps us understand the mindset of the potential technology users. But in a broader sense we need to be aware of overall directions and trends that a society is following.

Digitally literate societies have developed strong information and communication technology infrastructures. This information infrastructure and information and communication facilities directly influence design. A strong infrastructure can lead to a more stable, comprehensive and innovative design. Whereas missing facilities will adversely affect the design practice; leaving much of the possibilities as dreams and fantasies. Ubiquitous computing design is not only affected by the technical infrastructure but also upon how well informed the user is. Hence in ubiquitous computing context users also makes part of the infrastructure. The societal transformation in terms of information, information and communication infrastructure and the user awareness and skills is of importance if we need to understand the potential that future carries and the threats that wait.

In the following sections I will try to find out the direction, in terms of the information and information infrastructure, in which the societies are heading.

3.1 Information Society

The idea of information society was first brought, back in the year 1999 through the European Commission's initiative 'eEurope. An Information Society for All'[20]. This initiative set its objectives as follows [21]:

- Bringing every citizen, home and school, every business and administration, into the digital age and online.
- Creating a digitally literate Europe, supported by an entrepreneurial culture ready to finance and develop new ideas.
- Ensuring the whole process is socially inclusive, builds consumer trust and strengthens social cohesion.

The purpose to mention these enthusiastic targets is to give a meek idea of the audience and settings that are waiting for ubiquitous computing solutions and systems. It is worth mentioning that most of these targets have already been achieved by the European governments and rest is on their way.

The initiatives by major leaders in the world namely Europe and America and the keenness of governments around the world to embrace information and communication technologies reflects upon the role that governments are playing to carve out future.
So in the light of targets as defined by the EU [21] ‘information society can be termed as society where most of the population is digitally literate, has access to some common information resources through a well established communication infrastructure that is meant to bring social cohesion in society’.

Information society is characterized by the so-called well informed user, strong information and communication technology infrastructure, information access-points, information spaces, cyberspaces, and combined spaces. But the information societies are coming up with issues and opportunities that are kind of unique. Information societies have their own issues and problems. The psychological, emotional, behavioral and physical practices of information society inhabitants are quite different from those living in societies where humans are not that much dependent on information and communication technologies.

![Society shapes user and user drives design](image)

Figure 5 Society shapes user and user drives design

This makes the expectations from and challenges for design practitioners quite complicated. There are lots of factors in these societies that have to be considered before we come up with some solution. The exposure and expectations of users are quite high and at the same time they are unaware of the side-effects of systems that they are using or are luring for.

### 3.2 Society and Ubiquitous Computing Design

As against the conventional personal computing technologies, ubiquitous computing is going to come up with designs and solutions for a society that has undergone a continuous and thorough transformation. This transformation has its roots in technological revolution in general and advancement in information and communication technologies in particular. The conventional personal computing technologies that have emerged after 1970s and have taken an overwhelming form are also basis for this transformation. By conventional personal computing here I mean any form of present day personal computing that do not conform to ubiquitous computing framework. As far as infrastructural transformation is concerned, Governments have been playing a very active role to bring about this transformation. The ‘National Information Infrastructure (NII)’ for the American society, Singapore's Intelligent Island, Malaysia's the Multimedia Super Corridor 2020, Canada's the Information Highway [18]and the idea of an ‘Information Society’ hatched by European think tanks are a clear
indicator of this fact. It is, therefore, quite hard to ignore overall direction of society in ubiquitous computing design context.

Ubiquitous computing is taken as a science that is there to fully automate human environments, fill our environment with innumerable tiny computers, and promote a culture of augmentation and so on [8][16]. But if thoroughly reviewed the ubiquitous computing vision is that of an alternative design approach. The purpose was to come up with solutions that take PC technology or overwhelming Computing aides in background [13][14]. It was to free human attention from computers. If ubiquitous computing scientists and researchers now translate it as a science that is there just to fill environment with computers it’s more like half advocacy.

3.3 An Elusive Approach to Ubiquitous Computing

Ubiquitous computing is yet not a widely known science and the partial knowledge being conveyed by the technology zealots is leading us to a future where the ubiquitous computing solutions will further cause social problems [22]. The basis for the partial portrait of ubiquitous computing being drawn is the literature that most often discusses technological perspective completely or almost completely ignoring the social roots of the subject [8][13][15][16][17].

The result is the literature full of future scenarios where users are surrounded by millions rather trillions of tiny computers [17]. Or that expect humans depending upon augmented memory devices for their daily decisions making, and notions such as personal servers, personal wireless areas networks [16] and physical-virtual associations [15] are all highlighted in the literature. This situation can be leading to a point in time where humans are embedded emotionally, physically and psychologically in a cosmos of different sized computers. Ubiquitous computing is not supposed to change the way humans act naturally or in other words it is not supposed to change natural ways of interaction in certain context [22].

In the following paragraphs I have built up scenarios around real life situations and related them with ubiquitous computing and social setup. The last scenario represents the way things are moving through technology driven research.

3.3.1 Some Real Life Scenarios

3.3.1.1 Mobile Phone in Tubes

Every day when I travel in the underground tubes here in Stockholm, it’s a common observation that as soon as people board the tube, after taking seats they take out their mobiles and either start talking on phones, playing games or text-messaging.

Some of the researchers take it as an aid to their emotional needs and a facility helping develop and maintain associations [17]. But the question arises whether or not they are isolated from where they are by these devices? And this overwhelming dependence on technology for emotional and social needs can be a problem in disguise. Mobile phones are just a representative of a large family of gadgets that are considered as augmented memory devices.
3.3.1.2 **Train Station Check Points**

The entry points for the train stations especially the tubes need the passengers to take out their travelling pass, swap it through a slot in a certain way and then go ahead if it’s a valid travelling pass.

