A USABILITY EVALUATION FRAMEWORK AND A CASE STUDY ON A SUPPLIER PORTAL SYSTEM

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ABSTRACT

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The goal of this thesis is to provide a usability evaluation framework in the area of e-procurement technologies and a case study on this base. A survey of the concepts of human computer interaction, usability and usability evaluation techniques is carried out. Additionally current e-procurement technologies are explored and specifically a Company's Supplier Portal System which was employed in year 2003, as an e-procurement technology for the procurement of direct goods, is taken into consideration. Pointing from the findings of the survey, a usability evaluation methodology is developed based on user and task analysis of the Supplier Portal. Within this methodology, in terms of performance metrics of the Supplier Portal, usability attributes to be measured are determined and a checklist for a heuristic system evaluation is developed.

While a laboratory testing structure is proposed for the case, a usability satisfaction survey and empirical usability tests are implemented with the actual users of the Company Supplier Portal. Descriptive and inferential formal analyses of the survey and field test results are studied, contributing to the Usability Evaluation of the Portal. Lastly further prospects are pointed, where usability, formal analysis, supply chain management and systems design intercept.

Keywords: Usability Analysis, Usability Evaluation, Supplier Portal, e-Procurement, Formal Analysis, Heuristic Evaluation

ÖZ

BİR KULLANILABİLİRLİK DEĞERLENDİRMESİ ÇERÇEVESİ VE BİR TEDARİKÇİ PORTALİ SİSTEMİ ÜZERİNDE VAKA ÇALIŞMASI

Babayiğit, Elif Fatma

Yüksek Lisans, Endüstri Mühendisliği Bölümü

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Bu tezin amacı e-tedarik teknolojileri alanında, bir "Kullanılabilirlik Değerlendirmesi" çerçevesi oluşturmaktır. Öncelikle insan-bilgisayar arası etkileşimler, kullanılabilirlik ve kullanılabilirlik değerlendirmesi konuları için bir araştırma yapılmıştır. Sonrasında e-tedarik teknolojileri taranmış ve 2003 yılında özel bir şirket tarafından devreye alınmış olan Şirket Tedarikçi Portali üzerine bir kullanılabilirlik değerlendirmesi uygulaması yapılmıştır. Araştırmadan yola çıkılarak, Tedarikçi Portali sisteminin kullanıcı ve iş analizi üzerine temellendirilmiş bir kullanılabilirlik değerlendirmesi metodolojisi geliştirilmiştir. Bu metodoloji dahilinde, Tedarikçi Portali'nin performans

metrikleri olarak, ölçülecek kullanılabilirlik nitelikleri belirlendi ve bir sezgisel değerlendirme işaretleme listesi oluşturuldu. Laboratuar ortamında gerçekleştirilecek bir kullanılabilirlik test yapısı tanıtılırken, Şirket Tedarikçi Portali kullanıcılarıyla bir anket çalışması ve yine Şirket Tedarikçi Portali kullanıcıları ile deneysel kullanılabilirlik testleri gerçekleştirildi. Portalin Kullanılabilirlik Değerlendirmesi için anket ve test sonuçları üzerine tanımsal ve sonuçsal formal analiz çalışması yapıldı. Son olarak, Kullanılabilirlik, Formal Analiz, Tedarik Zinciri Yönetimi ve Sistem Dizaynı kavramlarının kesişimindeki gelecek açılımlara değinildi.

Anahtar Kelimeler: Kullanılabilirlik Analizi, Kullanılabilirlik Değerlendirmesi, Tedarikçi Portali, e-Satınalma, Formal Analiz, Sezgisel Değerlendirme

Güzel Annem,

Alânur Hanım'a ithaftır.

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LIST OF ABBREVIATIONS

A & SA : Agree and Strongly Agree

CA : Correspondence Analysis

DA & SDA : Disagree and Strongly Disagree

Dof : Degree of Freedom

GUI : Graphical User Interface

HCI : Human Computer Interaction

IC : Interval Confidence

ISO : International Standards Organization

LoBMIC : Lower Bound of the Confidence Interval for the Mean

MDS : Multidimensional Scaling

NC : No Comment

S : Sample Variance

SI : Satisfaction Item

UpBMIC : Upper Bound of the Confidence Interval for the Mea

C H A P T E R 1

INTRODUCTION

This thesis introduces a usability evaluation methodology for a Supplier Portal system. A Supplier Portal is an e-procurement technology within supply chain management. Nowadays more companies begin to employ this internet-based technology to provide an interface to their suppliers which will maintain the better integration and adaptation to their internal operations Firstly a review of Usability in line with Human-computer interaction is carried out, and then the methodology is introduced. Studying the design and implementation of such a Supplier Portal system, parameters for Usability Evaluation are proposed within human factors and supply chain management approaches. While introducing the usability testing of such a supply chain system, cognitive modeling perspective is combined with the corporate goals.

After the conceptual review of the terms in Chapter 2, in Chapter 3 the Usability Evaluation Plan for a Supplier Portal System is developed. Within this plan, usability goals for the Supplier Portal are set and empirical and satisfactory attributes to be measured are determined as indicators of the performance and preference metrics of the system. A heuristic evaluation guidelines list and a system checklist are also included, employed for the heuristic evaluation of the Supplier Portal.

In Chapter 4 the Supplier Portal technology is explored in terms of e-Supply-Chain prospects. The supplier portal is introduced in terms of the users and

processes it interacts with and the connection to the Usability Motivation is made.

In Chapter 5, the deployed Satisfaction Survey Analysis and Field User Tests are analyzed by descriptive and inferential methods. User profiles, usage patterns, user clusters are determined as conclusion and understanding the performance and preference levels for the Supplier Portal.

It is concluded with the overview of the usability evaluation methodology implemented and the formal analysis methods studied. Their implications are discussed. Lastly the importance of Usability Analysis in Systems Design and further developments in Usability Engineering are pointed.

C H A P T E R 2

CONCEPTUAL SURVEY

2.1 Human Computer Interaction

Systematic study of human performance began in earnest at the beginning of the 20th century in factories, with an emphasis on manual tasks. Ergonomics or Human Factors, both often used interchangeably, are concerned with user performance in the context of any system, whether computer, mechanical or manual. As computer use became widespread the research area on the process of interaction between human and computers developed concerned with the physical, psychological and theoretical aspects. Additionally information science and technology has influenced the development of HCI. The management and manipulation of information has changed with technology affecting the organizations and the work environment and systems also.

Taking the systems design as a central concern, HCI involves the design, implementation and evaluation of interactive systems in the context of the user's task and work.

User: an individual user or a group of users working together, or a sequence of users in an organization, each dealing with some part of the task or process.

Computer: Any technology ranging from the general desktop computer to a large-scale computer system, processes control system or an embedded system. The system may include non-computerized parts, including other people.

Interaction: Any communication between a user or a computer, be it direct (involves a dialog with feedback and control throughout performance of the task) or indirect (may involve background or batch processing).

These three definitions above form the three major issues of concern: the people, the computers and the tasks that are performed. The system must support the user's task, which gives the fourth focus, usability: if the system forces the user to adopt an unacceptable mode of work then it is not usable.

Therefore HCI studies to determine how the computer technology can be made more usable to people. Four strands provide the focus for the study

1. Human cognitive and physical capabilities and to incorporate knowledge of these, as guidelines, into the design of technology
2. Technology: what is available and how we can specify its functionality
3. Usability principles and paradigms and methods for evaluating designs against these
4. User's activity in terms of the tasks to be performed and the context in which they occur.

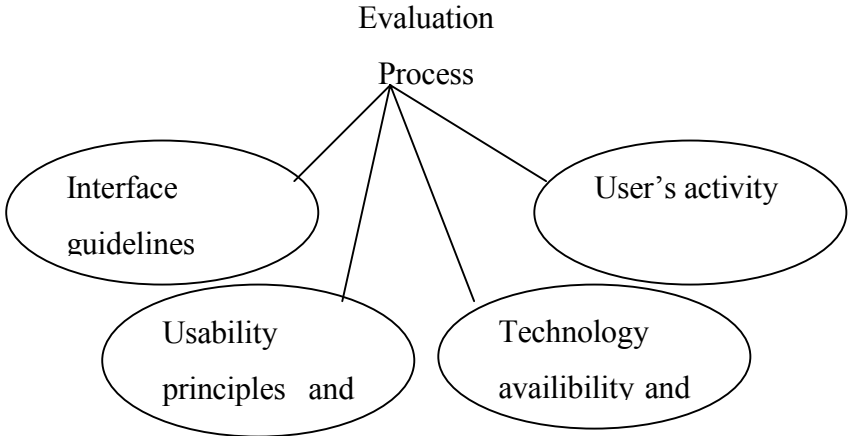

Figure 2.1.0 Evaluation Proces Basics

The central theme is the design of the computer technology that is interactive.

A design process; centered on the user therefore incorporate cognitive models and assess or predict the usability of designs.

In this study we take the first two strands straightforward as what we have at hand. Our technology is the supplier portal application, which has suppliers of the enterprise as users. We will explore through the usability paradigms and principles, interface design guidelines and the methods of evaluation proposed so far. Then a usability evaluation framework will be developed based on the functionality, user and task analysis of our system.

2.2 Usability

Usability can be defined as the degree to which a user can easily learn and effectively use a system to finish a job. In the beginning of the ISO 9241 component the following definition of usability is given:

Usability The effectiveness, efficiency and satisfaction with which specified users achieve specified goals in particular environments.

Effectiveness The accuracy and completeness with which specified users can achieve specified goals in particular environments.

Efficiency The resources expended in relation to the accuracy and completeness of goals achieved.

Satisfaction The comfort and acceptability of the work system to its users and other people affected by its use.

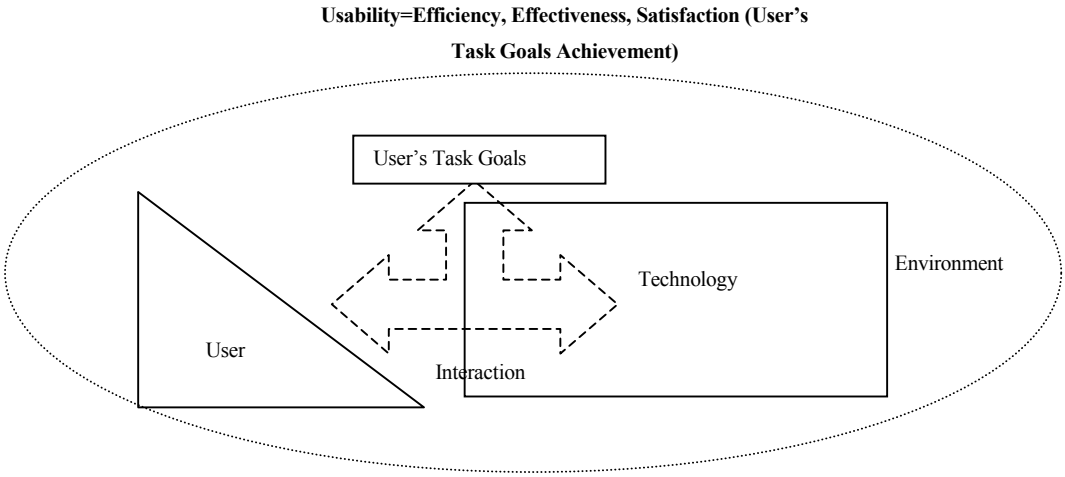

Figure 2.2.1 Usability Definition

Usability is a focused concern within the system acceptability. System acceptability basically is the question of whether the system is good enough to satisfy all the needs and requirements of the users and other potential stakeholders, such as the users' clients and managers. Below is a model of the attributes of system acceptability by Nielsen (1993).

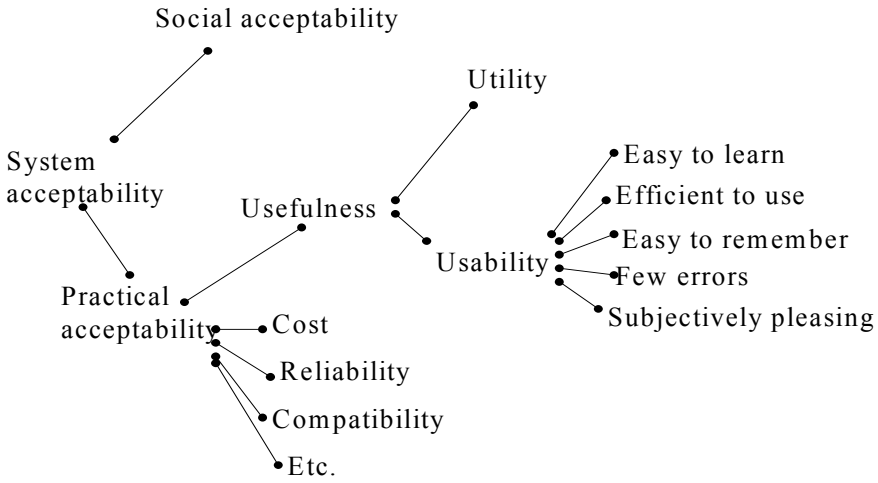

Figure 2.2.2 Attributes of system acceptability

Usefulness: is the issue of whether the system can be used to achieve some desired goal.

Utility: is the question whether the functionality of the system in principle can do what is needed

Usability: is the question of how well users can use that functionality.

Above all, Usability comes along as an iterative process that focuses on the system's (or the product's) use rather than its features and functions. It involves knowing the users and the work they do.

2.3 Usability Engineering Lifecycle

For a usability study several methodologies exist for particular needs, based on the usability needs and where the system implemented is in the product development cycle.

The stages of a Usability Engineering Lifecycle model:

1. Know the user
    a. Individual User characteristics
    b. The user's current and desired tasks
    c. Functional analysis
    d. The evolution of the user and the job
2. Competitive analysis
3. Setting usability goals (financial impact analysis may be included)
4. Parallel design
5. Participatory design
6. Coordinated design of the total interface

7. Apply guidelines and heuristic analysis
8. Prototyping
9. Empirical testing
10. Iterative design including to collect feedback from field use

In the following table, the usability methodologies employed in stages of product development are summarized:

Table 2.3.1 Usability evaluation techniques for product development stages

Product development stage	Work practice observations	Client interviews	End user interviews	Competitive analysis	Benchmarking	Standards and guidelines	Focus groups	Guided interviews with video	Contextual inquiry	Task analysis	Heuristic Evaluation	Usability testing	GUI guidelines and standards	Usability goals	End user definitions	Prototyping	Training materials	Reference manuals and help	Ongoing evaluation
Project initiation		√	√	√	√	√													
Business process definition	√	√					√	√	√	√									
Technical architecture				√	√						√	√	√						
Application development	√						√	√			√	√		√	√	√			
Distributed deployment												√					√	√	√

Usability engineering involves a variety of techniques that can provide important information about how customers work with the system to be evaluated (Dix and Finlay, 1998):

User and task observations- observing users at their jobs, identifying their typical work tasks and procedures, analyzing their work processes

Interviews, focus groups, and questionnaires- meeting with users, finding about their preferences, experiences and needs

Benchmarking and competitive analysis- evaluating the usability of similar products in the marketplace

Participatory design- participating in the design sessions, bringing the user's perspective to the early stages of the development

Paper prototyping- including users early in the development process through prototyped prepared on paper, before coding begins

Creation of guidelines- helping to assure consistency in design through development of standards and guidelines

Heuristic evaluations- evaluating software against accepted usability principles and making recommendations to enhance usability

Usability testing- observing actual users performing real tasks with the application, recording what they do, analyzing the results, and recommending appropriate changes.

2.3.1 Essential Features of a Usable Interface

Cognitive Modeling and Human Factors Disciplines have contributed to the knowledege about the essential fetures of an interface. Besides there have

emerged the guidlines, and heuristics for the design and evaluation of the interactive systems.

2.3.1.1 Cognitive Modeling & Human Factors Knowledge

It has been recognized that the introduction of an interactive computer system often changes the work environment and the cognitive demands placed on employees. Although the physical work load can be decreased at most of the workplaces through the utilization of computer systems, in some cases the mental workload might increase for particular users, due to inherent problems in information systems, such as the three below which Oliver (1995) points out:

- Disorientation
- Navigation inefficiency
- Cognitive overload.

As a consequence, the potentials of computer systems have to be tuned to the context of their utilization. There is a need for a multidisciplinary, need-driven, and user centered protocol for the design and development of interfaces. There have emerged general or context specific guidelines as the propagation of human factors knowledge, cognitive modeling and results of the evaluations.

The expected benefits of cognitive modeling are expected in terms of improved usability of interfaces, based on the represented knowledge about mental processes as well as predictability of human behavior in the course of human-computer interaction and avoidance of errors in the course of task accomplishment.

Cognitive models as representations of mental processes as well as their results are utilized to understand ‘what knowledge of the world is needed and how this knowledge can be used to achieve effective performance’ (Woods et al. 1988).

Below is a preference-based scheme for the usage of human factors knowledge in design, offered by Akoumianakis and Stephanidis (1997).