As against Stockholm in London they are using RFID tags as travelling passes where users don’t need to swap it through any slots. It’s just touch and go kind of solution.

Another scenario could be always opened gates that close only when their turns up somebody without a valid travelling pass.

In this case the first case is more ubiquitous in nature as the passengers are physically and mentally aware of what they are doing.

3.3.1.3 **Elevators and Accelerators**

Elevators help people cover vertical distances without much effort. A variation of elevators is the tilted electrical staircases where people can step up as well are helped by the moving elevator. A third variation of same facility is the accelerator where the moving belts help people travel horizontal distances at a greater speed.

The first form is total automation\(^1\). The second and third forms are more ubiquitous in nature as the users are being facilitated in whatever they are trying to do and are not totally dependent upon the system for their accomplishment.

3.3.1.4 **An Augmented Passenger**

Here is a scenario of a passenger that is depending upon memory aides and automated systems for his daily travelling activity. He has a personal digital assistant that helps him schedule his days, reminds him or his scheduled activities, helps him with his dressing according to the weather prediction information that it automatically collects from different wireless networks that it switches through during different days of time. The travelling pass is actually a chip that communicates with the control system at entry points in the underground tube stations and the PDA or personal digital assistant keeps it alive in the sense whenever the travelling pass is about to expire it automatically sends an advice to bank for money transfer to the traffic agency account and hence the whole system keeps on going.

This is a kind of scenario that we often find in modern literature. But if we think about the society full of dumb who depend upon portable machines even for their common chores it is a scaring idea.

3.3.2 **Some Comments**

The above real life scenarios are just a reflection of how our daily routines and attitudes are changing due to advent of technology and involvement of technical facilities in our lives. From these scenarios we can learn that:

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\(^1\) By total automation I mean implementing solutions that try to keep human interaction and intervention to a minimum or negligible level with the system while accomplishing the tasks that they are designed for.
• People are highly vulnerable to the technology and are undergoing social, psychological and emotional transformation in a seamless way. Device designers are coming up with more and more innovative devices. The marketing companies play a big role in presenting these devices as a new miracle. But the ultimate victim is the user who becomes an ultimate dependent and addict to these devices.

• This dependency on technological devices is indeed breeding problems that will be highlighted in coming years. The use of these devices to level of addictions can be generally observed. Failure of services crashes down the users as well functionally and emotionally. We need to maintain a balance between dependency and facilitation in this regard.

• The social patterns and social activities are automatically interconnected with the technology. Most of the connectivity is through internet or in other words through the devices that are connected to internet one way or another. Mobile phones are also one of the devices that have affected the social life of users. Just think of a mobile user who is taking dinner with his family and then receives a call from him boss that he can’t reject at any cost. This is not once in a while. The companies that provide free mobile facility to their employees expect them to keep their mobiles turned on round the clock and reply any calls that come from the company at any odd hours.

• We can see from the usage of most hand held devices that the designers of the gadgets do not think how they will embed into social setup. We can conclude it from the fact that despite numerous reports being published in news and research media market is bombarded with even more attention capturing devices one after another.

• Society cannot afford the absence of true ubiquitous computing solutions and designs anymore. Ubiquitous device and system designs that have their very base in social coherence and socio-technical balance can help society bringing humans to their very natural state.

• There is a need to make continuous and conscious efforts to change the attitude of designers. The designers of these automated systems called devices need to be taught about the adverse ways and manners in which their creations are affecting the users and society. They need to be realized that technology alone can’t bring serenity in human life and that their natural ways and direct social interaction has its own importance.

But the ubiquitous computing itself needs to resolve certain issues and face challenges. These challenges have emerged due to penetration of personal computing technologies into society, technology driven approach of designers, dualistic approach to solutions, changes in technology infrastructure etc. In the following section I will further elaborate the design challenges that the modern society poses for ubiquitous computing and the opportunities lying ahead.

### 3.4 Design Challenges

#### 3.4.1 Clarifying the Attitude

We need to clarify the attitude towards innovation [1]. The technological innovation directly or indirectly affects the social, organizational and behavioral systems and patterns.

In ubiquitous design perspective we need to decide whether we want ubiquitous systems to be loading or overloading humans with information load, equip him with gadgets as assistants or we want to facilitate him through his tools and the ‘tangible bits’[22].
3.4.2 Do we Mean Business

As designers we have responsibility towards society as well. Humans are very easily attracted by the new gadgets, new technologies and new products coming in the market. The marketing gurus make everything shine as gold. People are realized that they can’t survive without the latest technologies. The sole purpose is to bring profits to the big technical giants. The responsibility lies with designers to design products that are not ‘drugs’ in nature. So to say they do not make humans addict to their use.

3.4.3 High Expectations

The design expectations in an information society are quite high. The technical surroundings these days are entirely different from those back 10 years [6]. The high speed internet, powerful processors, developments in MEMs and nano-technologies, powerful software development facilities and most of all well informed users make the design scenario totally different.

3.4.4 Awareness or Information Over-load

The notions of well informed users and context aware solutions are also frequently used in literature. We need to clearly identify that are we overloading users with unnecessary information or we are really adding to his capabilities and skills that will help him broadly in his life.

3.4.5 Social Perspective of design

The designers need to be aware of the fact that social part of design is more important than technical part. If it were not a social problem there won’t have been any need to develop idea of ubiquitous computing. It was the social disturbance caused by the personal computing devices that made Weiser think about this new scientific approach towards computing [14].

3.4.6 The Technical Infrastructure

Technical issues such as making hardware and software disappear from desktop and go in the background, mobility issues such as redundant IPs, power supply for tiny processors, bandwidths, multiple sessions, agent based technologies replacing humans, interaction design [8]and issues such as integrating human body and information technology [3]are all yet to be resolved.

3.4.7 Preserving Social Systems

We need to preserve the social systems as against arguments desiring reshaping of social systems. We need building necessary knowledge across the society in this context. We need increasing pressure for the change [1]. The marketing tactics are being used to influence consumer desire and social attitudes but it will badly affect the human race in the longer run [7].
3.4.8 Privacy

Privacy is one of the biggest design challenges for the modern computing and ubiquitous systems. Protection of information, prevention of information dissemination, guaranteed access rights, and authorization are some of related issues [2].

3.4.9 Eco-Technical Issues

Even the smallest ICs and sensors produce some heat after consuming power. The question is that if solutions come up with millions and trillions of small processors and computers, will these solutions be environment friendly? Will they not cause any harm to echo system and create problem for the surroundings in which they are embedded.

3.4.10 Reliability

Think of a scenario in which trillions of tinny computers or to make it simple supposedly thousands of interconnected and interdependent computers that make up a system that’s total support for a human or group of humans. What if one of these stops working? Whole of the system will come to a halt. Troubleshooting such systems would be more than hard. Or there will be need of highly sophisticated and complicated tinny machines that can survive in a network or millions even if isolated or disconnected from some portions of the network.

3.4.11 Socio-technical Dependencies

The systems under consideration involving the augmenting gadgets or the networks surrounding humans will induce new social and technical dependencies in human lives [7] [8]. This will create new issues around emotional and psychological sustainability.

For example in countries like Sweden where people are connected more through internet than in physical world the internet communities are quite popular. But these communities develop the most unreliable relations where it’s quite easy for one of the involved parties to withdraw as against real world where there is a social pressure securing relation [5].

3.5 Opportunities

Whereas the present day and future information societies present numerous challenges, they carry opportunities as well. Some of them are given here under.

3.5.1 Digitally literate Users

The users in information societies are digitally literate, more open to innovation and inventiveness that the new solutions might bring with them. With the transformational power of ICTs [1] it’s quite possible for ubiquitous computing researchers to introduce the agenda of ubiquitous computing in the society.

3.5.2 Technical Infrastructure

Governments around the world are aware of the importance of information infrastructure and are working towards its establishment as part of their agendas [18]. It’s easier to customize
the existing facilities for ubiquitous computing solutions than setting up everything from scratch level.

3.5.3 Social Cohesion

The ubiquitous computing agenda of coming up with solutions that do not disturb the social life and social setup can be mapped with the EUs agenda of establishing social cohesion through use of information and communication technologies [21].

3.6 Conclusion

We can learn from the above discussion that the enhanced facilities and transformation in information society are leaving a strong impact on design. The technologies and technological products are changing the habits, attitudes, social practices and forms of social interaction. Extent of social cohesion, psychological and emotional dependencies, patterns of human interaction with their surroundings and perception towards surroundings is changing. This change to a greater extent is caused by the technology designs that are becoming part of society with each passing day.

With enhanced facilities, with better technological infrastructure ubiquitous computing has to face lots of challenges set up by the passing years. The challenges are there but they will further help researchers explore possibilities. The agenda of information society can be mapped with the social roots of ubiquitous computing thus aligning ubiquitous computing in the main stream. Ubiquitous computing has lot to do for the information society building.

Whereas Ubiquitous computing can take advantage of information society’s agendas and infrastructure there is need to take society out of the technological web. There is a need to involve the user or in other words society in the design process. Users should know what is being designed for them and how it will affect their lives. A holistic ubiquitous design approach and cooperative design practices can help us achieving these goals.

So far we have learnt about the ubiquitous computing system design basics, design practices, cooperative system design approach and holistic approach to ubiquitous system design. We have seen that in a broader scenario technology driven societies and users need our attention as designers of the technology based systems. But there is another key role player in this transformation. That is the governments. Governments are not only setting the social and technical directions of the societies but are being affected by the transformation themselves as well. In the following chapter we see how governments are going through this change and how they need support from ubiquitous computing in its holistic view for good.
In the last chapter I have briefly discussed the impact of technology on society and how ubiquitous computing can play its role towards social cohesion and psychological and emotional sustainability. I have pointed that the governments are the key drivers causing the transformation in the society. I have further discussed that the agenda of governments towards setting up an information society and ubiquitous computing can be mapped and hence society can be transformed to a point that won’t make us repent in coming years in the context of technological solutions implemented.

In this chapter I shall continue with a review of changes that the governments are going through around the world. These changes will lead us to future information societies. We need to be careful with the e-Government solutions while drawing the face of future. The real ubiquitous computing solutions can help us tackle many of the complex issues such as extent of automation, nature of interaction, social cohesion and social, psychological and emotional sustainability.

4.1 Change

In a country like Pakistan with more than 160 million of population getting national Identification Card was not easy. Getting forms from ID card offices, filling them, getting them attested from gazetted officers, standing in queues to submit the forms. Then waiting for long time that could reach to months to get the identity card was quite a common practice. The delays were mostly on the part of government.

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1 Civil servants who are authorized to validate and witness the truthfulness of documents.
employees. Getting duplicate or bogus identity cards was hard to control as there was no centralized control or centralized record of this data.