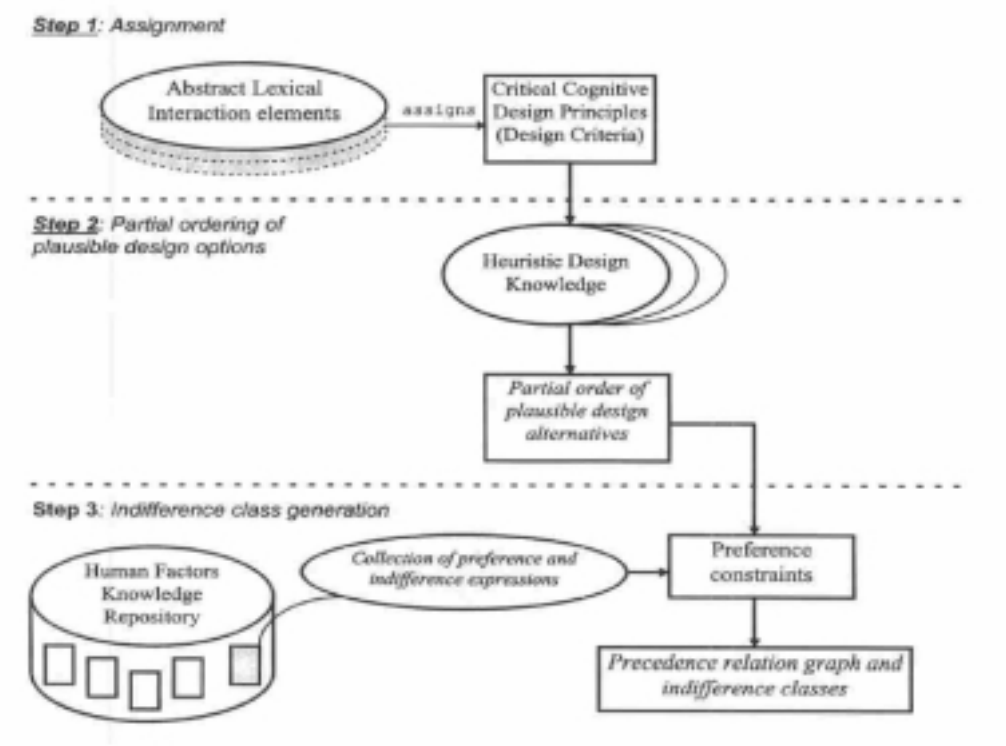

Figure 2.3.1 Usage of Human Factors Knowledge in systems design

This study is concerned with essential features of human computer interfaces, human factors knowledge as guidelines that raise consideration on the cognitive levels of HCI.

Following is a classification of available guidelines which employ human factors expertise in the design of user interfaces of interactive systems.

Table 2.3.2 Human Factors Techniques User Interface Design

Instrument Category	Example References
Guidelines	Smith and Mosier (1986); Philips (1995)
Style Guides	Apple Computer (1992); IBM Corporation (1991); Microsoft (1992, 1995); Open Software Foundation (1993)
Criteria and design principles	Gerhardt-Powals (1996); Vanderdonckt & Bodard (1996); Bastien & Scapin (1992,1995); ISO 9241 (1994)
Checklists	EVADIS (Reiterer and Oppermann (1993, 1995)
Standards	ISO 9241 (1994); MIL-STD-1472D (1993)
Heuristic Evaluation	Nielsen (1993)
Analytical methods and cognitive theories	K-LM (Card, Moran and Newell, 1980); GOMS (Card, Moran & Newell, 1983); Lewis & Polson (1990); Lewis, Polson, Wharton Rieman (1990); ERMIA (Green et al., 1996)

2.3.1.2 Design criteria

A design criterion is defined as a quality attribute or predicate for an interaction object class. Below are the various measures (design criteria) the studies call:

- Accuracy
- Shortest positioning time
- Mostly preferred option
- Task completion time
- Effective target width
- User satisfaction
- Action time

- Planning time,

As well, there are some sort of evaluation and validation (e.g. statistical significance of results) in specific application domains.

For example input-output devices may be taxonomically classified according to various application-specific criteria such as,

- Space required
- Suitability for graphical input
- Ease of use
- Suitability for prolonged use
- Amount of training required Integrality and seperability
- Cursor control

Top Ten Mistakes In Computer Interface Design

Following are the famous mostly known DON'T DOs (45):

1. Using Frames
2. Gratuitous Use of Bleeding-Edge Technology
3. Scrolling Text, Marquees, and Constantly Running Animations
4. Complex URLs
5. Orphan Pages
6. Long Scrolling Pages
7. Lack of Navigation Support
8. Non-Standard Link Colors
9. Outdated Information
10. Overly Long Download Times

In the following section guidelines for a usable interface depicted in the literature are explored.

2.3.1.3 Guidelines For A Usable Interface

There are a vast amount of guidelines with various specifications and contexts. It is summarized under eleven consideration points the guidelines those to be utilized for the heuristic evaluation of our system, the Supplier Portal. The guidelines are depicted in Table 2.4.2. For explanations and comments please refer to App. A1. The implementation details of the Heuristic Evaluation according to these eleven guidelines can be seen in App. D.

Table 2.3.3 Guidelines for Usable Interface

1. DESIGN CONSIDERATIONS	Establish Level of Importance Reduce User's Workload Be consistent Provide feedback to users Limit use of frames
2. CONTENT/CONTENT ORGANIZATION	Establish Level of Importance Provide Useful Content Put Important Information At Top of Hierarchy Use Short Sentence/Paragraph Lengths Provide Printing Options
3. TITLES AND HEADINGS	Use Well Designed Headings
4. PAGE LENGTH	Determine Page Length Determine Scrolling vs. Paging Needs
5. PAGE LAYOUT	Align Page Elements Establish Level of Importance Be Consistent Reduce Unused Space Put Important Information At Top of Page Format for Efficient Viewing
6. FONT AND TEXT SIZE	Use Readable Font Sizes Use Familiar Fonts
7. READING AND SCANNING	Use Reading Performance or User Preference Enhance Scanning Determine Scrolling vs. Paging Needs
8. LINKS	Position Important Links Higher Show Links Clearly Indicate Internal vs. External Links Use Descriptive Link Labels Use Text Links Avoid Mouse Overs Repeat Text Links Present Tabs Effectively Show Used Links
9. NAVIGATION	Keep Navigation Aids Consistent Use Text-Based Navigation Aids Group Navigation Elements Place Navigation On Right
10. SOFTWARE VS. HARDWARE	Determine Connection Speed Reduce Downloading Time Consider Monitor Size Identify Users' Screen Resolution Design for Full or Partial Screen Viewing
11. ACCESIBILITY	Use Color Wisely Design for Device Independence Provide Alternative Formats Provide Redundant Text Links Provide User-Controlled Content

2.4 Usability Evaluation

Evaluation is required to assess the designs and test the systems to ensure that they actually behave as expected and meet the requirements of the user. There is a close link between the evaluation, modeling and prototyping techniques.

Evaluation of the design of an interactive system: Evaluation throughout the design life cycle feeding back into modifications of the design tends to focus on evaluation by the designer without direct involvement of the user. There are four possible approaches:

1. Cognitive walkthrough
2. Heuristic evaluation (e.g. guidelines, checklists)
3. Review-based evaluation
4. Use of models

Evaluation of the implementation, whether full or prototype, studies the actual use of the system.

2.4.1 Goals of Evaluation

The first step in a usability evaluation study is to determine the goals of the evaluation. Then one can decide the methods and techniques to be employed in the study and the attributes to be measured in line with the goals of the evaluation. Below are the three main goals of evaluation.

1. To assess the extent of system's functionality

The system's functionality must accord with user's task requirements. The design of the system must enable the user's task requirements

Therefore in tests the following points are investigated:

- User's task requirements?
- User's expectations of the task (there are also user expectations independent of the task).
- The appropriate functionality available in the system.
- The system is clearly reachable by the user to perform the required tasks more easily.
- Match between the use of the system and the user's expectations of the task.

Evaluation may also include measuring the user's performance with the system to assess the effectiveness of the system design in supporting the task.

2. To assess the effect of the interface on the user:

The following points helps to evaluate the effect of the interface on the user:

- How easy is the system to learn?
- System's usability
- The user's attitude to the system
- Areas of the system, which overload the user by some way (ex. Requiring the user to remember excessive amount of information)

3. To identify any specific problems with the system:

The aim is to find out the aspects of the design:

- Which cause unexpected errors when used in the intended context
- Which cause confusion amongst users.

By this proactive evaluation potential problems can be solved without any loss of resources.

2.4.2 **Styles of Evaluation**

There are mainly two types of evaluation according to the environment they are performed. These are the evaluation carried out under laboratory conditions and the evaluation done in the field (the work environment).

2.4.2.1 Laboratory

This evaluation can be performed with or without users involved. Sophisticated audio/visual recording facilities are required. Below, the table summarizes the advantages and disadvantages of laboratory evaluation studies.

Table 2.4.1 Advantage and Disadvantages of Usability Laboratory Testing

Advantages	Disadvantages
• Two-way mirrors • Instrumented computers • Subject operates in an interruption free environment	• Lack of context- filling cabinets, wall calendars, books etc. • Unnatural situation • Difficult to observe several people cooperating on a task in a laboratory situation • As interpersonal communication is heavily dependent on the context. • Appropriate for: o System is to be located in a remote or dangerous location o Very constrained single-user tasks o When we want to manipulate the context in order or uncover problems or observe less used procedures o To compare the alternative designs within a controlled context. Controlled experiments.

2.4.2.2 Field Studies

Field studies are carried out in the natural environment of the actual users. Below are the several aspects of the field usability studies:

- High level of ambient noise
- Greater level of movements
- Constant interruptions.
- Open nature of the situation; interactions between systems and between people is observable.
- Interruptions are observable. (Interruptions expose saving and restoring)
- The context is retained, user is observed in his natural situation.
- Long time observations are possible.
- However users are influenced by the presence of the analyst or the recording equipment.

So, we always operate slightly removed from the natural situation, in line with the Heisenberg uncertainty principle.

The following table summarizes the applied techniques for usability evaluation (Baecker, 1995).

Table 2.4.2 Usability Evaluation Methods

Method Name	Lifecycle Stage	Users Needed	Main Advantage	Main Disadvantage
Heuristic Evaluation	Early design, "inner cycle" of iterative design	None	Finds individual usability problems. Can address expert user issues.	Does not involve real users, so does not find "surprises" relating to their needs.
Performance Measures	Competitive Analysis, final testing	At least 10	Hard numbers. Results easy to compare.	Detailed investigation is required to find the individual problems.
Thinking Aloud	Iterative design, formative evaluation	3-5	Pinpoints user misconceptions. Cheap test.	Unnatural for users. Hard for expert users to verbalize.
Observation	Task analysis, follow-up studies	3 or more	Ecological validity; reveals users' real tasks	Appointments hard to set up. No experimenter control.
Questionnaires	Task analysis, follow-up studies	At least 30	Finds subjective user preferences. Easy to repeat.	Pilot work needed (to prevent misunderstandings.)
Interviews	Task Analysis	5	Flexible, in-depth attitude and experience probing.	Time consuming. Hard to analyze and to compare.
Focus Groups	Task analysis, user involvement	6-9 per group	Spontaneous reactions and group dynamics. Participatory dimension to design.	Hard to analyze. Low validity
Logging Actual Use	Final testing, follow-up studies	At least 20	Finds highly used (or unused) features. Can run continuously.	Analysis programs needed for huge mass of data. Violation of users' privacy.
User Feedback	Follow-up studies	Hundreds	Track changes in user requirements and views.	Special organization needed to handle replies.

2.5 Heuristic Evaluation

Heuristic evaluation is a systematic inspection of a user interface for usability. Using some of the currently available techniques such as guidelines, checklists and criteria, it is directed to facilitate a more effective coupling among the design, development and evaluation phases of the system user interface.

Nielsen is one of the gurus, maybe the most famous, in the area of usability. His website useit.com is one of the most referenced. He has worked as a usability consultant for many firms. In the following section the basic usability heuristics developed by Nielsen et al. (2003) so far are explored.

2.5.1 The Ten Usability Heuristics

1. **Visibility of system status:** The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.
2. **Match between system and the real:** The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.
3. **User control and freedom:** Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.
4. **Consistency and standards:** Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.
5. **Error prevention:** Even better than good error messages is a careful design, which prevents a problem from occurring in the first place.

6. **Recognition rather than recall:** Make objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.
7. **Flexibility and efficiency of use:** Accelerators, unseen by the novice user, may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.
8. **Aesthetic and minimalist design:** Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.
9. **Help users recognize, diagnose, and recover from errors:** Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.
10. **Help and documentation:** Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.

2.6 Usability Testing

Usability Testing is the most fundamental method usability method and is in some place irreplaceable, since it provides direct information about how people use computers and what their exact problems are with the concrete interface being tested. Below is a specific model of a usability evaluation study by Nielsen et.al.

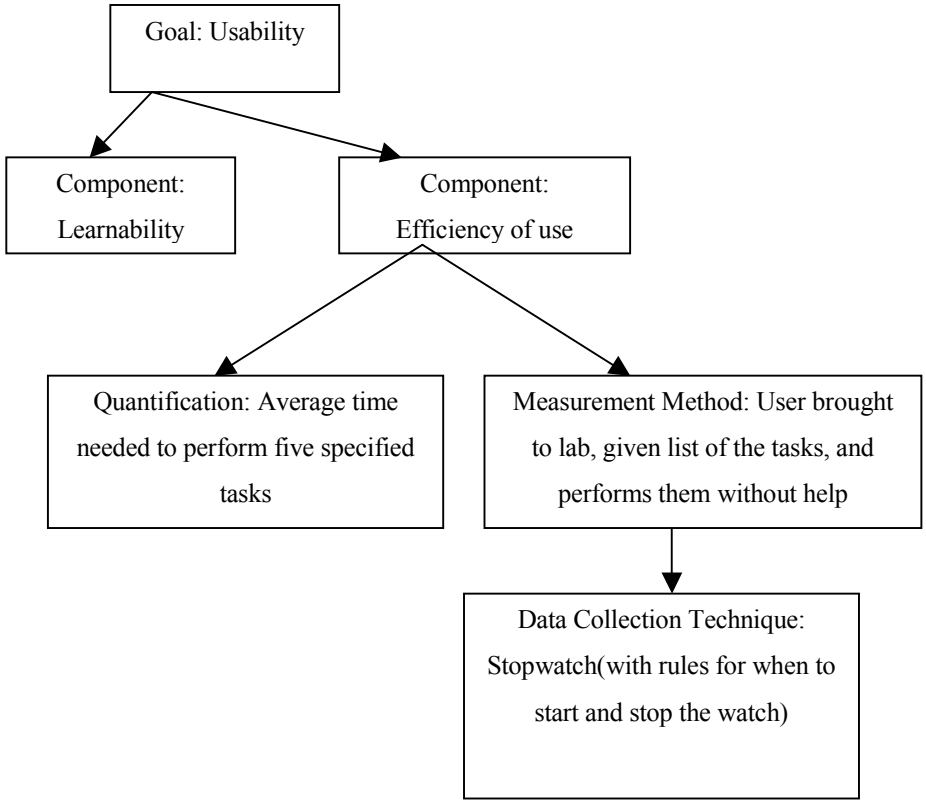

Figure 2.6.1 Model of Usability Measurement

2.6.1 Attributes to be measured

Determination of the attributes to be measured during the evaluation study is one of the most important steps. These attributes emerge from the usability goals determined in the beginning of a usability study. In parallel with the studies in the literature, we have come out with three main usability goals for our system. These are:

- Error rates
- Learnability

- User Performance (Expert, novice)

The attribute 'Error rates' is straightforward as it is the rate of the users' making errors during performing a task. Learnability and user performance are explained in the following sections.

2.6.1.1 Learnability

Learnability: The system should be easy to learn so that the user can rapidly start getting some work done with the system.

Below is the illustration of the two learning curves for hypothetical systems one focuses on the novice user, being easy to learn but less efficient to use, and the other that is hard to learn but highly efficient for expert users. In establishing a system, what is important is how to best ride the best parts of both curves. As a note, the standard learning curve does not apply where users are transferring skills from previous systems.

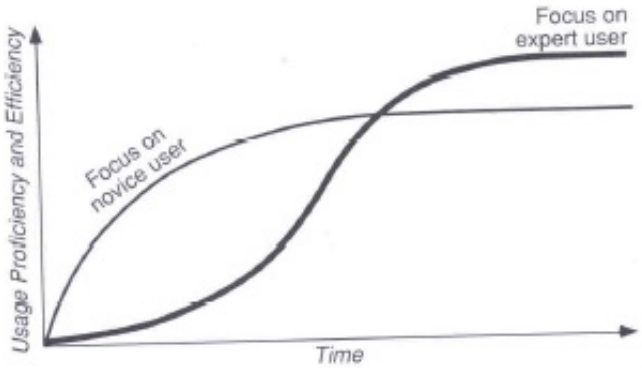

Figure 2.6.2 The Learning Curve

Initial ease of learning: Time it takes for a novice user to reach a specific level of proficiency in using it.

The specified level of proficiency: the users have to be able to complete a certain task successfully. Alternatively, users are specified to be able to complete a set of tasks in a certain, minimum time before one will consider them as have "learned" the system.

In the usability evaluation framework questions are, 'how long it takes for a user to achieve complete mastery of a system?' but also 'how long it takes to achieve a sufficient level of proficiency to do useful work?'