It was until 1999 when Government decided to establish NADRA (National Database and Registration Authority). A centralized database was setup to maintain the record of demographic information and statistics. Getting NIC is not that hard now. Even there are facilities to apply for the card online. There are no unnecessary delays and nationals get it within specified time. The citizens can check the status of their application and corresponding response online. Getting bogus NIC is not possible as the thumb impression for each citizen is there in the centralized database. This jump from huge registers, nosy clerks, delays, favoritism and chaos to electronic database, IT literate clerks, regulatory control and transparency was a big leap. It added to the trust of citizens in government. It improved the efficiency of one department, added to government control. This was not all; it proved to be a milestone in a journey towards a change in organization change in government departments both at provincial and central levels. IT departments were established in all the provinces and an E-government secretariat was established at central level. Public servants from both provincial and central government departments are being trained in different traits of IT. Now people can purchase railway tickets, pay their utility bills and taxes online through the websites of concerned departments. All the government departments are maintaining websites. All the tenders, job announcements and other major announcements have to be published on websites as required by the regulations. All the major banks are offering online banking services. The above picture is just a short-hand description of a big change that government departments, the citizens and related stakeholders are undergoing in Pakistan.

It is not just Pakistan; more than 170 countries in the world are undergoing this change [11]. The target more or less is same i.e., to exploit information technology to modernize government and provide better and cheaper services, delivery of public services online, access to public-sector information by all citizens [12], connecting all citizens to information resources, making citizens digitally literate and ensuring all process is socially inclusive adding to social cohesion [13].

E-Government can be defined broadly as the use of information and communication technologies (ICTs) in the public sector to improve its operations in terms of efficiency and effective delivery of services. While advanced countries are already achieving the goals as part of IT initiatives [1], developing and underdeveloped countries are yet facing the problem of lack of funds and resources to deliver services effectively [5].

While in the empirical governance context there are discussions about ‘virtue’ and ‘competence’ [2]; e-government researchers are exploring issues such as quality of service and quality of experience [10] in the users’ context. Technological assistance for conducting government affairs has changed the vision, issues, challenges, organization behavior, mindset of both public and public servants, nature of interaction and the skill set requirements for all stakeholders.

4.1.1 **Where shall the change lead?**

Human beings augmented by myriad devices almost equal to natural humans [18], selecting their representatives through electronic voting process, the candidates
carrying out their canvassing through email, SMS, websites, web-logs, and online media facilities trying to get as much supporters in electronic communities as possible.

All the transactions between citizens and government are seamless in a way that they are carried out in the background all stakeholders being aware that they are there. But they don’t have any concerns unless there is some abnormality. These abnormalities are notified by the system and also the relative recommendations are made.

Healthcare services would comprise online doctor agents that will listen to the patients’ problem pick up the symptoms and generate prescriptions that will be printable on part of patient and will be updated to the pharmacy database. Special recalls at the time of medication dozes by SMS will help patients regulate their medicine. In case of emergencies online advice will be available and instant messaging service with ambulance facilities will be available.

Students have options to attend the class from home PC, through palm top or on the campus. Hence there is no possibility that the students will miss any lectures. The office workers will have the options to work from home or at the work place making work more flexible.

These and similar scenarios can be drawn about all the aspects of society and life in future. This can be possible flow towards future as a result of the progress and experimentation being made in the name of ubiquitous computing. But if thoroughly investigated we can see that this entire situation will destroy present organizational and social structures and will accompany chaos.

4.1.2 The real challenge
There has been a significant gap so far, between the vision of ubiquitous computing and the outcome thereof. User experience has been different from what ubiquitous computing promises [7]. Notion of invisibility as presented by Weiser i.e. embedding computers and computing beyond desktop into the work environment, work practices and artifacts has been misinterpreted as coming up with solutions involving millions and trillions of tiny computers embedded around humans[6] [15] [16]. This situation can lead to a very complicated future.

Computer applications and solutions need to be tailored to the actual skills and work places of the people using them [3]. The social, emotional and psychological impacts of the solutions and situations arising out these solutions have to be evaluated and kept in view.

Whereas at the heart of the sustainable development discussions is the concern that human interactions with the environment are becoming, or have already become, impossible to maintain in the long run [4], the shaping of human interactions with technology based digital environment needs special attention. In this direction we need design community support, early planning, consistency, and multiple funding mechanisms to carry out the research [8].
4.2 A Ubiquitous E-government Scenario
In the following paragraphs I have tried to build up scenarios and explained how they are ubiquitous in nature. Readers can find a clear difference between the given scenarios and total automation¹.

4.2.1 Voting\Elections

The voters go out to polling stations after the politicians convince them to vote for their candidates and parties. Voters cast their votes and the ballet boxes are such that they identify which voter has casted vote for which candidate and hence the result is announced as soon as the voting is finished or the timeline is reached.

Here the voters come out for voting that a more natural action and caste the vote that's more natural. The presence of presiding officers and political agents is more a real life fact or ground reality. But the hectic job of counting has been replaced by the computing solution embedded in the so called artifact or the ballet box. This ubiquitous computing solution will help increasing the efficiency and transparency of the voting procedure.

4.2.2 Legislation\Policy Making

Governments have established guidelines for people's interaction over internet, consumer protection, legal terms for electronic contracts; intellectual property protection in cyberspace etc. Issues such as foreign commercial relations and jurisdiction, security and monetary authority and the relation between individual and state are also of utmost concern [9].

Ubiquitous computing can provide the knowledge base for the decision makers and legislators through 'ubiquitous legislation tools'. These potential tools can be simple computerized tools that help policy makers and legislators through scenario building and possibilities. The input and the final choice of decision will rest with the decision maker.

4.2.3 Electronic Mails and Electronic Communities

Digital democracy includes online communication to elected representatives, electronic forums and participation in community meetings [11]. Margret Wheatley studied internet communities and subsequently termed them as anti-communities. She was convinced that these communities have zero cost of exit and that communities can only be formed when we stuck with each other [17] (in physical world). Author’s personal exposure to the internet communities is same i.e., people enter and leave communities quite easily and often frequently.

These communities can’t be used as a platform to carry out serious affair as government and democracy. Though media as electronic mail and websites can be

¹ By total automation I mean implementing the technology based designs and solutions that minimize human interaction with the system. Where as Ubiquitous computing preaches about taking computing technology in the background we can imply it desires human intervention to a necessary level.
used for communication but they can’t replace the real world communities. Neither can they be as effective as real world communities.

4.2.4 Healthcare

Healthcare services are one of very sensitive area as it directly involves human lives. The care and attention that humans can receive from a human being can not be replaced by software agent doctors. Technology should remain purely is assisting position in this field. Use of technology for coordination and communication [19] or for alerts to the patients is possible but that too to a limited extent when the patient is self dependent and self sufficient. Even a thousand alerts to a patient who is in critical condition cannot help him with medication. Similarly a thousand software agent doctors cannot find what a human doctor can judge through physical examination and checkup. Moreover coordination of the laboratory staff with real time and software agent doctors will be totally different. Furthermore if human and software agent doctors both are involved in a chain, it will be quite hard to fix responsibility in examinable situations.

4.2.5 Utility Bills

In countries like Pakistan, each house has three different meters measuring the consumption of electricity, water and natural gas. Phone usage is recorded automatically on the end of service provider and the internet rates are normally flat depending upon the bandwidth provided.

At the end of each month, ‘meter readers’ from three departments, providing utilities, come and record meter readings. After that the bills are sent through courier or especially appointed personnel.

The consumers go to banks and submit the bills after spending couple of hours in queues. 

Total automation would mean meters sending the consumption data to central databases of the concerned departments. The departments would be sending an email to bank of the consumer and sending an SMS to the consumer. The bank would automatically make the transaction sending an email to the consumer as acknowledgement.

But there will be political pressure in this case about thousands of persons working as meter readers and a whole sum of amount needed to replace the meters with sophisticated ones. Moreover the meter readers are in no way causing inconvenience to the consumers.

A preferred solution could be meter readers recording data through special devices that don’t allow manipulation and automatically transfer data to central computing system that comprises central data repository and calculations modules. It sends the emails to banks as well and SMS to the consumers. This system will improve efficiency; enhance transparency and integrity of data, and save consumers from hassle and fatigue.
4.3 Conclusion

The recent sections discussed the changing trends in governance and the possible direction that things can take. In the name of ubiquitous computing, total automation, virtual reality and mixed reality solutions are being implemented. Implementation of e-government solutions sets the direction of technological advancement in the country as a whole. If we as designers don’t make the right decision and don’t come up with true ubiquitous computing solutions, we shall be misleading societies towards social, organizational, psychological and emotional chaos. We should remember that ‘Today’s problems come from yesterday’s “solutions”’ [17].

Following chapter discusses a case study from public sector in Pakistan. We shall see how traditional system design approach came up with something that could have been far better if a holistic ubiquitous computing design approach and cooperative design would have been incorporated in the process.
5 CASE STUDY

5.1 Introduction

In the recent chapter I have discussed how information and communication technologies have affected governance and government. I have also discussed related issues especially from ubiquitous computing perspective. Discussions concluded that ubiquitous computing and cooperative design can help governments achieve their socio-technological agendas.

In this chapter I shall try to explore some practical issues associated with design practices in e-government project design, in countries like Pakistan. The basis for my discussion is one of the e-government projects that come from Pakistan. I personally worked with the project from 2003 to 2004 (carried out feasibility studies for the purpose). I helped the concerned in preparing the basic official documents for the project namely feasibility report and PC-I document. However the basis for the discussions in the following sections is the proposed system as mentioned in software requirement specification (SRS) Report, in addition to my personal experience and knowledge about the organization and the system. The reason for making SRS basis for my discussions is the fact that this becomes the basis for design of software system. The factors ignored in this basic document are supposed to be missing in the final solution as this reflects the requirements as pointed out by the user. Interviews with the professionals who prepared the SRS are also a source of information.

My main target will be to probe into the methodology adopted by the analysts for the requirement identification, the missing factors from the methodology and the affects that will be caused by their absence. I shall further try to highlight how cooperative design could have made a difference.

5.2 Introduction of the project

Punjab Small Industries Corporation was established in the year 1961 to contribute to the small industries development in the province of Punjab (Pakistan). The mission of the organization was to promote small and cottage industries through market driven industrial and credit support, contributing to employment generation and socio-economic uplift of the province.

PSIC carries out its operations through its regional (namely regional office) and sub-regional offices (namely district development office). The delay in information flows, pended decisions, space for corruption, and undue influence of the regional office employees due to absence of any centrally integrated information system were 1

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1 By user I mean the prospective user of the system under consideration.
2 Provinces in Pakistan are divided into Divisions and the Divisions are further divided into Districts for administrative purposes.
some of the reasons that lead the higher management of PSIC to seek help from Information and communication technologies.

The purpose of the Information System as proposed in the SRS report is as follows:

“The current scheme is designed to connect the Head Office and others Offices, Projects of PSIC at different locations and to removes delays and communication gap that exists in the existing setup. It will also help increasing transparency in the working of organization.”

“The scheme also includes the development and hosting of **Online Sales Store** web site that will market the products and **Online Sale Services** of **PSIC’s Pakistan Handicrafts Shops**¹ at the national and international level, increasing the sales volume.”

It further says, “Overall the scheme will be establishing a setup that will be milestone on the road towards the establishment of e-government. The system, to automate the tasks, will cover the whole organization and effect and improve each and every department (pg1).”