2.6.1.2 User Performance

Refers to the expert user's steady state level of performance at the time when the learning curve flattens out. A typical way to measure efficiency of use is to get a sample representative of expert users, measure the time it takes these users to perform some typical test tasks.

2.6.2 Goal Setting: Rating and Scaling of the Attributes

Attributes determined to be measured are then balanced by assigning relative importance. This is called Goal Setting.

Priorities have to be given based on an analysis of the users and their tasks after specification of the usability metrics of interest. If it is not possible to collect statistically reliable measures of usability metrics specified, the idea of the level of the usability can be used. For each attribute of interest, it can be specified several different levels of performance (minimum level that is acceptable, planned level of performance within goal-setting, theoretically best possible value).

An example of a Usability Goal Line (Rideout, 1991) notation can be used for goal setting. User errors per hour using the system:

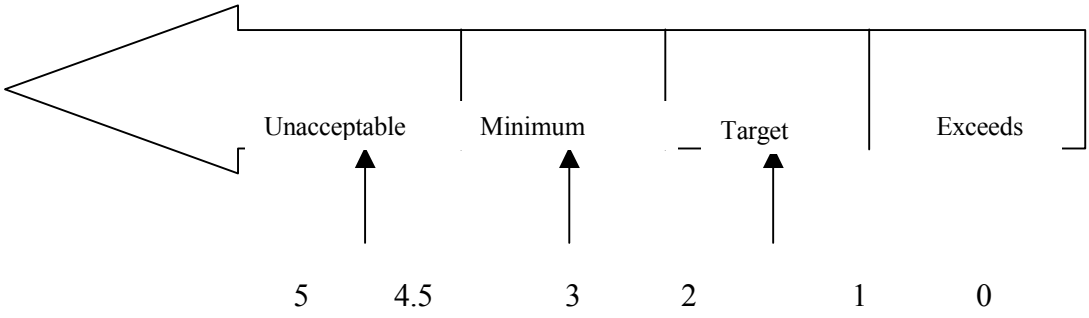

Figure 2.6.3 Usability Goal Setting Line

Additionally a Financial Impact Analysis can also be used for goal setting. In short, it analyzes the impact of a Usability attributes' level changes in financial terms if possible, and goals are set accordingly.

2.6.2.1 Severity Ratings

Single Scale Rating

- 0= this is not a usability problem
- 1= cosmetic problem only- need not be fixed unless extra time is available on project
- 2= minor usability problem- fixing this should be given low priority
- 3= major usability problem- important to fix, so should be given the priority
- 4= usability catastrophe- imperative to fix this before product can be released

Combination of Orthogonal Scales

Table 2.6.1 Orthogonal Scales for Usability Attributes

		Proportion of users experiencing the problem	
		Few	Many
Impact of the problem on the users who experience it	Small	Low severity	Medium Severity
	Large	Medium Severity	High Severity

There are two points needs attention in usability testing which are the *reliability* and the *validity.*

Reliability is the question of whether one would get the same result if the test were to be repeated.

Validity is the question of whether the result actually reflects the usability issues one wants to test.

2.6.3 **Reliability**

Nielsen (1993), in a survey of 36 usability studies has found that the mean standard deviation was 33% for measures of expert user performance (measured in 17 studies), 46 % for measures of novice-user learning (measured in 12 studies), 59 % for error rates (measured in 13 studies). In all cases the standard deviations are expresses as percent of the measured mean value of the usability attribute question. These numbers can be used to derive early approximations of the number of the test users needed to achieve a desired confidence interval.

The results show that:

- Error rates tend to have the highest variability (they require more test users to achieve the same level of confidence)
- The same level of confidence can be achieved with fewer test users for measures of learnability.
- And even fewer users for measures of expert user performance.

2.6.4 Validity

Validity questions whether the Usability Test measures something of relevance to usability of the real system in real use. Typical validity problems are:

- Using wrong users
- Giving the users wrong tasks
- Not including time tasks
- Not including social influences.
- Confounding effects.

2.6.5 Test Goals

Evaluation can be separated into two in terms of its goal (Queensbury, W. 2003).

Formative Evaluation: is to learn which detailed aspects of the interface are good and bad, and how the design can be improved.

Summative Evaluation: is to assess the overall quality of an interface, for example, for use in deciding between two alternatives or as part of a competitive analysis to learn how good the competition is.

In this study our aim is to focus on our system only and determine the good and bad aspects for improvement and further steps. No competitive analysis is necessary there fore formative evaluation will be our evaluation style.

2.6.6 **Test Plans**

Below are the basic questions needs to be answered to implement a usability test (Rubin, 1994):

- The goal of the test: What do you want to achieve?
- Where and when will the test take place?
- How long is each test session expected to take?
- What computer support will be needed for the test?
- What software needs to be ready for the test?
- What should the state of the system be at the start of the test?
- What should the system/ network load and response times be?
- Who will serve as the experimenters for the test?
- Who are the test users going to be, and how are you going to get hold of them?
- How many test users are needed?
- What test tasks will the users be asked to perform?
- What criteria will be used to determine when the users have finished each of the tasks correctly?
- What user aids will be made available to the test users?
- To what extent will the experimenters be allowed to help users during the test?
- What data is going to be collected, and how will it be analyzed once it has been collected?
- What will the criterion be for pronouncing the interface a success? Often it is the planned level for the previously specified usability goals.

2.6.7 Getting Test Users

Our test users must be representative of the intended users of the system.

- Novice vs. Expert Users
- Between subjects vs. within subjects testing.

Between-subjects: Different users use different parts of the system. Problem: individual differences. Random assignment of tasks or matched assignment (equally many assignments from different categories).

Within-Subjects: Skill transfer between tasks having got similar to the system in the first task. In order to control this effect, tasks are assigned in different orders to matched groups.

2.6.8 Test Tasks

The test tasks can be designed based on the task analysis or based on a system identity statement listing the intended uses for the system proposes Dix and Finlay (1998). Our tasks are determined.

- The test tasks should be small enough to be completed within the time limits of the user test, but they should not be so small that they become trivial.
- The test task should specify what the user is asked to produce.
- The test tasks should be given in written format.
- The first task should be extremely simple to increase the user's morale.
- The last task should be designed to make users feel that they have accomplished something.

2.6.9 Stages of A Test

In general, a usability testing structure contain the following steps, while it can include the heuristic evaluation and detailed survey sections additionally.

1. Preparation
2. Introduction
3. The test itself
4. Debriefing-including satisfaction questionnaires, further comments
5. Performance Measurement

Whether usability goals are achieved and for assessing competitive systems, user performance is always measured by having a group of test users perform a predefined set of tasks while collecting time and error data.

C H A P T E R 3

USABILITY EVALUATION PLAN

This is a sample of a usability test/evaluation plan for our Supplier Portal system:

This document describes the usability evaluation plan for Supplier Portal. The purpose of a usability evaluation is to predict the expected performance of the actual user using the system, product and materials, as well as detect any serious problems prior to the release of the system. This plan includes the following sections:

1. Purpose of the usability evaluation
2. Target audience
3. Design of the usability evaluation
4. Data collection methodology
5. Deliverables

3.1 What is Supplier Portal?

Provide a high level overview of the purpose, functionality, and key features of the application.

Describe whom the application was designed for.

Describe the platform on which it runs, and any special equipment, skills, and or knowledge needed to use it.

3.2 Design Usability Goals

Describe usability goals that were defined before the product was developed.

The evaluation will focus on determining if the needs of the user are met in an easy to understand, useful, and productive manner. Specific measurable goals for the usability evaluation are outlined in the Usability Evaluation Goals section of the thesis.

Table 3.2.1 Usability Attributes Determined

Usability Characteristic	**Definition**
Understandability	Ability for the users to find and retrieve the information they need easily.
Learnability	Ability for users to learn the system easily.
Reliability	The confidence level of the user on the information, which s/he will rely on for his/her Company related tasks, screened on the portal.
Error recovery & prevention	The utilization and usefulness of the tutorial, help menu and informative messages
Controllability	The control the user has on the system in terms of navigation and error prevention
Efficiency of use	Ability for users to save time in their work once they've learned the system.
Effectiveness	The accuracy and completeness of the Portal service
Subjective user satisfaction	Users' overall feelings about the system. Does it meet their task expectations?

Purpose of the Usability Evaluation

The usability evaluation of the Supplier Portal application will evaluate the potential for errors and difficulties involved in using the application for suppliers in answering the procurement needs of the enterprise and using the

reporting sections of the portal. Some of the areas that will be tested through the usability evaluation process were derived from a heuristic evaluation performed on Supplier Portal.

3.2.1 Concerns

This section outlines the specific concerns that are taken into consideration for the Supplier Portal system. These are determined after the introduction with the system, taken into consideration with system requirements and goal.

Some specific questions to be addressed in this usability evaluation include:

1. Will users be able to install the application from a network or internet with no assistance?
2. Can users successfully navigate through the application? Is the system status clear to users at all times?
3. Is the menu metaphor readily recognizable by the user?
4. Does the menu facilitate the ability of the user to navigate through the application?
5. Is the information logically organized and grouped for the non-Company person? Can they easily locate the information they are looking for?
6. Are the menus used and the reporting interfaces recognizable to users and do they facilitate system use/understanding?
7. Can the application be used with only the on-line help, or is a paper-based user guide required?
8. How will users feel about using the on-line help? Is context-sensitive help a requirement for our users?
9. Are there tasks that users will want to perform (i.e., printing specific information) that are not currently supported by the Supplier Portal?

3.2.2 Usability Evaluation Goals

Specific usability goals were determined from the above concerns. These goals allow for the creation of evaluation scenarios and tasks that will let us know if our concerns are valid and what measures can help us determine if in fact the participants are having trouble completing the tasks.

The concerns listed above should be translated into measurable usability goals for the usability test. This is a sample of some usability goals that were used during a recent test.

The laboratory evaluation study is supposed to be based on the following usability goals determined by the writer with the perspective of the similar studies in the literature:

- Participants will be able to install the application from internet in 15 minutes or less, with no assistance from a help desk.
- Participants will be able to begin using the application with no documentation.
- Participants will be able to complete activities or locate specific information within specific time limits. A series of tasks will be designed. We will time users during the usability evaluation.
- Participants will be able to move from function to function and menu to menu with no expressed or visible difficulty.
- Participants will be able to find related information with no expressed or visible frustration.
- Participants will have no more than two false attempts in finding specific information.
- Also use of a survey to determine subjective reactions will be utilized:
- Users feel that the menus used and the reporting interface are recognizable and do facilitate system use/understanding?

- Users feel comfortable using only the on-line help, or if context-sensitive help is a requirement.
- Users feel the on-line help provides them with all of the information necessary to use the system.
- Users feel that the on-line reference answers all of their order receive and reporting related questions.

3.3 Target Audience

The selection of participants whose background and abilities are representative of the portal's intended end user is a crucial element of the evaluation process. Valid results will be obtained only if the participants selected are typical end users of the portal\ so the suppliers, or are matched as closely to the criterion as possible.

3.3.1 Background

Describe the background of the users. Include pertinent information, such as education, computer experience, job functions, job responsibilities, skills, education, etc.

3.3.2 Subject Selection Criteria

The selection of participants whose background and abilities that are representative of the products intended end user is a crucial element of a successful usability evaluation. The evaluation will be valid only if the people evaluated are typical end users of the product, or as close to a selected set of characteristics as possible.

The following list shows the key characteristics of the end users that are considered as critical differentiators for successful adoption, and use, of

Supplier Portal. These characteristics are the basis for participant selection for the usability evaluation. The participants will be selected to reflect the range of characteristics shown below.

- Job Function
  - Manager
  - Technical (i.e., engineering, software development, product development, manufacturing)
- Computer literacy
  - Low, medium, high
- Use of electronic support tools (email, vmail, Internet access, PC or workstation, etc.)
  - 0-2 tools, 3-5 tools, more than 5 tools
- Educational level
  - Up to high school, baccalaureate degree, graduate degree

3.4 Design of the Usability Evaluation

Each individual session will consist of a set of tasks and an interview/questionnaire for the participants to complete. The individual evaluations will take place in the following order, a performance evaluation in which each participant is asked to perform a series of real-life tasks. A questionnaire and an interview after each performance evaluation to gather additional insights from the participants about Supplier Portal

3.4.1 The Evaluation Process

The usability evaluation process is as follows:

Heuristic Evaluation and Checklist Study for the Portal

A heuristic evaluation and a checklist study is a valuable step before any usability evaluation is carried out in the field or the laboratory. For the Heuristic Evaluation of the Supplier Portal according to the general guidelines and a checklist adapted from Xerox Usability Toolkit (1999).

Participant greeting and background questionnaire

Each participant will be personally greeted by the evaluation monitor and made to feel comfortable and relaxed. The participants will be given name tags and asked to fill out a short background questionnaire. The issue of confidentiality will be explained and the participants will be asked to sign nondisclosure statements.

Orientation

The participants will receive a short, verbal scripted introduction and orientation to the evaluation. This material will explain the purpose and objective of the evaluation, the need for product anonymity until after the evaluation, and additional information about what is expected of them. They will be assured that the product is the center of the evaluation and not themselves, and that they should perform in whatever manner is typical and comfortable for them. The participants will be informed that they are being observed and videotaped and asked to sign the appropriate release forms if not already completed.

Performance evaluation

The performance evaluation consists of a series of tasks that are evaluated separately and sequentially. The individual participants complete the tasks

while being recorded on video and observed by the usability specialists. The scenario is as follows:

After the orientation, the participants will be asked to sit down at the computer. The evaluation administrator will give the participants the task scenario booklet and instruct them on the use of the help desk.

After the participants begin working through the evaluation scenario, they will be encouraged to work without guidance except for the provided material and the product itself. The evaluation administrator may ask the participant to verbalize his or her thoughts if the participant becomes stuck or hopelessly confused. These occurrences will be noted by the evaluation administrator, and will help to pinpoint the cause of the problem.

Participant debriefing

After all tasks are complete or the time expires, each participant will be debriefed by the evaluation administrator. The debriefing will be taped and will include the following:

Completion of a brief post evaluation questionnaire in which the participants share their opinions on the product's usability, appearance of application screens, and general impressions of the product

Participant's overall comments about his or her experience

Participant's responses to probes from the evaluation monitor about specific errors or problems encountered during the evaluation

The debriefing session serves several functions. It allows the participants to say whatever they like, which are important if tasks are frustrating. It provides important information about each participant's rationale for performing specific

actions, and it allows the collection of subjective preference data about the application and its supporting documentation.

After the debriefing session, the participants will be thanked for their efforts, and released. They will be given a small token of appreciation as they leave.

Logistics

A typical office environment will be simulated during the usability evaluation. Because the application is a networked one, the usability evaluation must take place in a location where a network connection is available. The office will be large enough to comfortably accommodate a desk for the participant to sit at while completing the evaluation.

Requirements for the Evaluation

- Usability lab and evaluation personnel
- Prepared evaluation documents
- Space arrangements required for evaluation environment and lab setup
- Participants that reflect the profile of potential users
- Support person for length of usability pilot evaluation and evaluation sessions

Materials Design

The following materials will be designed and developed for use in the usability evaluation:

1. Participant profile analysis
2. Task scenario package
3. Evaluation participant debriefing materials

3.5 Data Collection Methodology

Data will be collected through direct observation.

Measures to be collected include the following:

1. The average amount of time to complete each task
2. The percentage of participants who finished each task successfully
3. The number of cases in which the participants were not able to complete a launch due to an error from which they could not recover
4. The number of times the participant used the help line or on-line documentation for each task
5. The number of positive or critical statements about the on-line help documentation
6. Number of and types of errors, including:

    - *Observations and comments*. The evaluation monitor notes when participants have difficulty, when an unusual behavior occurs, or when a cause of error becomes obvious.
    - *Non-critical error.* A participant makes a mistake but is able to recover during the task in the allotted time.
    - *Critical error.* A participant makes a mistake and is unable to recover and complete the task on time. The participant may or may not realize a mistake has been made.

7. The number of indications of frustration or joy from the participant
8. The number of subjective opinions of the usability and aesthetics of the product expressed by the participants

3.5.1 Deliverables

At the completion of the usability evaluation, a formal analysis will be performed. A final evaluation report and a highlight tape will be provided, which will detail the significant problems and observations detected during the usability evaluation, and recommendations to address the findings, will be delivered.

C H A P T E R 4

THE SUPPLIER PORTAL SYSTEM ANALYSIS

4.1 Supplier Portal Technology

Internet based procurement (e-procurement) creates private, Web-based procurement markets that automate communications, transactions and collaboration between supply chain partners. With an emphasis on cutting costs and enhancing productivity, e-procurement is deployed in the areas of indirect procurement, sourcing and direct procurement/ supply chain management.

Specifically, e-Procurement solutions targeting direct procurement activities have resulted in

- Improved visibility of customer demand and supply chain capacity
- Increased accuracy of production plans and forecasts
- Reduced inventory and operations costs
- Shortened procurement cycles
- Enhanced responsiveness.

A supplier portal is such an e-Procurement technology targeting direct procurement activities. Enterprises are using portal technology to increase efficiency, reduce expenses and increase revenue- by allowing employees; partners, suppliers, customers or constituents to find pertinent information expediently collaborate on specific issues, and exchange business transactions and information real-time via a single interface.