### 5.2.1 Proposed System

The proposed system comprises 5 major modules namely:

1. Online Sales Store Integrated with Financial Accounting System
2. Online Loan Handling Management System Integrated with Financial Accounting System
3. Online Financial Accounting System
4. Online Inventory Control System Integrated with Financial Accounting System
5. Online Payroll System Integrated with Financial Accounting System

Purpose of the online store was to boost the sales of handicrafts crafted by the skilled workers in the handicrafts workshop. Online store was broadly classified into Purchase, Transaction, Customer Service, Data Mining, Marketing, Inventory Management, and User Management subsystems (pg36).

The online loan management system was to offer online services for Credit Schemes applicants and concerned employees to enter their reports to save the time in order to provide better services to the applicants. The system enabled public or users to download the form from the web site from anywhere….. This module was meant to manage the one of the activities of the organization (PSIC) that is loan application processing, forwarding, and recovery etc (pg39).

The Online financial Accounting module was supposed to handle the financial aspects of the PSIC Head Office, Regional Offices and its project offices (pg31).

¹ PSIC has a handicraft centre two handicraft shops. The online sales store was proposed to boost the sales.
The proposed Online Inventory Control System consisted of modules handling the changes in inventory in the organization (pg33).

The payroll module was to maintain the profile of employees with their history and generate payroll as and when required (pg38).

The description shows clearly that the organization was taking its first step towards embracing information and communication technologies. Before this project was started a payroll application was working at head office. Furthermore computers were being used for designing of products in the handicraft workshop. As a whole in the organization computers were being used simply as text editors.

5.2.2 Functional Description of Modules by Authors of SRS

5.2.2.1 Online Sales Store

“…..The features of Online Sales Store applications are grouped into subsystems.

- **Purchase**
  - Search Product with Category Wise, Size wise and color wise
  - Browse for a Product with Category Wise, Size wise and color wise
  - View Cart
  - Add to Cart
  - Delete from Cart
  - Update Cart
  - Customize a Product

- **Transaction**
  - Checkout
  - Purchase Extended Warranty
  - Upgrade System

- **Marketing**
  - Manage Marketing Promotions
  - Market Survey
  - Up Sell/Cross Sell Products
  - Product Rating

- **Data Mining**
  - Find Best Selling Products
  - Forecast Product Demand

- **Inventory Management**
  - Manage Inventory

- **User Management**
  - User Registration
  - Login
  - Create Customized Page
5.2.2.2 Online Loan Management System

This module will manage the one of the activities of the organization that is loan application processing, forwarding, and recovery etc. The main features of this module include:

- Loan Application Process
- Loan disbursement
- Loan Installments plan
- Loan Recovery
- Loan History
- Reports

5.2.2.3 Online Financial Accounting System

“An online accounting solution is required for PSIC Head Offices, Regional Offices, District Development Offices and its projects at different locations. Head Office, Regional Offices and Project Offices use the software through dial up connection. The accounts will maintain separately by **HO, RO, DDO** and its **project offices** and also if user want to view the reports on consolidate basis then the system will provide it on consolidate basis. When some transaction will be made then it should automatically update the server at Head Office. This Online Accounting Software module will handle the financial aspects of the PSIC Head Office, Regional Offices and its project offices…..” (pg31)

5.2.2.4 Online Inventory Control System

“…Whenever there is some purchase / sale done in HO¹, RO², DDO³, Handicrafts Shops or some other PSIC Projects than it will automatically affect the accounts of respective projects. All the data will be handle project wise and there will be option to view the reports or enter the data for single projects, multiple projects or for all projects…..” (pg33)

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¹ Head Office
² Regional Office
³ District Development Office
5.2.2.5  **Online Payroll System**

“….. The PSIC users connect through dial up connection and access the page for payroll entry. Whenever some transaction will be made in the RO/DDO and other PSIC Projects, it will automatically effect on the centralized database in the head office. And if there is some problem regarding connection then software will run offline and user will transfer the data later when connection is established with the main server at Head Office….” (pg 38)

5.2.3  **Purpose of the system**

While going through the SRS document we come across the purpose of the document as defined by the authors of the document as follows:

“This is the Software Requirements and Specification document that specifies in detail … the behavior of the application via Use Cases in adherence with the UML standard. The actors of the system and the stakeholders are specified as the direct and indirect users of the system. It gives a high level overview of the functionalities of the system. This document defines the user requirements in a concise and clear manner via use cases…….”

“……..The Software Requirements Specification reviews the stakeholders of the system who indirectly influence the system and the actors who directly interact with the system. It gives a high level overview of the functionalities of the system. The features offered by Online Sales Store are defined and grouped into subsystems. This document defines the user requirements in a concise and clear manner via use cases.”

5.2.4  **Methodology**

The methodology followed to carry out the studies has not been mentioned anywhere in the document. However as per telephonic conversation with one of the analysts who prepared the SRS document, it comprised meetings and interviews with management, reviews of documentation stating organizational procedures, and consultation with IT people from PSIC.

The general method followed by analysts compiling the requirements and ‘problem definition’ is that officially a ‘focal person’ is declared by the concerned department that is going for technological change. The focal person briefs analyst about the overall functioning of the department. He further guides analyst to sub-departments or sections of the department if so desired by the analyst. The analysts normally interview departmental and sub-departmental heads and gather the necessary information regarding functioning of these departments.