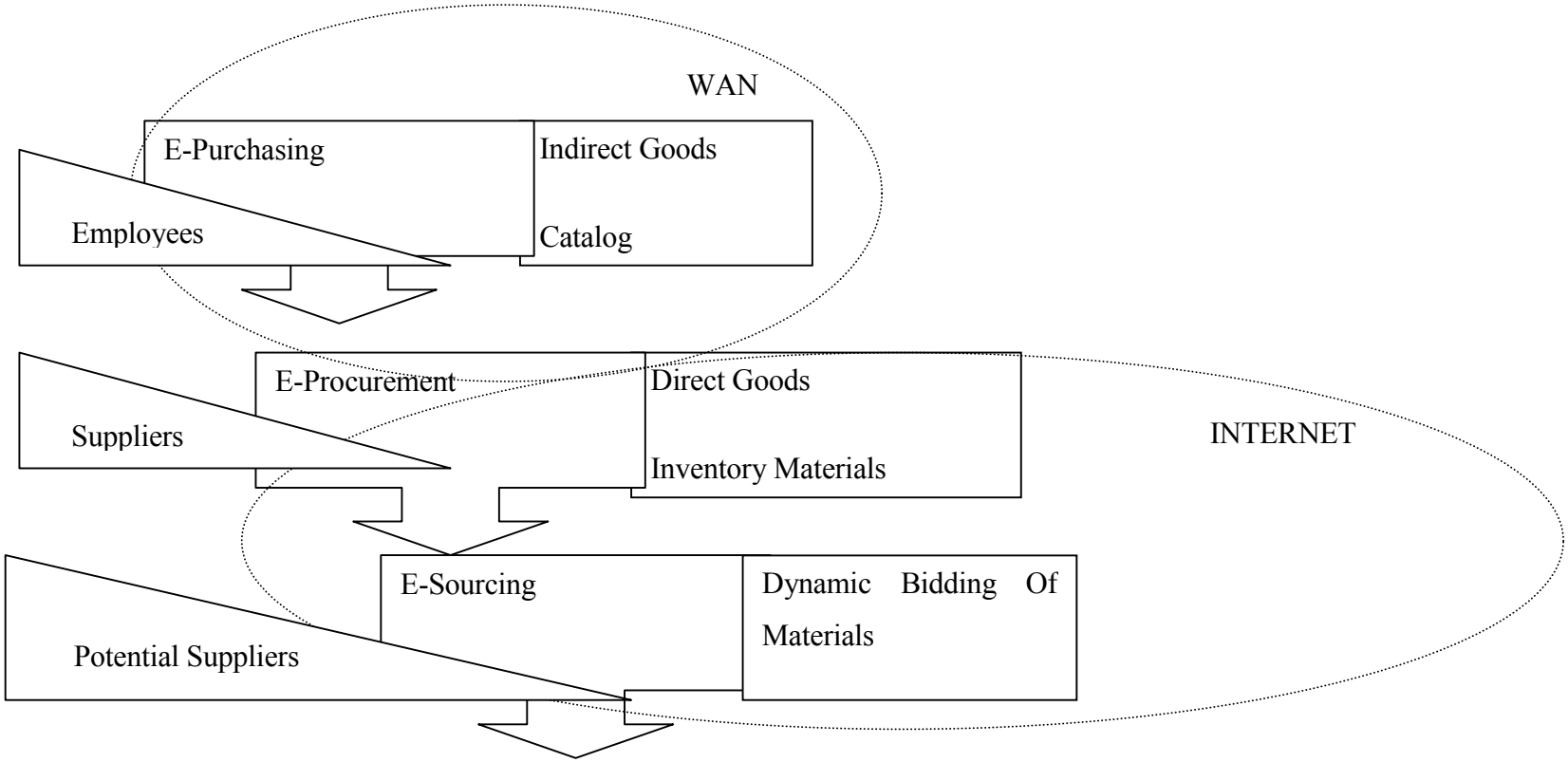

Figure 4.1.1 e-Supply Chain Perspective

The success of the supplier portal technology is keen to e-Sourcing. Enterprises utilizing Internet-based sourcing (e-Sourcing) technologies will be able to negotiate significant unit cost (i.e. “price”) reductions; shorten sourcing cycles; enhance decision-making capabilities; gather improved product, market, and supplier intelligence.

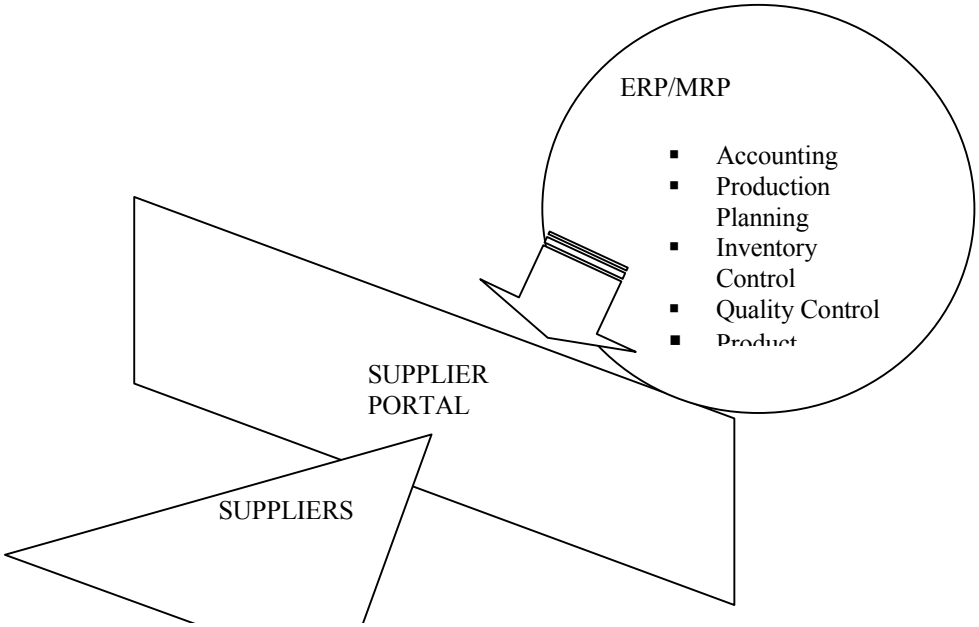

Figure 4.1.2 The Supplier Portal Interface

However it is no doubt that implementation of the e-Procurement technologies such as a supplier portal is just the beginning of the work. The effective and efficient deployment of such a technology becomes crucial for further activities of enterprises. Different than the indirect procurement technologies supplier portals emerge as the first applications that employ the outsider stakeholders, suppliers to the internal operations of enterprises. Putting the security issues aside, adaptation of the suppliers to the internal network of the enterprise comes as one of the big issues. A diversified network of suppliers brings a variety of new models of users and tasks to the organizational network of the enterprise.

Having built a portal it is crucial to have procedures and the resources to manage the content and the knowledge communities that the portal serves, to ensure the portal continues to offer the functionality, usability and information that will make the users' most effective needs are satisfied. In terms of this effective distributed deployment issue, a usability evaluation study becomes a must.

Two key features should characterize the back-end evaluation function for the portal system as presented:

1. A continuous formative evaluation during the development and implementation of the SP system assuring the quality of the Internet-based procurement for business entities of the enterprise.
2. A summative evaluation process during the post-implementation operation of the SP system to assure a 100%-quality assurance.

4.2 The Supplier Portal

The Company, which is stated as the biggest firm in Turkey by the journal Capital, has employed the Supplier Portal technology in 2003-second quarter. The portal became widely used generally in the second half of the year. The implementation of the evaluation is carried out in this phase. In the sense of distributed deployment, the ongoing evaluation will be a base for further developments, and new technologies employment.

By the end of the study the amount of the users Portal users had reached around 700 users from about 120 companies, each using the Supplier Portal to accomplish their specific information related tasks related to The Company's supply chain process.

The Supplier Portal was mainly serving as a reporting media in the time of the study. It had 16 reporting screens under three main menus, which are Finance, Planning and Procurement namely.

Table 4.2.1 The Supplier Portal Organization

Main Menus	Reporting Screens	Report Definition
Finance	Account Summary	Screening the Account Summary
	Weekly Payment List	Screening the Weekly Payment List
	Guarantees and Advances	Screening the guarantees and advances the firm have in The Company
	Letter of Agreement	Screening the agreement letters on prices
	Company Information	Screening and requesting modifications on Company information
Planning	Order Letter	Screening the order letter for the Company's related facility
	Material Flow	Screening the material flows such as, received, quality control accept/rejects, consignment consumption of materials supplied by firm in a facility
	Deposit Inventory List	The inventory levels that The Company supplies to the firm on deposit
	Consignment Inventory List	Consignment material consumption amounts for each facility
	Production Plan	Production Plan of each facility hourly actualized, showing the produced and to be produced models for a given period
	Quality Control Performance	Quality Performance data and graphics for a given period
Procurement	Technical Drawings	Technical Drawings of Materials
	MALBİS	Malbis means the Material Information System which includes specifications The Company requires for the material
	Price List	Prices of the materials on a given date period

Below, the access procedures are outlined to better understand the access and usage of the Portal.

- Only the suppliers have access to the Portal.
- Portal access is provided by an ID Number and a Password by which a certificate is installed on the computer the Portal will be accessed.
- An ID Number can login from only one computer, which is the one the certificate is installed. This implies the access to the Portal is hardware dependent.
- Portal disconnects when there is no activation in the page for a determined time.
- The Company's employees don't have access to the Portal. (Only the system department, responsible from the Portal serving has access).
- The system administrator, who is in the Company's Procurement Systems Department, helps the Suppliers about their problems, by mail and phone. (Helpline)
- Technical Drawings and MALBİS functions are not fully functioning due to internal database modification projects.

Below is the Process Flow Diagram summarizes the information flow to and interactions with the Supplier Portal and its users.

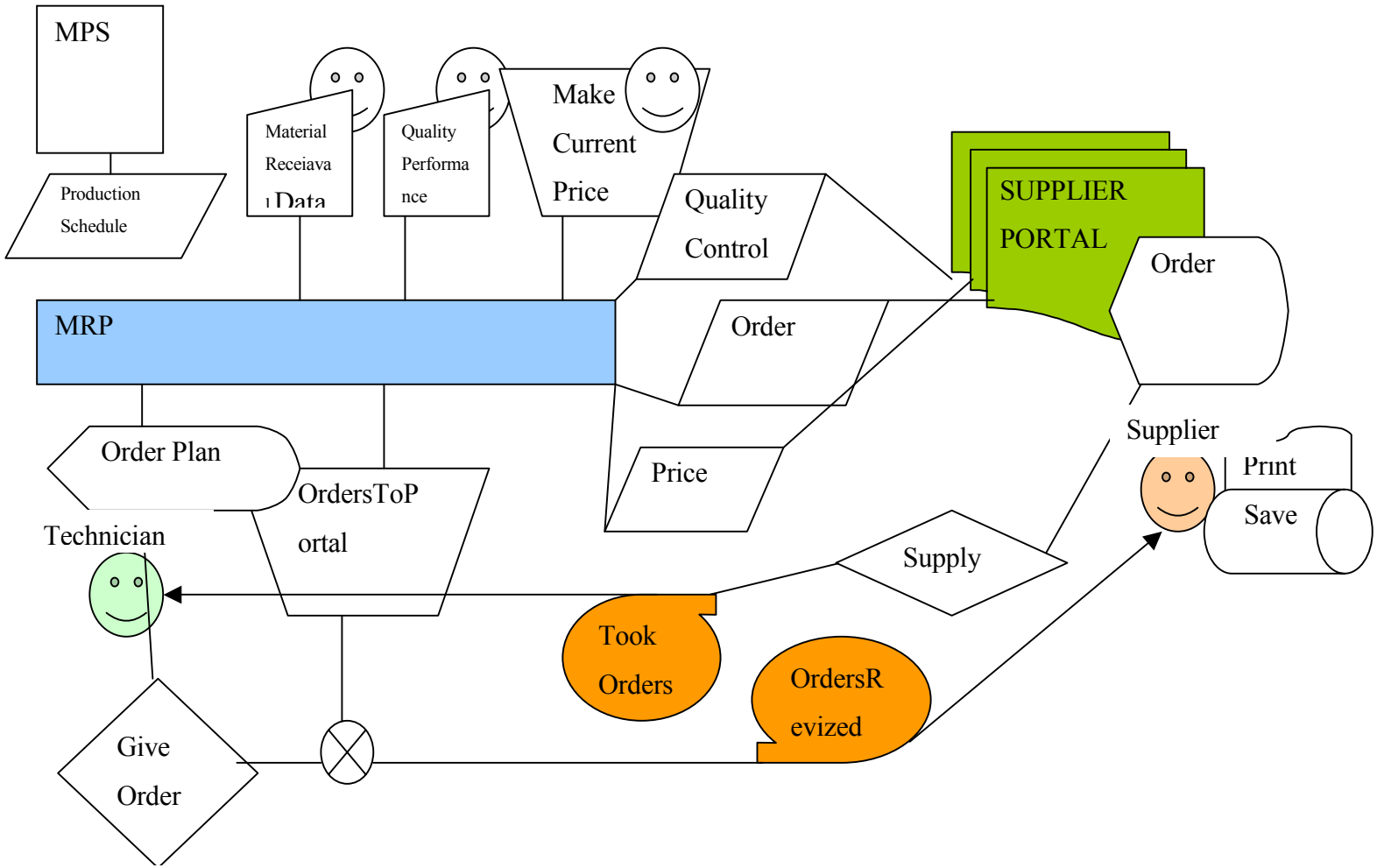

Figure 4.2.1 Process Flow Diagram

4.2.1 Data transfer to the Portal

As can be seen in the process flow diagram MPS (Master Production Schedule) supplies the Material Requirements Planning Module with the production plan data. The materials and the suppliers, and order parameters are defined in the system. MRP program and the orders are calculated. The Materials Planning Engineer explores through the data and gives the decision of order. Than s/he approves the orders that are assigned to the Supplier in the MRP module. Thus the orders are transferred to the Portal.

After revision of the orders, the Materials planning engineer calls or e-mails to the Supplier, requesting him or her to indicate the convenience.

Also, the responsible employee through the MRP system supplies the Quality Performance and Price Currency Data to the Portal.

The Production Plan directly transfers to the Portal without human effect. However the transfer was not activated in all facilities in the time of the study.

On the consignment case, again the firm makes the invoice after The Company uses the material in production. The amount of the usage of the material is directly transferred from MRP to the Portal as the consignment usage report. The supplier takes invoices based on these reports on a periodical basis.

4.2.2 Data Retrieval

Supplier enters the Portal whenever s/he wants. The supplier is informed about the order revision only by the email or the telephone call of the Company's materials planner. Then the supplier screening the orders, and making his new planning, informs the Company's materials planning engineer of the convenience of supply.

The material flow, quality control performance and price data is entered and made current in the system on continual basis. So the supplier can rely on the data currency.

The production plan, deposit inventory, consignment inventory data ought to be current on hourly basis.

4.3 System Usability Evaluation Motivation

The usability evaluation is carried out on the system depicted out above.

The main goal of the evaluation program is to assess the 'real' outcomes of the Supplier Portal subsystem:

Are the relations better between the suppliers and the purchasing business units, is there a quicker service, and does the enterprise get relevant business information?

The aim is to improve the efficiency and the effectiveness of the actual Supplier Portal implemented based on the evaluation results, through the monitoring of the business partners' recommendations. The use of technological media in the form of a SP obviously requires continual maintenance and technical support for the end users, suppliers of the enterprise in our case. In order to avoid potential frustration exhaustive testing should be done before the deployment of the SP media to allow for a high level of intensive communication and usage among the enterprise's business entities and the business partners.

C H A P T E R 5

FORMATIVE USABILITY ANALYSIS OF THE SUPPLIER PORTAL

5.1 Method

The study consisted of a survey that was put in the Supplier Portal in a downloadable format and usability test carried out in the field with the actual users.

With the aim of investigating the level of users' satisfaction and their feedback on the usability of The Supplier Portal, the survey was designed on a 5-point Likert scale to gather information about learnability, efficiency, reliability, visibility, controllability, helpfulness and users' overall subject satisfaction. The questions were adapted from basically QUIS (Questionnaire for User Interaction Satisfaction) which was developed by Shneiderman (1981) and lately was refined by Norman and Chin (1988), a web questionnaire sample of WAMMI (Website analysis and Measurement Inventory, 2000), and Lewis's (1995) study on computer usability satisfaction. Users are required to indicate their degree of agreement to each question and provide their background information in addition to their frequency of use of the menus and additional comments.

User experiments are carried out with the actual users, where time completion data and error rates are measured as the performance metrics and user comments are collected by informal interviewing.

5.2 User Profiles

The survey is carried out with the actual users of the Supplier Portal, the Company's suppliers, to be a base for conclusive information regarding user satisfaction with the site. For the questionnaire form please see App E.1.

By the time of this study 20 users had returned completing the survey. The survey is still online on the Portal and the returning surveys are still being collected. The survey has been modified in line with the first round results. These modifications will also be outlined. The users who completed the survey ranged from managers to technical staff. The age average of the users is 31,5 with 9 nine of the users under the age of 30 of which the youngest was of age 23. 8 of the users were between ages 30-40 and only three of the users were about 40 with the oldest of age 42. 9 of the users were from ladies and 11 were from gentlemen. All were university graduates with one Master's degree.

Majority of the users had computer experience for about between 6 to 10 years, 4 had experience for more than 10 years and only one had computer experience less than 6 years. Slightly more than half of the users were using computer more than 20 hours a week and only 3 of them spent with computers less than 10 hours. All of the respondents were users of the standard office programs such as spreadsheet, word processor and mail software. However in one case the user didn't use Excel spreadsheet program. This was important because the only downloadable format in the Portal was this.

When we come to the portal experience, one of the subjects had been using the Portal for less than 2 weeks and one for about 1 month, and 2 months each. The

rest of the users had been using the Portal for about 4 months. The portal had been serving for about 5 months.

In addition to what is summarized above, below in the table of the user profiles one can see the demographic data besides the computer experience and job title data of the users.

Table 5.2.1 User Profiles

User #	Title	Title Level	Branch	Age	Education	Gender	Computer Experience	Computer Usage (hrs/wk)	Foreign Language	City
u1	Facility Manager/Owner	Manager	Facility	40	University	M	5-10 years	Betw 5-10 hrs	English	Eskişehir
u2	Sales Engineer	Engineer	Sales	23	University	F	5-10 years	More than 20 hrs	English, Italish	İstanbul
u3	Company Customer Representative	Engineer	Sales	28	University	F	3-5 years	More than 20 hrs	English	İstanbul
u4	Finance Responsible	Engineer	Finance	28	University	M	5-10 years	More than 20 hrs		Ankara
u5	Facility Manager/Owner	Manager	Facility	33	University	M	More than 10 years	Betw 10-20 hrs	English	Ankara
u6	Planning Engineer	Engineer	Production Planning	27	M.Sc.	M	More than 10 years	More than 20 hrs	English, German	Ankara
u7	Technical Manager	Manager	Production, Sales	42	University	M	5-10 years	Betw 5-10 hrs		
u8	Accounting Responsible	Engineer	Finance	27	University	F	5-10 years	More than 20 hrs		İstanbul
u9	Finance Manager	Manager	Accounting	34	University	F	5-10 years	More than 20 hrs		İzmit
u10	Sales Representative	Engineer	Sales	34	University	F	5-10 years	More than 20 hrs	English	İstanbul
u11	Sales Manager	Manager	Sales	27	University	F	5-10 years	Betw 10-20 hrs	English	İstanbul
u12	Facility Manager/Owner	Manager	Facility	34	University	M	3-5 years	Betw 5-10 hrs		Ankara
u13	Production Planning Manager	Manager	Facility	41	University	M	5-10 years	Betw 10-20 hrs		İzmit
u14	Sales Engineer	Engineer	Sales	26	University	M	More than 10 years	More than 20 hrs	English	İstanbul
u15	Finance Responsible	Engineer	Finance	24	University	F	5-10 years	More than 20 hrs	English	İstanbul
u16	Production Manager	Manager	Production, Sales	37	University	M	5-10 years	Betw 10-20 hrs	English	Ankara
u17	Sales Executive	Manager	Sales	31	University	M	More than 10 years	Betw 10-20 hrs	English	İzmir
u18	Planning and Quality Assurance Executive	Manager	Production Planning	33	University	F	5-10 years	More than 20 hrs		Ankara
u19	Planning Chief	Manager	Production Planning	29	University	F	5-10 years	More than 20 hrs		Bursa
u20	Production Manager	Manager	Production, Sales	33	University	M	5-10 years	Betw 10-20 hrs	English	İstanbul

5.2.1 Usage Patterns

As explained in the System Analysis section the Supplier Portal has several functionalities within. These functionalities are organized under three main categories namely, Finance, Planning and Procurement. With the motivation of understanding the usage patterns of the users, we acquired additional data in the survey besides the demographic and satisfaction data. These are basically:

- How long they have been using the Portal
- How frequently they enter the Portal
- Which menus they use and at what frequency
- How they use the data they acquire from the Portal, in what format (for ex. By downloading the excel file or just screening the page which is in a web page form)

Acquisition of these data aimed to help us understanding and sketching out usage patterns of the users including their task requirements and the relationship between the data they acquire from the Portal and their other tasks. Job title and title levels information, had been collected for registration purposes, was also considered for supplementary purposes in the same direction. The usage pattern data is summarized in the table below:

Table 5.2.2 Usage Patterns

User #	Title	Title Level	Branch	Portal Experience	Portal Access Freq	Portal report data usage format	Account Summary	Weekly Payment List	Guarantees and Advances	Letter of Agreement	Company Info	Order Letter	Material Flow	Deposit Inv. List	Consignment Inv. List	Production Plan	Quality Control Performance	Price List	Technical Drawings	MALBİS
u1	Facility Man./Owner	Manager	Facility	4 months	Few/ a day	Screen	Smtimes	Frqntly	Never	Smtimes	Smtimes	Frqntly	Never	Never	Never	Smtimes	Smtimes	Frqntly	Never	Never
u2	Sales Engineer	Engineer	Sales	2 months	Few/ a month	Excel	Never	Never	Never	Never	Never	Frqntly	Never	Never	Never	Smtimes	Never	Frqntly	Never	Never
u3	Company Customer Rep.	Engineer	Sales	3 months	Few/ a month	Excel	Never	Never	Never	Never	Never	Smtimes	Never	Never	Never	Never	Never	Frqntly	Never	Never
u4	Finance Responsible	Engineer	Finance	4 months	Few / a week	CpyPstWord	Frqntly	Frqntly	Smtimes	Smtimes	Smtimes	Frqntly	Smtimes	Never	Never	Never	Smtimes	Frqntly	Never	Never
u5	Facility Manager/Ownr	Manager	Facility	4 months	Few / a week	NoteTake	Never	Never	Never	Never	Never	Never	Never	Never	Frqntly	Never	Never	Frqntly	Never	Never
u6	Planning Engineer	Engineer	Prdctn Plnng	3 months	Few / a month	CpyPstWord	Never	Never	Never	Never	Never	Frqntly	Never	Never	Never	Smtimes	Never	Never	Never	Never
u7	Technical Manager	Manager	Prdctn, Sales	4 months	Few / a month	NoteTake	Smtimes	Frqntly	Smtimes	Smtimes	Smtimes	Frqntly	Smtimes	Never	Never	Smtimes	Smtimes	Frqntly	Never	Never
u8	Accounting Resp.	Engineer	Finance	1 month	Few / a month	CpyPstWord	Never	Smtimes	Never	Smtimes	Smtimes	Never	Never	Never	Frqntly	Smtimes	Never	Frqntly	Never	Never
u9	Finance Manager	Manager	Accountin g	4 months	Few / a week	Print	Never	Smtimes	Never	Smtimes	Smtimes	Never	Never	Never	Frqntly	Smtimes	Never	Frqntly	Never	Never
u10	Sales Representative	Engineer	Sales	4 months	Few / a week	CpyPstWord	Frqntly	Smtimes	Never	Smtimes	Smtimes	Frqntly	Smtimes	Never	Never	Never	Never	Frqntly	Never	Never
u11	Sales Manager	Manager	Sales	4 months	Few / a week	CpyPstWord	Smtimes	Smtimes	Never	Smtimes	Smtimes	Frqntly	Smtimes	Never	Never	Never	Never	Frqntly	Never	Never
u12	Facility	Manager	Facility	4 months	Once/ a week	NoteTake	Smtimes	Frqntly	Smtimes	Smtimes	Smtimes	Frqntly	Never	Never	Never	Never	Never	Frqntly	Never	Never

User #	Title	Title Level	Branch	Portal Experience	Portal Access Freq	Portal report data usage format	Account Summary	Weekly Payment List	Guarantees and Advances	Letter of Agreement	Company Info	Order Letter	Material Flow	Deposit Inv. List	Consignment Inv. List	Production Plan	Quality Control Performance	Price List	Technical Drawings	MALBİS
	Manager/Ownr																			
u13	Productin Planning Man.	Manager	Facility	4 months	Few / a week	Excel	Smtimes	Frqntly	Smtimes	Smtimes	Smtimes	Frqntly	Never	Never	Never	Smtimes	Never	Frqntly	Never	Never
u14	Sales Engineer	Engineer	Sales	4 months	Few / a month	Print	Never	Never	Never	Never	Never	Never	Never	Never	Frqntly	Smtimes	Never	Frqntly	Never	Never
u15	Finance Responsible	Engineer	Finance	1 week	Few / a month	NoteTake	Never	Never	Never	Never	Never	Frqntly	Never	Never	Frqntly	Never	Never	Frqntly	Never	Never
u16	Production Manager	Manager	Prdctin, Sales	3 months	Few / a week	Screen	Smtimes	Smtimes	Smtimes	Smtimes	Smtimes	Frqntly	Frqntly	Smtimes	Never	Smtimes	Smtimes	Frqntly	Never	Never
u17	Sales Executive	Manager	Sales	4 months	Few/ a week	CpyPstWord	Smtimes	Never	Never	Smtimes	Smtimes	Frqntly	Smtimes	Never	Never	Never	Smtimes	Frqntly	Never	Never
u18	Plan.g.&QualityAss. Mng.	Manager	Prdctn Planning	3 months	Few/ a week	Print	Smtimes	Frqntly	Smtimes	Smtimes	Smtimes	Frqntly	Smtimes	Smtimes	Never	Frqntly	Smtimes	Frqntly		Never
u19	Planning Chief	Manager	Prdctn Plang	4 months	Few/ a week	Excel	Never	Smtimes	Never	Never	Smtimes	Smtimes	Never	Never	Frqntly	Smtimes	Smtimes	Never	Never	Never
u20	Production Manager	Manager	Prdctn, Sales	4 months	Few/ a week	Print	Smtimes	Smtimes	Never	Never	Never	Frqntly	Never	Never	Never	Smtimes	Smtimes	Never	Never	Never

5.2.2 User Clustering Analysis

To be a base for the further analysis of the satisfaction data, clustering analysis is carried out with the portal usage patterns. The users are clustered in two ways and satisfaction data is further analyzed for the correspondence of the clusters and the satisfaction levels. Correspondence analysis is carried out for every satisfaction item. No significant correspondence is seen for the clustering of the TaskMotiv clusters. However, in the Correspondence Analysis of the PortalExper clustering there is seen significant dependence between some Satisfaction Items and the clusters.

As seen in the Table User Profiles, none of the users stated that they had used the MALBİS or the Technical Drawing Menu. In fact these menus haven't earned the functionality yet. Integration of these capabilities of Company intranet system and the Portal was being worked on in the time of this study. These menus are basically put for the ongoing projects within The Company. Once the projects come to the end, data will be integrated to the Portal. However these menus being nothing under with no message indicating why the menus don't work causes confusion for the users. These menus could be put away or if the project deadlines are near, appropriate messages must be put. Production Plan had the same problem, since integration of the Plan in all facilities is not completed and again the lack of informative message caused problem.

As the clustering method k-means clustering is deployed. The two different criteria used in the two different cluster analyses are TaskMotiv and PortalExper. For the clustering method details please see App H.1.

5.2.2.1 TaskMotiv Clusters

TaskMotiv clustering is based on the usage frequencies of the menus. These clustering criterion points to the task requirements of the users and aimed to give alarm if the Portal has gaps in terms of certain menus, which are serving certain task requirements. Besides determining whether such a case is true is important since a very different satisfaction level of a certain menu group affects the satisfaction level for the complete Portal system. TaskMotiv aims to help us understand dissatisfied needs of a specific task profile. Below the users and their corresponding clusters are summarized:

Table 5.2.3 TaskMotiv Clusters

Composition of the clusters:					
	OrderOnly	ConsOnly	OrderPlus	FirmX	ConsPlus
Cluster	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5
Within-groups inertia	0,10	0,04	0,23	0,02	0,07
Size	4	3	8	2	3
	u2	u5	u1	u16	u8
	u3	u14	u4	u18	u9
	u6	u15	u7		u19
	u20		u10		
			u11		
			u12		
			u13		
			u17		

These clusters represent the task characteristics of the user. When we looked at the clusters deeply, we could name the clusters accordingly:

Cluster1- **OrderOnly**: These users' jobs are sales oriented. Their firms work with the Company on order basis. They take orders and transfer the appropriate data to production planning or their job also includes the production planning. Their jobs do not require finance tasks since there are other users from the finance departments accomplishing finance related tasks.

Cluster 2- **ConsOnly** When we look at the users in this cluster we realize their firms work on only consignment basis with The Company. These are not the only consignment-working firms in the sample, however the others forming the ConsPlus cluster take also orders for some the materials they supply.

Cluster 3- **OrderPlus** This is the largest cluster of our sample with size of 8. Firms are working on order basis. These users look at the orders as well as also interested in the finance data like prices, agreements etc. 6 of them are managers or firm owners.

Cluster 4- **FirmX** These users are from the same firm. In our sample they are the only two people who are from the same firm. In fact when further analyzed this firm is seen to make deliveries to a facility a couple of times a day. The firm and the Company work on a half a day inventory level. So the frequency of the Portal access, especially the Planning module differs from the others. Additionally, The Company owns deposit material to this firm. Therefore the Deposit Inventory List is used by this cluster occasionally.

Cluster 5- **ConsPlus** These cluster with size of 3 includes users from firms, which work with The Company both on order and consignment basis.

5.2.2.2 PortalExper Clusters

PortalExper clusters are based on the clustering of the users according to their experience level of Portal usage. This clustering is thought to detect any

dependencies between users' Portal experience level and the problems they encounter with. The dissatisfaction of the novice users and the progress of the understandability of the user by gaining some experience are explored by the analysis based on these clusters.

PortalExper clusters are trivial since experience with the Portal is directly asked in the survey. Below are the clusters and the users within:

Table 5.2.4 PortalExper Clusters

Portal Experience	User #
1 WEEK	u15
1 MONTH	u8
2 MONTHS	u2
3 MONTHS	u16
	u18
	u3
	u6
4 MONTHS	u1
	u10
	u11
	u12
	u13
	u14
	u17
	u19
	u20
	u4
	u5
	u7
	u9

These clusters will be used for the inferential analyses.

5.3 User Satisfaction Analysis

The level of users' satisfaction and their feedback on the usability of The Supplier Portal is investigated with a survey, which included 32-Items satisfaction level questionnaire.

The questions were adapted from Shneiderman's QUIS which was lately refined by Norman and Chin (1988), a web questionnaire sample of WAMMI (2000), and Lewis's (1995) study on computer usability satisfaction. Basically centering around the following usability dimensions:

- Understandability (in terms of visibility, organization and terminology)
- Controllability (error prevention, navigation)
- Learnability (learning speed, ease, experience effect)
- Efficiency (time, efficiency in other dimensions)
- Reliability (completeness and accuracy of information)
- Effectiveness (right time, right report)
- Helpfulness (tutorial, help menu, installation)
- Users' overall subjective satisfaction. (General questions, expectations)

The satisfaction level part used a 5-point Likert-scale scale collapsed across disagree, strongly disagree and agree, strongly agree and a no comment option.

5.3.1 Survey Evolution

Current survey took its form after some revise. The satisfaction items in the pilot survey contained much more questions than in the current survey. There were 94 satisfaction items including many similar questions. These aimed to construct the reliability of the study and to be sure of the users' answers'

consistency. However this survey could not be put in the portal since this long survey wasn't preferred for practical purposes. Also from the comments of users it was understood that the return rate of the questionnaire would be in danger since the actual users would fill this survey voluntarily during their busy workday. The survey was reduced to 32 items each defining a different direction of the usability attributes aimed.

5.4 Satisfaction Data Analysis

There are 32 satisfaction items in the survey. Based on the satisfaction level data for each item which has captured through the surveys, descriptive and inferential analyses are carried out for the usability evaluation of the Portal. As the data analysis tool, The Xlstat version 6.19 data analysis module, which was compatible with MS Excel, by Addinsoft Corp. was used (47).

In the descriptive part, the profiles of the satisfaction items and the usability attributes are sketched out by descriptive statistics, and analyses are carried out for the clustering of the users. As well, in the inferential part of the Satisfaction Data Analysis, Factor Analysis, Multidimensional Scaling and the Correspondence Analysis with clusters are employed.

5.4.1 Descriptive Analysis

One of the most useful analyses, particularly for iterative testing and design, is the profile. The profile reveals the strengths and weaknesses of the system by showing the deviations of the means above and below a criterion. Basically descriptive statistics are utilized to generate the profiles by calculating the means and standard deviations for each item in the Satisfaction Survey. The means are then graphed on a scale from 1 to 5.