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1 Focal person is one of the people serving in the organization (department). He is supposed to be well-aware of the functions and procedures of the department.
Another source of information is the procedural documentation that is normally available with all government departments. Different forms, Performa, booklets or any other literature also becomes basis for the report generation.1

5.3 Some Highlights

5.3.1 Who is the focus, software system or users?

After going through document it is quite obvious that the focus of studies was purely the system and not the system users. All the definitions, descriptions and explanations are around functioning of system. It is quite obvious from project description and description of the modules. Use cases have been used to describe the detailed requirements. But the use cases do not consider users, use of context or user needs. Here is a use case that makes it clearer (All the use cases have the same structure and structural elements and can be reached in the appendix if needed): (pg 115):

<table>
<thead>
<tr>
<th>Name</th>
<th>Edit Tax</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>This use case is used for employee tax editing. It is used when there is need to change the employee tax after some specific period. A screen will be appearing consisting of employee designation.</td>
</tr>
<tr>
<td>Actor</td>
<td>PSIC User</td>
</tr>
</tbody>
</table>

**Basic Information’s**

- **This use-case starts when the user accesses the define Edit Tax screen page**
  1. When the user access the screen.
  2. The employees will be selected by selecting the employee designation from the combo box. The change will be done in the required employees record and than it will be saved by clicking on the save button.
  3. The screen must consist of all the necessary buttons related to data entry, record editing, record searching, record deletion etc.
  4. The user id and date of record addition / record editing must be saved in database for history purpose.

**Alternate Flow**

- **Data Validation**
  1. Symbol (*) must be mentioned with the mandatory information.
  2. All the error handling handled in a proper way. If any error occurs than there must be proper error message and it must be saved in database for record purpose.

**Pre-conditions**

- The user is logged in and screen is displayed.

**Post-conditions**

- The user has successfully saved the data.

The use case is described in functional context i.e. at what stage of operation this action will be taken. It further discusses the software objects or the application controls appearing on the computer screen and the sequence of the events taking place. The user and the context of use have been given least importance without going into any details. The user has been given a general title for all use cases.

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1 This information is based upon personal experience of author as well telephonic interviews with Mr. Qasim Sajad Project Manager, Punjab Information Technology Board Lahore, Pakistan and Mr Umer Mobeen Qureshi Senior Analyst Information Technology Department (The interviews are conducted on April 7, 2008).
The basic information also revolves around different functional steps and around different application controls as combo box, buttons, user id and date.

The data validation section is there to ensure the integrity of data. The pre and post conditions also take into account only functional involvement of the user.

5.3.2 Analysis methodology

The methodology adopted by the analysts for the system under consideration and rest of projects taken up by the mentioned departments is same. The general practice is to have a broad overview of the system and develop reports that become basis for development of hardware and software infrastructure and facilities. The major part of information comes from managers or active players in the departments. Or at most the people in the IT sections of the departments provide information that is unreliable as most of these departments are newly established. The employees serving in these departments don’t have much to do with the real work practices and procedural flows in the organizations. Thus most of the designs implemented in different organizations are carved by aliens indeed.

In short we can say that the systems being developed have least to do with the users’ say.

![Design](image)

Figure 7 Discussed design don’t have much to do with human factors

5.3.3 The missing FACTORs

Here is a list of possible factors that could have added to the strength of the project. The probability that system would be a success could be increased. These factors are quite critical when taking into account cooperative design and also from a ubiquitous computing perspective.

- The user participation in the whole process is missing. The term used to represent the user i.e. *PSIC USER* is quite a vague term and does not make any
distinctions between people from different sections and traits. It ignores the capabilities and skills of the people working in different positions.

- The report has not mentioned anywhere how the system will affect the users. The only thing that has been mentioned is that it will increase the efficiency of the users and the organization.

- There is no discussion about how the system will change the organizational culture. It is important to note that a culture which accommodates laziness, irregularities and delays was prevailing. Most of the employees were part of the culture under the protection of trade union.

- There is no discussion about the competence of the users and how they will fit with the system. The skills of the users, their competence, and their capacity to accommodate the technological agenda are completely missing from the reports.

- The meetings were held and planning for the system was done in the head office. Most of the delays and problems were on the part of Regional and District Development Offices. No special attention has been paid to them (the analysts even did not visit sub-offices).

- There is no discussion about how will the users undergo this technological and organizational change at psychological, emotional and personal level as against professional levels mentioned in above lines.

- There is no discussion of how the system will affect the work experience and work practices in the organization. The studies and reports do not contain even the broader description of work practices as against the requirements of cooperative design where we involve the individuals in the design process to get better understanding.

- There are no measures mentioned to tackle the resistance expected from the trade union and employees who were used to delays, personal influences and were afraid of technology (one of the human factors).

- The organization under consideration is a public sector organization and its services are directly related to the general public. General public has not been involved in the studies and neither has been mentioned anywhere in the studies. The reports do no mention how will the system affect the general public. Will it add to their comfort or will it add to their problem. The literacy rate in southern parts of the province is quite low and in rural areas it is quite possible that the people carrying out small scale business or establishing cottage industry might not be literate enough to take full advantage of the system.

- Sustainability is always an issue for long term projects. No measures have been mentioned in the reports at any level to encounter the possible hazards that could even cause failure of the project.

- There is no part discussing the possible factors that could cause system or project failure. There can be plenty of factors that can be possible cause of failure of a project. But no attention was paid to them.

- The project SRS was prepared in 2004, the analysts are doing the same job and using same methodology. It shows they are not aware of role of human factors in design. The situation will lead to a point where the software will need to be redesigned.

- Finally we can point out that ‘Cooperation’ is missing from whole of the methodology that has been used for carrying out these studies.
5.4 Some Comments

As we have seen by going through the case study and the preceding section the proposed design missed large number of critical factors that would have been taken into account if ubiquitous computing design methodology would have been employed in combination with cooperative design practices.