Below are the box-plots of the results:

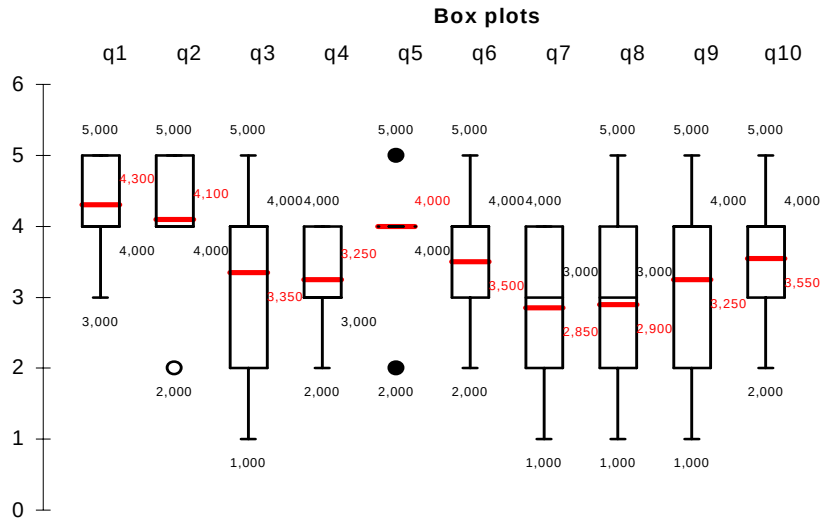

Figure 5.4.1 BoxPlots: Satisfaction Items q1-q10

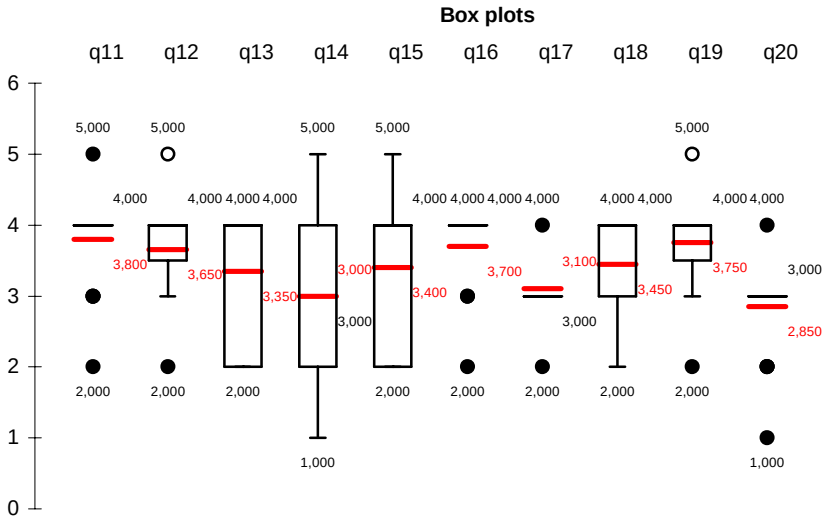

Figure 5.4.2 BoxPlots: Satisfaction Items q11-q20

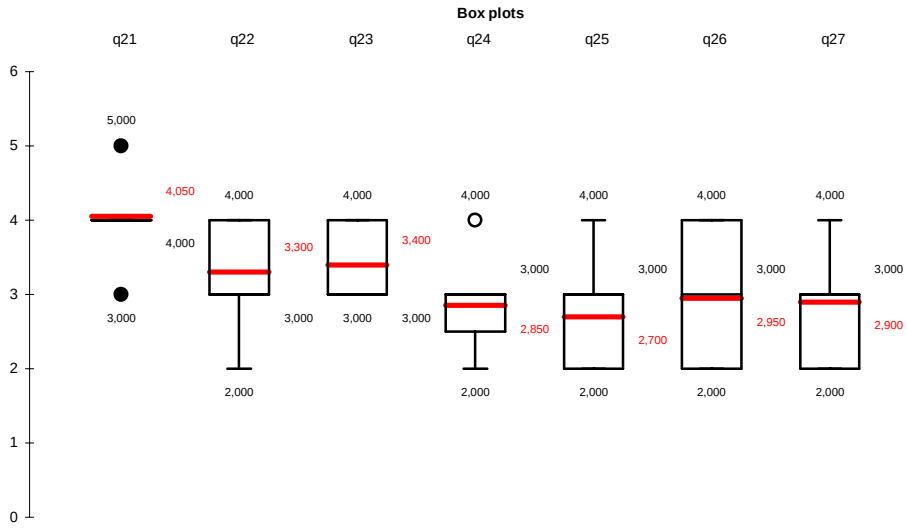

Figure 5.4.3 BoxPlots: Satisfaction Items q21-q27

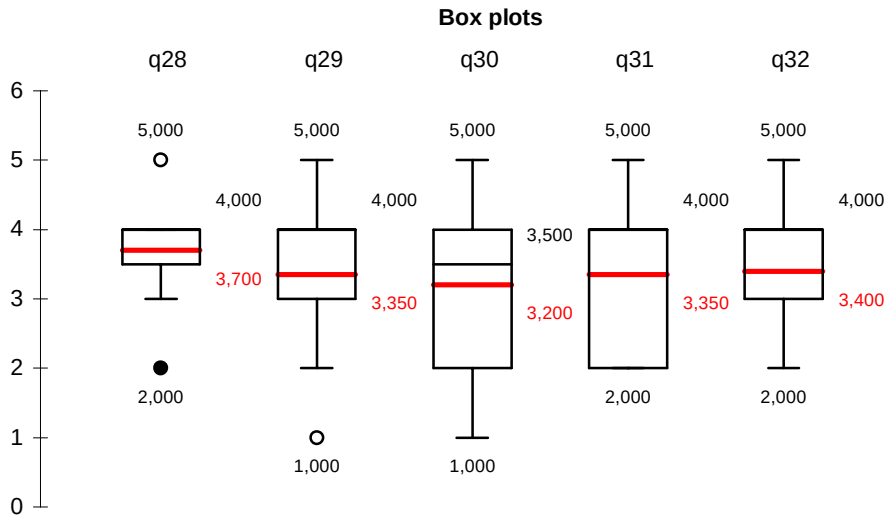

Figure 5.4.4 BoxPlots: Satisfaction Items q28-q32

The midpoint of the rating scale, which is 3, can be used as a criterion. If the item is above 3, it is perceived as being better than an arbitrary, mediocre value. However, that is generally not good enough, since in the survey 3 is stated as the NoComment answer. For the “just after release” phase of our system, it is appropriate to make the goal setting as to succeed the (4) value, which is the Agree option for the usability metric satisfaction items.

It is useful to plot a confidence interval around each mean in order to determine its reliability. The confidence interval also indicates whether the mean of an item is significantly above or below some criterion. For example, if a 95% confidence interval includes 5 within its boundaries, then it indicates that the mean is not significantly different from 5 at the 0,05 level of significance.

These profiles are indicators fro the areas to identify the areas in the application which are particularly good or particularly bad.

Below are the profile tables:

Table 5.4.1 Satisfaction Items Profiles

Item #	Descriptive Table	Min	# Mins.	% of Mins.	Mean	s	SE	LoB MIC	UpB MIC	1st quart	Median	3rd quart	Max	Range
q1	Menus are constructed in a logical and easily understood way	3,00	1	5,00	4,30	0,56	0,13	4,03	4,57	4,00	4,00	5,00	5,00	2,00
q2	Arrangement of information on pages is consistent and helps to understand	2,00	2	10,00	4,10	0,83	0,19	3,70	4,50	4,00	4,00	5,00	5,00	3,00
q3	Amount of information that can be displayed on the screen is adequate	1,00	1	5,00	3,35	1,15	0,26	2,80	3,90	2,00	4,00	4,00	5,00	4,00
q4	Going back to the previous screen is easy	2,00	4	20,00	3,25	0,77	0,18	2,88	3,62	3,00	3,00	4,00	4,00	2,00
q5	Terminology relates well to my work	2,00	2	10,00	4,00	0,77	0,18	3,63	4,37	4,00	4,00	4,00	5,00	3,00
q6	Computer terminology is not used too frequently	2,00	4	20,00	3,50	0,92	0,21	3,06	3,94	3,00	4,00	4,00	5,00	3,00
q7	There is continuous information feedback about what the system is doing	1,00	2	10,00	2,85	0,96	0,22	2,39	3,31	2,00	3,00	4,00	4,00	3,00
q8	Error messages indicate the problem clearly	1,00	1	5,00	2,90	1,04	0,24	2,40	3,40	2,00	3,00	4,00	5,00	4,00
q9	Is easy to get started with for the novice users	1,00	2	10,00	3,25	1,13	0,26	2,71	3,79	2,00	4,00	4,00	5,00	4,00
q10	Exploration of menus by trial and error is encouraging and safe	2,00	2	10,00	3,55	0,74	0,17	3,19	3,91	3,00	4,00	4,00	5,00	3,00
q11	Remembering abbreviations and menu names is easy	2,00	1	5,00	3,80	0,60	0,14	3,51	4,09	4,00	4,00	4,00	5,00	3,00
q12	It is easy to learn using the Portal	2,00	3	15,00	3,65	0,79	0,18	3,27	4,03	3,50	4,00	4,00	5,00	3,00
q13	Portal is fast enough	2,00	6	30,00	3,35	0,91	0,21	2,91	3,79	2,00	4,00	4,00	4,00	2,00
q14	I can always be sure of the actuality of the information displayed	1,00	1	5,00	3,00	1,10	0,25	2,47	3,53	2,00	3,00	4,00	5,00	4,00
q15	I can be sure that the information displayed is always complete and true	2,00	6	30,00	3,40	0,97	0,22	2,93	3,87	2,00	4,00	4,00	5,00	3,00
q16	Error prevention messages are sufficient	2,00	2	10,00	3,70	0,64	0,15	3,39	4,01	4,00	4,00	4,00	4,00	2,00

Item #	Descriptive Table	Min	# Mins.	% of Mins.	Mean	s	SE	LoB MIC	UpB MIC	1st quart	Median	3rd quart	Max	Range
q17	Ability to undo operations is adequate	2,00	1	5,00	3,10	0,44	0,10	2,89	3,31	3,00	3,00	3,00	4,00	2,00
q18	System failures occur seldom	2,00	4	20,00	3,45	0,80	0,18	3,06	3,84	3,00	4,00	4,00	4,00	2,00
q19	Ease of operation increases with experience with the system	2,00	1	5,00	3,75	0,62	0,14	3,45	4,05	3,50	4,00	4,00	5,00	3,00
q20	I can make some arrangements and shortcuts based on my needs	1,00	1	5,00	2,85	0,65	0,15	2,54	3,16	3,00	3,00	3,00	4,00	3,00
q21	I can accomplish tasks knowing only a few commands	3,00	2	10,00	4,05	0,50	0,11	3,81	4,29	4,00	4,00	4,00	5,00	2,00
q22	Accessing the online tutorial is easy	2,00	2	10,00	3,30	0,64	0,15	2,99	3,61	3,00	3,00	4,00	4,00	2,00
q23	Tutorial informs clearly based on task goals	3,00	12	60,00	3,40	0,49	0,11	3,16	3,64	3,00	3,00	4,00	4,00	1,00
q24	Completing tasks using only online tutorial is possible	2,00	5	25,00	2,85	0,57	0,13	2,58	3,12	2,50	3,00	3,00	4,00	2,00
q25	It is easy to get solutions for problems from the help menu	2,00	7	35,00	2,70	0,56	0,13	2,43	2,97	2,00	3,00	3,00	4,00	2,00
q26	Installation of the Supplier Portal to computer is easy	2,00	7	35,00	2,95	0,80	0,18	2,56	3,34	2,00	3,00	4,00	4,00	2,00
q27	Gives informative messages when installation fails	2,00	6	30,00	2,90	0,70	0,16	2,56	3,24	2,00	3,00	3,00	4,00	2,00
q28	Portal helps me do my job efficiently	2,00	2	10,00	3,70	0,71	0,16	3,36	4,04	3,50	4,00	4,00	5,00	3,00
q29	Portal saves time	1,00	1	5,00	3,35	0,96	0,22	2,89	3,81	3,00	4,00	4,00	5,00	4,00
q30	Portal enables me to reach the information I need whenever I want	1,00	1	5,00	3,20	1,21	0,28	2,62	3,78	2,00	3,50	4,00	5,00	4,00
q31	I can reach the complete and actual information comfortably	2,00	6	30,00	3,35	0,96	0,22	2,89	3,81	2,00	4,00	4,00	5,00	3,00
q32	Portal meets my expectations	2,00	4	20,00	3,40	0,86	0,20	2,99	3,81	3,00	4,00	4,00	5,00	3,00

When we look at the profile with the worst Satisfaction Level Mean Confidence Interval Lower Bound, which is item 8 [Error messages indicate the problem clearly], it is 2,40 in fact under the mediocre value. This, indicating dissatisfaction with the informativeness of the error messages, gives a yellow alarm. When we look at the minimum value it is 1, meaning that one of the users strongly has dissatisfaction about the informativeness of the error messages. These can be taken as a red alarm. In fact really in the field tests this flaw was observed in the field test too, as the lack of the timeout message. Then when we go to the next lowest items below are the ones with SIM CILB under 3. If their means are also under 3, this is also an indicative measure to further focus on this aspect of the Portal.

Table 5.4.2 To be improved Satisfaction Items

Item #	Satisfaction Item	LoB MIC	Mean	UpB MIC	% of min. val.	Minimum	Range
q7	There is continuous information feedback about what the system is doing	2,39	**2,85**	3,31	10,00	1,00	3,00
q8	Error messages indicate the problem clearly	2,40	**2,90**	3,40	5,00	1,00	4,00
q9	Is easy to get started with for the novice users	2,71	3,25	3,79	10,00	1,00	4,00
q14	I can always be sure of the actuality of the information displayed	2,47	3,00	3,53	5,00	1,00	4,00
q20	I can make some arrangements and shortcuts based on my needs	2,54	**2,85**	3,16	5,00	1,00	3,00
q24	Completing tasks using only online tutorial is possible	2,58	**2,85**	3,12	25,00	2,00	2,00
q25	It is easy to get solutions for problems from the help menu	2,43	**2,70**	2,97	35,00	2,00	2,00
q26	Installation of the Supplier Portal to computer is easy	2,56	2,95	3,34	35,00	2,00	2,00
q27	Gives informative messages when installation fails	2,56	**2,90**	3,24	30,00	2,00	2,00
q30	Portal enables me to reach the information I need whenever I want	2,62	3,20	3,78	5,00	1,00	4,00

One can continue this inspection s/he is satisfied that the major problems are identified. Then we start with the item having the highest mean. We ask ourselves why this aspect was rated so high and how it can be used to further enhance the software. Satisfaction Item 1 [Menus are constructed in a logical and easily understood way] has the highest mean 4,3 with lower bound 4,03 for Satisfaction Level Mean. In fact it has received only one NoComment opinion as the minimum satisfaction level from the users. Nearly all of the users had found the menu organization understandable. Good point indicates that the menu construction is logical and easily understandable. Then when we go the next highest items the following table shapes:

Table 5.4.3 Strong Points of the Portal

Item #	Satisfaction Item	LoB MIC	Mean	UpB MIC	% of min. val.	Min	Range
q1	Menus are constructed in a logical and easily understood way	4,03	4,30	4,57	5,00	3,00	2,00
q21	I can accomplish tasks knowing only a few commands	3,81	4,05	4,29	10,00	3,00	2,00
q2	Arrangement of information on pages is consistent and helps to understand	3,70	4,10	4,50	10,00	2,00	3,00
q5	Terminology relates well to my work	3,63	4,00	4,37	10,00	2,00	3,00

The cognitive workload the Portal requires seems to be minimized discarding the risk of cognitive overload (q21). The information arrangement has also satisfied the users in terms of consistency and understandability. One fair good point that has rated well is that the terminology is used is relating to the users work, providing the users another cognitive comfort. We can say that the site cognitive structure has taken above the average satisfaction points in general.

5.4.1.1 Usability Attributes

In addition to individually analyzing the Satisfaction Items, they are analyzed after being grouped under eight basic Usability Attributes The Portal is aimed to gain high Satisfaction Scores. The descriptive analysis is done for each group and then the groups are analyzed by the Satisfaction Items contribute. The eight groups defined are:

- Understandability (In terms of visibility, organization and terminology)
- Controllability (error prevention, navigation)
- Learnability (learning speed, ease, experience effect)
- Efficiency (time, efficiency in other dimensions)
- Reliability (completeness and accuracy of information)
- Effectiveness (right time, right report)
- Helpfulness (tutorial, help menu, installation)
- Users' overall subjective satisfaction (general questions, expectations)

Items in a group indicate different dimensions of an attribute which may be independent. For example one dimension in the learnability such as getting started with item may get bad satisfaction ratings while usage gets easier by gaining experience with the system getting favorable results. This shows the system is suitable for experienced users while not for novice users.

Below is the table showing the Attributes and the Items that contribute to that Attribute.

Table 5.4.4 Usability Attributes and Satisfaction Items Contributing

Item No	q	q	q	Q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	Total Item #
Attr	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	
CONTROLLABILITY				1			1	1								1	1			1	1												7
EFFECTIVENESS																														1	1		2
EFFICIENCY													1															1	1				3
HELPFULNESS																						1	1	1	1	1	1						6
LEARNABILITY									1	1	1	1							1														5
RELIABILITY														1	1			1															3
UNDERSTANDABILITY	1	1	1		1	1																											5
OVERALL SATISFACTION																																1	1
Totals	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	

Below the satisfaction profiles are summarized as the satisfaction agreement percentages of the Usability Attributes.

Table 5.4.5 Usability Attributes Satisfaction Profiles

Attribute Satisfaction Levels	A & SA	NoCommnt	D & SDA	SAgre	Agree	NoCommnt	Dsgr	SDsgr
CONTROLABILITY	%44	%37	%19	%3	%41	%37	%16	%3
EFFECTIVENESS	%55	%10	%35	%10	%45	%10	%33	%3
EFFICIENCY	%65	%15	%20	%3	%62	%15	%18	%2
HELPFULNESS	%24	%53	%23	%0	%24	%53	%23	%0
LEARNABILITY	%70	%17	%13	%5	%65	%17	%11	%2
OVERALL SATISFACTION	%55	%25	%20	%5	%50	%25	%20	%0
RELIABILITY	%58	%10	%32	%3	%55	%10	%30	%2
UNDERSTANDABILITY	%78	%8	%14	%22	%56	%8	%13	%1

A & SA: Agree and Strongly Agree D & SDA: Disagree and Strongly Disagree

When we look at the table above it is seen that understandability has taken the maximum agreement on satisfaction followed by learnability. Both have low 'No Comment' and 'Disagreement' ratings. When we look to check whether there is any 'Strongly Disagreement' of Satisfaction Understandability has little with %1.

The maximum dissatisfaction levels are of the attributes Effectiveness, Reliability. Tough the Satisfaction Levels are above the average, and are about 0,55 for both, the high dissatisfaction is sufficient to be alarmed for improvement. Effectiveness and Reliability have received 0,3 and 0,2 Strong Disagreement of Satisfaction Ratings.

The Controllability and Helpfulness Satisfaction 'Agreement' Ratings have resided below the 0,5. These two Attributes also have the highest 'No Comment' Ratings. Especially Helpfulness has 'NoComment' rating of 0,53, which means that more than half of the users have no comment of the

Helpfulness of the system. Since all the users have been using the system for about 5 months at most, they should have some idea for the helpfulness of the system. This indicates a problem for the helpfulness, causing deeper analysis to the Satisfaction Items.

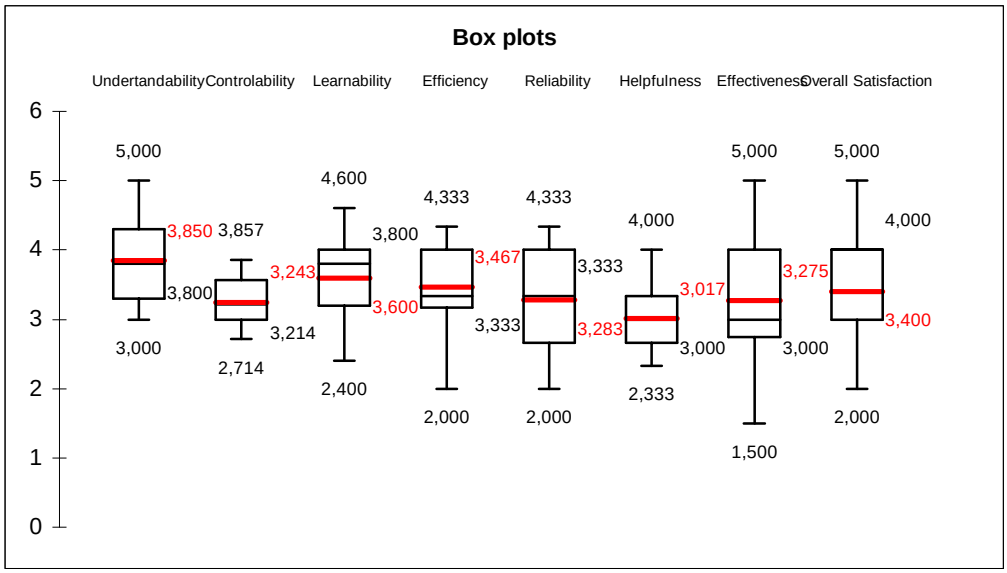

Figure 5.4.5 BoxPlots: Usability Attributes

In the following table the Usability Attributes Satisfaction Levels are shown with the detail of the Satisfaction Items contribute to the Attribute

Table 5.4.6 Usability Attributes Satisfaction Profiles (detailed)

Usability Attributes Satisfaction Levels	ItemNo	Satisfaction Item	A & SA	NC	D & SDA	SAgre	Agree	NoCommnt	Dsgr	SDsgr
CONTROLABILITY	4	Going back to the previous screen is easy	%45	%35	%20	%0	%45	%35	%20	%0
	7	There is continuous information feedback about what the system is doing	%30	%35	%35	%0	%30	%35	%25	%10
	8	Error messages indicate the problem clearly	%35	%20	%45	%5	%30	%20	%40	%5
	16	Error prevention messages are sufficient	%80	%10	%10	%0	%80	%10	%10	%0
	17	Ability to undo operations is adequate	%15	%80	%5	%0	%15	%80	%5	%0
	20	I can make some arrangements and shortcuts based on my needs	%10	%70	%20	%0	%10	%70	%15	%5
	21	I can accomplish tasks knowing only a few commands	%90	%10	%0	%15	%75	%10	%0	%0
TOTAL CONTROLABILITY			%44	%37	%19	%3	%41	%37	%16	%3
EFFECTIVENESS	30	Portal enables me to reach the information I need whenever I want	%50	%10	%40	%15	%35	%10	%35	%5
	31	I can reach the complete and actual information comfortably	%60	%10	%30	%5	%55	%10	%30	%0
TOTAL EFFECTIVENESS			%55	%10	%35	%10	%45	%10	%33	%3
EFFICIENCY	13	Portal is fast enough	%65	%5	%30	%0	%65	%5	%30	%0
	28	Portal helps me do my job efficiently	%75	%15	%10	%5	%70	%15	%10	%0
	29	Portal saves time	%55	%25	%20	%5	%50	%25	%15	%5
TOTAL EFFICIENCY			%65	%15	%20	%3	%62	%15	%18	%2
HELPFULNESS	22	Accessing the online tutorial is easy	%40	%50	%10	%0	%40	%50	%10	%0
	23	Tutorial informs clearly based on task goals	%40	%60	%0	%0	%40	%60	%0	%0
	24	Completing tasks using only online tutorial is possible	%10	%65	%25	%0	%10	%65	%25	%0
	25	It is easy to get solutions for problems from the help menu	%5	%60	%35	%0	%5	%60	%35	%0
	26	Installation of the Supplier Portal to computer is easy	%30	%35	%35	%0	%30	%35	%35	%0
	27	Gives informative messages when installation fails	%20	%50	%30	%0	%20	%50	%30	%0
TOTAL HELPFULNESS			%24	%53	%23	%0	%24	%53	%23	%0
LEARNABILITY	9	Is easy to get started with for the novice users	%60	%10	%30	%5	%55	%10	%20	%10
	10	Exploration of menus by trial and error is encouraging and safe	%60	%30	%10	%5	%55	%30	%10	%0
	11	Remembering abbreviations and menu names is easy	%80	%15	%5	%5	%75	%15	%5	%0
	12	It is easy to learn using the Portal	%75	%10	%15	%5	%70	%10	%15	%0
	19	Ease of operation increases with experience with the system	%75	%20	%5	%5	%70	%20	%5	%0
TOTAL LEARNABILITY			%70	%17	%13	%5	%65	%17	%11	%2
OVERALL SATISFACTION	32	Portal meets my expectations	%55	%25	%20	%5	%50	%25	%20	%0
TOTAL OVERALL SATISFACTION			%55	%25	%20	%5	%50	%25	%20	%0
RELIABILITY	14	I can always be sure of the actuality of the information displayed	%45	%10	%45	%5	%40	%10	%40	%5
	15	I can be sure that the information displayed is always complete and true	%65	%5	%30	%5	%60	%5	%30	%0
	18	System failures occur seldom	%65	%15	%20	%0	%65	%15	%20	%0
TOTAL RELIABILITY			%58	%10	%32	%3	%55	%10	%30	%2
UNDERSTANDABILITY	1	Menus are constructed in a logical and easily understood way	%95	%5	%0	%35	%60	%5	%0	%0
	2	Arrangement of information on pages is consistent and helps to understand	%90	%0	%10	%30	%60	%0	%10	%0
	3	Amount of information that can be displayed on the screen is adequate	%55	%15	%30	%15	%40	%15	%25	%5
	5	Terminology relates well to my work	%90	%0	%10	%20	%70	%0	%10	%0
	6	Computer terminology is not used too frequently	%60	%20	%20	%10	%50	%20	%20	%0
TOTAL UNDERSTANDABILITY			%78	%8	%14	%22	%56	%8	%13	%1

EFFECTIVENESS:

When we further look at the Effectiveness attribute we see that %40 of the users strongly think that Portal does not enable them to reach the information whenever they want. Some of the comments are due to the hardware dependency of the system because the certificate of one user can be installed only to one computer. Hardware dependency has been thought for security issues. The hardware dependency must be thought on again, discussed with the suppliers if needed. And if this is a must, the reason for the hardware dependency must be communicated to the users.

Some of the dissatisfaction comments come from the disconnections in the server. The server closures must be minimized. If the closure is required due to system modifications the users must be informed onwards.

Again some of the dissatisfaction about effectiveness comes from the not fully functioning menus. Malbis, Technical Drawing and Production Plan menus need to be provided fully serving as soon as possible.

RELIABILITY:

Reliability had one of the highest dissatisfaction levels. %32 of the users were dissatisfied with the reliability of the system. An important portion of the problem seems to be about the currency of the information in the Portal. This can be due to the manual data transfer and the processes within the Company internal MRP. In fact within the companies internal structure, its processes and tasks also goes through an orientation motivated towards the e-Supply Chain Perspective. Recently an orientation plan has started in the Company, for the effective integration of the internal systems with the Portal.

CONTROLLABILITY:

Controllability was the other attribute that does not have high enough satisfaction ratings. The attribute dissatisfaction level can be accepted to be low enough. However the NoComment rate is high. We have to look deeper at the attribute to find out the high NoComment rate. Whether this is due to inapplicability or nonserving Satisfaction Items. Items 20 and 17 have taken the lowest satisfaction rates. These are the 'ability to undo operations' and 'can make some arrangements and shortcuts based on my needs' items. In fact the Portal does not include much flexibility for arrangements and shortcuts. Users may not be sure if there are ways to make arrangements and shortcuts that they don't know. Undoing the operations is not very important for the users currently since Portal serves only data screening oriented tasks yet.

Besides the more than half of the users do not agree that the error messages indicate the problem clearly and more than %70 don't agree that they receive feedback about what the system is doing when they work with it. These are the additional important points need improvement.

HELPFULNESS:

Help menu and installation seems to be problematic for the users. In fact help menu does not exist but the Tutorial. Tutorial items seem to have high NoComment ratings which may direct us to reason that it is not utilized effectively. Tutorial usage must be communicated to the user and improvements must be done if needed.

LEARNABILITY:

Learnability with the satisfaction items it includes seems, not to have catastrophic dissatisfaction problems. In fact for such a new system this rates can be accepted as a success in terms of system design.

UNDERSTANDABILITY:

Only "the amount of information displayed is adequate" item has received strong dissatisfaction. This kind of gap has also alarmed in the Heuristic Evaluation that in the Production Plan page there is no option to view the page without scrolling. Basically Production Plan and consignment inventory list screens can be revised.

The other Understandability items such as menu organization, consistency of page arrangements, and terminology usage have received good satisfaction levels.

OVERALL SATISFACTION:

Slightly more than half of the users of the Supplier Portal agree that the Portal meets their expectations. %20 disagree with this statement and 20% gave NoComment. While there is no strong disagreement for overall satisfaction statement, only 5% strongly agree their expectations are met. The next step after this usability evaluation study will be to make the improvements in the system to turn the % 25 NoComment and %20 disagree Satisfaction rates to agreement and to try to reach the rate of 100% for the users' "I Strongly Agree that the Supplier Portal meets my expectations". Then comes, the "I strongly agree the system exceeds my expectations" statement.

5.4.2 Inferential Analysis

After the analysis and interpretation of the descriptive statistical results there are further analysis tools we can deploy. In usability analysis studies, there are various approaches however there is not a distinct methodology. In this study some inferential analysis methods are utilized and their implications are discussed. These are factor analysis, Correspondence Analysis and Multidimensional Scaling.

5.4.2.1 Grouping of the Satisfaction Items with Factor Analysis

If we had deployed the pilot survey, which had 94 items with similar groups of items within, combining the items into smaller categories would be necessary. The statistical method to determine if this is appropriate is Factor analysis. Although we have 32 items, factor analysis is utilized if it was possible to combine some of the items into subscale scores. As expected the factor analysis gave no linear dependency between the 32 satisfaction items.

As we have mentioned in the descriptive analysis section, here categorization is different from the grouping made for satisfaction profiles. There, the items form different dimensions of a Usability attribute while; a category contains the items that investigate the satisfaction levels rising from a same cause.

Factor analyses carried out up to 19-factor number Factor analysis of the 32 Likert-scale satisfaction items were conducted using the image factoring method with varimax rotation. However the factor analyses found no evidence to reject the independencies of the items. For the details of this study please refer to App. H.6.

5.4.2.2 A Multidimensional Scaling Analysis Study

Multidimensional Scaling (MDS) is a data analysis method which is widely used in marketing and psychometrics. The aim of the methods is to build a mapping of a series of individuals from a proximities matrix (similarities or dissimilarities) between these individuals. In the ideal case where we have a matrix giving the distances between some points on a surface (for example the cities of a country), the MDS allows to rebuild exactly to map of the points (within about a symmetry and/or rotation). To build an optimal representation, the MDS algorithm minimizes a criterion called "Stress". The closer the stress is to zero, the better the representation.

We have not seen the application of this data analysis method in the usability analysis literature but in marketing. The application of the method gave some meaningful results so the study is presented.

The application of the method can be better interpreted by the application example below. MDS can be applied on a data correspond to a survey performed over 10 testers which have been asked to rate (the score range from 1 to 5) five products, where only the product P1 is already available on the market. Suppose these products are different types of chocolate bars.

MDS aims to show how the products position themselves on a map, given the opinion of the testers. For the method dissimilarities matrix is computed for the results and MDS.

If the rank of the dissimilarity is high this means that the testers have collectively well distinguished the products among each other. For example it is not surprising that two products have the highest rank for the one which contains more chocolate than the other. Similar average scores can also have high ranked dissimilarity due to the opposed opinions of the products. For

example added peanuts to the chocolate product may be appreciated by some testers and not by some other.

When we come to our Usability Satisfaction Survey data, we can position the Satisfaction Items in our survey and may have a chance to find out if some Usability dimensions don't seem to be very dissimilar.

The results of the dissimilarity are summarized below as a comparative table with the best fit, so the best stress value with 4 dimensions. The pairs with the rank up to 8 form 17 item pairs in the table.

Two columns are added to the table lately, which contain the usability attributes that each item belongs to, which were defined in the descriptive analysis section.. Of the 17 pairs which came out to most similar in the MDS, 8 pairs' items happened to be in the same usability attribute group. Four pairs included the overall satisfaction attribute and another attribute and the other pairs were from (controllability-learnability), (learnability-helpfulness), (reliability-learnability). In fact, the MDS gave meaningful results for our attributes and the satisfaction items. Learnability came out to be closely related to the controllability, helpfulness and reliability of the system in users minds. These results also are prospective for deeper analyses of 'control feeling' or the beliefs such as people don't rely on things that they don't know much about.

These results are also prospective in terms of usability attributes definition. The users have put the usability satisfaction items of the same or related attributes in similar places according to some dimension. Therefore we can say that the evaluation of the Portal by the satisfaction items grouped in the Usability Attributes determined is somewhat in line with the perceive of the Attributes and the Satisfaction Items questions by the users.

As a conclusion, the MDS method allows to map the Satisfaction Items that have been rated by the testers. It provides us with a richer interpretation than simple statistics would.