The designs based upon approaches that ignore human requirements and just eliminate the functional requirements come up with outcomes that are hard to handle. The social and cultural impacts, work practices, communities of practice everything affects the design process and design. The system designers need to take into account the human factors as much as the technical aspects of the system.

5.5 Discussion

It’s a general economics principle that demand drives the supply in general in consumer market. The products that accommodate the requirements of the consumers (users) in best way lead the market. One of the examples is from china where Haier (an appliance making company) had to reinvent their washing machines as farmers were using them to wash vegetables. [3] Whereas it is a valid fact for the consumer products same reality is true for the technology design.

Personally I believe that computing technology design is no different from designing any of the consumer products. But as against consumer products the technology based solution design involves really big amounts and even bigger amounts are required to amend or undone the design. Apart from the amounts the effect of computing technology on human life is far more than any other technologies. And the factors such as human factors, involved in the technology design have so far been ignored or misunderstood to a larger extent. The breadth of factors involved can be imagined by the following statement of Michael Maddox, a senior scientist for human centric technologies:

‘…… it dawned on me that we have done a very poor job of educating people, including our clients, as to what it is that we actually do. Most technical people are aware of certain aspects of human factors, such as usability testing and ethnography (in situ observations and interviews). However, the breadth of human factors is poorly understood…’ [7]

And the fact that we don’t take into consideration the human factors most of the time is quite obvious from the report that is basis for the case study. It is not just the report but the standard being used to draw use cases also ignores human factors and emphasizes just on the functional aspects of the system.

Especially in e-government projects the need to address change management issues has been highlighted. And all the stakeholders within organizations and within community of users have to be involved in the process to make the change a success and to help them adjusting to the new realities [9]. ‘Co-construction of technology, society and citizenship in everyday life’ [8] as preached by cooperative design best serves the purpose as discussed in second chapter.
Figure 8

Although the level of participation of users in the design process was questioned earlier but there is a consensus about user being the real informant of work practices and procedures [1].

The social and cultural shaping of information and communication technologies and technology based infrastructures is need of the hour [5]. And ubiquitous computing can best comprehend all these issues being part of its agenda [10].
6 CONCLUSION AND FUTURE WORK

The research probed into role of cooperative design in ubiquitous computing perspective, with reference to the changing attributes of society and the associated issues, the changing shape of public service delivery and need for a change in design methodology in ubiquitous computing projects.

The overall research brought together social and societal aspects, agenda of governments from IT perspective, human factors and design methodology to develop a framework in which we need to re-assess ubiquitous computing design methodology. Lucy Suchman’s idea of artful integration provided guidelines for bringing together social, cultural, political and technical facets of design. Whereas, so far, these factors are treated by the respective domain experts; cooperation between these experts can help us coming up with information systems designed based upon the real holistic approach as recommended by Robert Milner. Most carefully I can say that long term system users and domain experts including technology experts, all need to play their role as system designers.

It was learnt that for a successful ubiquitous computing design, designers need to consider the end user interactions in the context of use and the usability of the technology in its underlying infrastructure. In other words coming up with a desired ubiquitous computing design is impossible without involving the users, domain experts, human factors, the work practices and work settings. This has made the participatory and cooperative design methods and practices an immense and highly desirable trait for ubiquitous computing.

Whereas holistic approach towards ubiquitous computing system design is required, research revealed that ‘cooperative design’ can be quite a suitable methodology for ubiquitous computing projects the reason being involvement of ‘inter-disciplinary’ domain experts in the design process along with user and ‘designer1’. It was however discovered that cooperative design in only a modified and transformed form of participatory design.

As the research progressed it was learnt that Ubiquitous computing can take advantage of information society’s agendas and infrastructure and that there is need to take society out of the technological web. Users should know what is being designed for them and how it will affect their lives. There is a need to involve the user or in other words social actors in the design process. Cooperative design embedded in the holistic approach towards design can help ubiquitous computing in informing users and exploiting the information that they carry from design perspective.

It was further learnt that the agenda of information society can be mapped with the social roots of ubiquitous computing thus aligning ubiquitous computing in the mainstream with governing bodies.

\[1\] The term has been used in conventional meanings. In cooperative design all the parties involved will be acting as designers in their place.
It was found that there is a need to come up with ‘correct design’ or we shall be misleading societies towards social, organizational, psychological and emotional chaos.

The case study validated that ignoring human factors, users and user-needs is resulting in solutions that don’t accommodate the human needs, culture, work settings and work practices.

We conclude that there is a need to re-configure ubiquitous computing design techniques and analysis methodologies. This research reached the conclusion that a holistic ubiquitous computing design approach integrating all the different aspects, in collaboration with cooperative design can help coming up with desirable system designs.

### 6.1 One Final Comment

Ubiquitous computing not only takes into account the functional aspects of the system but also the way systems are being run and the actors in and around the systems. By actors in the system I mean the people who are interacting with operational and functional modules of the system and by actors around the system I mean people who are affected by the system in any way

Overall research, literature review and case study exposed that there is a need to bring about a change in the attitude of the designers. Whereas ubiquitous computing is related with technology design it also includes the ways and techniques in which we carry out system studies, the ways in which we configure and build the infrastructure for ubiquitous computing systems and of course the reshaping of equipment and technological gadgets.

### 6.2 Future Work

The thesis work can become basis for a more thorough probe into aligning cooperative design with ubiquitous computing. Furthermore it can help people who are interested in understanding human factors and their relation with technology and holistic approach towards design. There can be probe into how can agenda of governments and ubiquitous computing be mapped. There can further be studies carried out to transform and align Software requirements specification documentation with ubiquitous computing requirements.
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