Table 5.4.7 Comparative Table -Satisfaction Items

Pair	Dissimilarity	Disparity	Distance	Dissimilarity rank	Disparity rank	Distance rank	Item A	Item B	Attribute Item A	Attribute Item B
q31 - q32	1,732	1,732	1,401	1	1	3	I can reach the complete and actual information comfortably	Portal meets my expectations	Effectiveness	Overall Satisfaction
q26 - q27	1,732	1,732	0,980	1	1	1	Installation of the Supplier Portal to computer is easy	Gives informative messages when installation fails	Helpfulness	Helpfulness
q22 - q23	2,000	2,000	1,229	2	2	2	Accessing the online tutorial is easy	Tutorial informs clearly based on task goals	Helpfulness	Helpfulness
q29 - q32	2,646	2,646	2,044	3	3	9	Portal saves time	Portal meets my expectations	Efficiency	Overall Satisfaction
q10 - q12	2,828	2,828	1,473	4	4	4	Exploration of menus by trial and error is encouraging and safe	It is easy to learn using the Portal	Learnability	Learnability
q17 - q20	3,000	3,000	2,394	5	5	14	Ability to undo operations is adequate	I can make some arrangements and shortcuts based on my needs	Controllability	Controllability
q24 - q25	3,000	3,000	1,948	5	5	6	Completing tasks using only online tutorial is possible	It is easy to get solutions for problems from the help menu	Helpfulness	Helpfulness
q10 - q23	3,000	3,000	2,744	5	5	27	Exploration of menus by trial and error is encouraging and safe	Tutorial informs clearly based on task goals	Learnability	Helpfulness
q16 - q19	3,000	3,000	2,519	5	5	18	Error prevention messages are sufficient	Ease of operation increases with experience with the system	Reliability	Learnability
q20 - q24	3,162	3,162	2,623	6	6	20	I can make some arrangements and shortcuts based on my needs	Completing tasks using only online tutorial is possible	Controllability	Learnability
q19 - q21	3,162	3,162	2,215	6	6	12	Ease of operation increases with experience with the system	I can accomplish tasks knowing only a few commands	Learnability	Learnability
q11 - q23	3,162	3,162	3,023	6	6	44	Remembering abbreviations and menu names is easy	Tutorial informs clearly based on task goals	Learnability	Learnability
q6 - q32	3,162	3,162	3,368	6	6	74	Computer terminology is not used too frequently	Portal meets my expectations	Understandability	Overall Satisfaction
q17 - q23	3,162	3,162	3,040	6	6	45	Ability to undo operations is adequate	Tutorial informs clearly based on task goals	Controllability	Learnability
q16 - q23	3,162	3,162	2,771	6	6	29	Error prevention messages are sufficient	Tutorial informs clearly based on task goals	Reliability	Learnability
q28 - q32	3,162	3,162	2,000	6	6	7	Portal helps me do my job efficiently	Portal meets my expectations	Efficiency	Overall satisfaction
q25 - q27	3,162	3,162	2,146	6	6	10	It is easy to get solutions for problems from the help menu	Gives informative messages when installation fails	Helpfulness	Helpfulness

5.4.2.3 Correspondence Analyses

Correspondence analysis (CA) seeks the best simultaneous representation of two sets that make up the rows and columns of a contingency table, where these two sets have symmetrical roles. For the statistical purposes the Malbis and Technical Drawing Menu usage data is excluded in the analysis. Since none of the users used these menus, the frequency vectors of these menus were both zero vectors. In both analyses cluster number is set to 5.

Correspondence Analysis between TaskMotiv Clusters and User Satisfaction Levels

A correspondence analysis for one of the satisfaction items is explained in detail below. For further analysis details please see App H. Below is the contingency table of the Satisfaction Levels for the Satisfaction Item 28 with the statement of 'Portal helps me do my job efficiently:

Table 5.4.8 Contingency Table -TaskMotiv clusters: q28

Portal helps me do my job efficiently	Agree	Dsgr	NoCommnt	SAgre
ConsOnly	2	1	0	0
ConsPlus	1	0	1	1
FirmX	2	0	0	0
OrderOnly	1	1	2	0
OrderPlus	8	0	0	0

When we look at the chi-square independence test results are summarized as:

Table 5.4.9 Chi-square independence test:TaskMotiv-q28

Chi-square (observed value)	18,413
Chi-square (critical value) (df = 12)*	21,026
One-tailed p-value**	0,104
α	0,050

The one-tailed p value is smaller than α, the level of significance which is 0,050. Therefore the decision is not to reject the null hypothesis of independence between the rows and the columns. In other words, the dependence between the rows and the columns is not significant. We have no evidence to say that there is dependency between the TaskMotiv clusters and the user's satisfaction about the efficiency of the Portal. Users from different tasks related positions do not differ in terms their satisfaction for efficiency.

Below is the contingency table chart, which also shows the absence of a pattern:

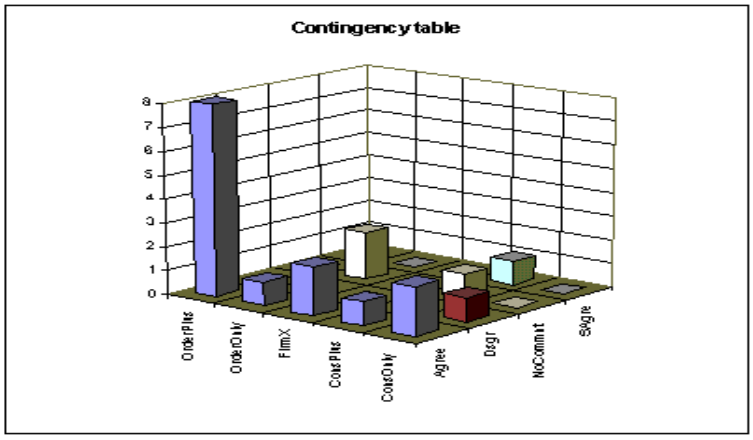

Figure 5.4.6 Contingency Table Chart -TaskMotiv: q28

* **Critical value:** Value of the statistics under the null hypothesis for the probability 1-alpha (right-tailed test). Reject the null hypothesis when the observed value is greater than the critical value.

** One-tailed p-value: Probability under the null hypothesis to obtain a result as extreme as the observed one, towards the right-tail of the distribution. Reject the null hypothesis when the probability is lower than the alpha level.

Correspondence Analysis between PortalExper Clusters and User Satisfaction Levels

Secondly the Correspondency analysis is carried out for between the portal experience of the users and their agreement on that the portal helps them do their jobs efficiently. Table 5.4.10 summarizes the answers from the PortalExper clusters below:

Table 5.4.10 Contingency Table -PortalExper clusters: q28

Portal helps me do my job efficiently				
	Agree	Dsgr	NoCommnt	SAgre
1 month	0	0	1	0
1 week	0	1	0	0
2 months	0	1	0	0
3 months	3	0	1	0
4 months	11	0	1	1

Table 5.4.11 Chi-square independence test:PortalExper-q28

Chi-square independence test:	
Chi-square (observed value)	26,896
Chi-square (critical value) (df = 12)	21,026
One-tailed p-value	0,008
Alpha	0,050

At the level of significance alpha=0,050 the decision is to reject the null hypothesis of independence between the rows and the columns. In other words, the dependence between the rows and the columns is significant.

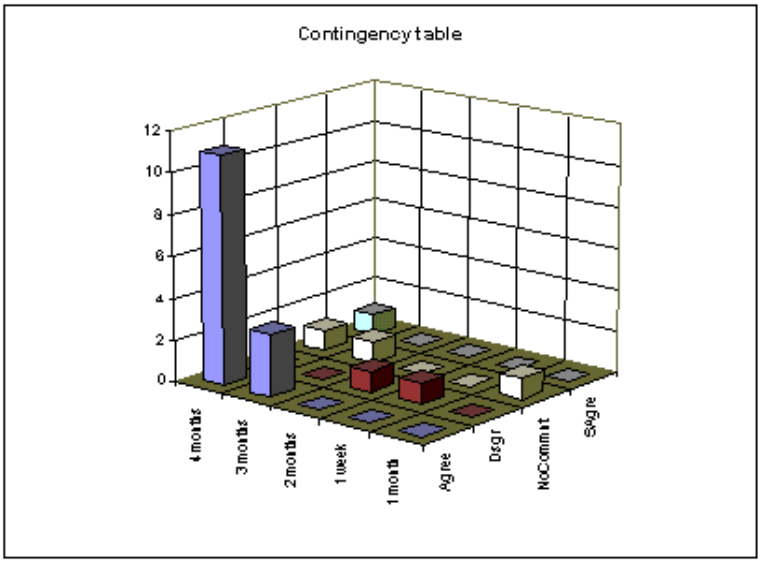

Figure 5.4.7 Contingency Table Chart -PortalExper: q28

As can be interpreted from the contingency table chart the as the users of the Portal become more experienced their agreement on the helpfulness of the Portal for their job also increases. These means that the users need an adaptation period to efficiently use the Portal. What is required is to support the novice users to come out of the adaptation period.

5.5 User Testing

User testing is done in the field. It is requested from users to carry out three tasks, which includes the Portal usage. The tasks could be done consecutively without logging out from the Portal. Logout before each task was not preferred because it would bring an unnatural atmosphere to the usage. The aim of the testing was basically to observe the interaction between the users and the system directly, and to try to capture their responses (positive or negative), which cannot be gained from survey analysis. Time study was also included in the observations.

5.5.1 Methodology and Materials

To keep the testing session near to the natural situation, neither the written task lists are used nor was the user restricted to do standard steps. The task scenarios that were not very different than his/her usual tasks were told to the user. After completion of each task the next scenario is told and requested. Three tasks were sorted from the easiest to the most complex one.

As the recording equipment a cell phone is used with a stopwatch menu. Firstly video camera was thought as the recording media however it was decided not to be used. The reason for this was that the video recording would affect the users doing the tasks. Additionally because the data in the Portal that includes, prices, advances, payment lists and the Production Plan of The Company has a confidential side the video recording could cause an important discomfort. Additionally since cell phones are more familiar in day-life than the stopwatches, users would be less influenced from the presence of the recording equipment.

5.5.1.1 Participants and Environment

The recommended minimum users number for the Usability Tests are 10. In our case we accomplished a Pilot Usability Test with four users, to provide a test base for the Usability Tests decided to be carried with more users. In one of the tests the recording failed, however valuable observations and comments were obtained from this observation too. One of the users entered one of the menus for the first time. In one of the studies the third task couldn't be carried out because the connection with the portal server failed and couldn't be maintained for half an hour. There were high interruptions in 2 of the 4 studies. The interruption time intervals were excluded from the time data.

5.5.1.2 Test Tasks

The tasks are listed below:

"I am going to request you to go through a number of tasks. I would like to emphasize that you are not being tested, rather we are interested in testing our Supplier Portal for further improvements and design."

- Your firm telephone numbers have been changed a week ago, and you have requested the change by using the portal 2 days ago. Now, could you please login to the Portal and look if the modification has been made in your firm's profile?
- Now, a mail came from your contact engineer in the Company that the orders have been revised. Could you please take the orders as to be used in by our production planning?
- In the orders there seems to be delivery request for tomorrow, which you think that didn't exist in the previous order letter. In the previous order letter there was a request in the same amount for today and you have just delivered that material. Please try to find out that whether, the order for tomorrow in the current letter is the order that you have sent today, but just delayed, or it is a new order request.

After the tests the users were asked if they had any suggestions about the Portal.

- What do you like best about the site?
- Do you have any suggestions for improvement?

In the performance data the task completion times and error rates were measured. Below is the table summarizes the performance data measured.

Table 5.5.1 Field Test -Task Completion Times

Task Completion Times	# values used	# values ignored	Usr1	Usr2	Usr3	Range	Mean	s	SE	LoB MIC	UpB MIC
Login	3	0	33,47	35,03	30,20	4,830	32,900	2,013	1,423	26,777	39,023
Firm Info Enter	3	0	12,57	23,07	9,58	13,490	15,073	5,785	4,090	-2,526	32,673
Info Page Task	3	0	8,00	6,47	7,33	1,530	7,267	0,626	0,443	5,361	9,172
Orders Page Enter	3	0	21,09	23,07	21,01	2,060	21,723	0,953	0,674	18,825	24,622
Orders Page Task	3	0	33,55	52,02	22,90	29,120	36,157	12,030	8,507	-0,445	72,758
Materials Flow Page Enter	3	1	Waited for 100,48	15,01	16,11	1,100	15,560	0,449	0,550	0,318	14,194
Materials Flow Page Task	3	1		15,01	16,11	17,140	31,610	6,997	8,570	4,948	10,321

Error rates were also measured as summarized in below:

Table 5.5.2 Field Test -Error Rates

Error Rates	IE Total	NE Total	RE Total	Total Error	Mean Err Rate	Planned Target Level
Login	1	1	0	2	0,66	0
Firm Info Enter	0	0	0	0	0,00	0
Info Page Task	1	0	0	1	0,33	0
Orders Page Enter	2	0	0	0	1,66	0
Orders Page Task	0	0	0	1	0,33	0
Materials Flow Page Enter	2	0	0	0	0,33	0
Materials Flow Page Task	0	0	0	0	0,00	0
Logout		2	0	2	1,00	0

IE: Input Error NE: Navigation Error RE: Retrieval Error

Input Error: The errors occur when the users make input for access to reports or pages.

Navigation Error: The errors lead users to different pages from the pages where they can accomplish their tasks.

Retrieval Error: Errors done while retrieval of data. This is the most important error type; due to the nature of the Portal's service, issues related to reliability are catastrophic.

5.5.2 Task Analysis

Analysis of each task is as follows:

Task1- Login:

- Users enter to a main page and then from a link saying 'Entrance to Reporting Screen' they enter to the id-password screen.
- This one level may be redundant. User three had made a shortcut to the second page.
- User 2 couldn't remember from where to enter on the first page. She said that the link was insignificant.
- Users entered their Ids. User2 made a typing mistake of Caps Lock. No error prevention message existed for this.
- Users approved the certificate alert which seems to be unnecessary.
- Users come to the main screen where the menus exist on the left.

Task2- Firm Info Enter

- No error, the menu was clear and significant.

Task3- FirmInfoTask

- This task was for testing warm-up purpose. No error.

Task4- OrdersPageEnter

- Users could enter to the letter of order menu directly from the menu on the left. This was a good point.
- Two users entered the date interval wrongly, without using point as the separator. The system hadn't given any message for the format, only error message told about the format. Users tried the calendar for the date entrance after the error indication rather than trying to type again.

Task5- OrdersPageTask

- 2 of the users copied the order data and opened a Word document and pasted the data in that. Although no retrieval error is recorded the copy-paste inclusion for the order-taking task is very defenseless to errors. Appropriate formats must be acquired to prevent copy-paste situations.
- User 2 tried to download the excel file, however when she opened the file, it took time her to understand the file, since the excel format was not very visible.

Task6- MaterialsFlowPageEnter

- All of the users indicated that they would call the Company's engineer for this kind of problem; one of them said that he would look at the last waybill (irsaliye) number of the material which also exists in the order letter. And by comparing the number in the portal and the number of his last delivery he could conclude. However he also said that he would still call the Company's engineer. MaterialFlow page wasn't a page they used frequently. They didn't have difficulty in finding the appropriate material flow type from the drop down menu. One user requested he flows for all their materials rather than finding it from the materials list

screen. One of the users had copied the stock number in he order letter, directly pasted it.

- As can bee seen in the table during the testing of User 1 the portal server got out of service. We waited the page to come for 100,48 minutes which indicates that the system does not give enough feedback about the current state of the system. This user also indicated that when he waits at the page for long time while he has to make another task independent of the Portal, the portal access fails due to time out reason. When the time out disconnection occurs from the Portal page does not change. The portal stays in the same page where it was and when clicked to another menu, or tried to make an entrance to report just nothing happens. It is highly probable that users wait for the page come uninformed of that the time out disconnection has occurred. In the server fail case after waiting for one and a half minute the user said that this could be due to time out. Then he closed the window and opened a new, trying to enter to the portal entrance page again. But the page didn't open.

Task7- MaterialsFlowPageTask

- Both of the users did not have difficulty to understand the material flow information.

Task8- Logout

- None of the users utilized the logout button. Rather all of them closed the window by clicking the standard right corner cross of the window. This is an error due to the security reasons.

5.5.3 User suggestions

When asked what information/functionality subjects would like to see on the site and what else tasks they would like to be able to perform that would make their day-to-day activities easier, the following responses were collected:

- Phone number lists for people in different locations
- Logout (in fact it exists)
- A site map
- Order Approval function
- 'Current price check' function, which will request approval from The Company that the prices are actual.
- Alert indicates whether there had been a revise in orders or the price list since the last access.
- Message indicating whether the page have disabled because of timeout case.
- To be able to access the material sub trees.
- To be able to see the prices of the all materials they sell to each facility of the Company on one page.

When asked what they like best about the site, the responses were the following:

- "Clean" and simple look and feel
- The site organization
- The simple layout
- The recognizability of the menus
- The ease with which information can be located on the site.
- To be able to screen the current prices whenever they want
- To be able to watch the production plan

As a conclusion the menu structure was accepted by the users and the information in the reports were easily perceived by the user. The login to the Portal could be more trivial and the date entrance for screening some reports could be made error free by an indication of the date entrance format. Users seemed to copy and paste the data to other file formats, downloadable files should be made available in several file types. Additionally the excel files downloaded must not need additional formatting when downloaded and opened. The users wanted to be informed about the currency of the orders and the other reports by the portal automatically. As an additional organizational alternative the hyperlink structure came into question from a user's attempt to enter the information about a material by double clicking on the material stock number on a report. Additional suggestions were the inclusion of the material sub trees, a site map and a Company phonebook in the Portal, which were very valuable ideas for portal's future development and are likely to be implemented within the improvement revisions.

CHAPTER 6

CONCLUSION

6.1 Our Study

In this study we take the Usability concept in the distributed deployment phase of the system, when the system was released and put into use. Usability attributes to be measured for performance evaluation are determined and based on these a system heuristic evaluation checklist is developed. The Supplier Portal's Usability is evaluated with this checklist. Additionally, within the Usability Evaluation Plan developed a Usability Testing basement is constructed.

Based on the conceptual survey a Usability Evaluation Case Study is implemented. Supplier Portal is taken as the system to be evaluated.

After the Heuristic Evaluation of the system according to the Ten Usability Heuristics and the Heuristic Checklist, a system analysis is carried out introducing the users and the processes the Supplier Portal interacts with. Afterwards a usability survey which is put in the Supplier Portal and user field tests are deployed with the actual users of the system, the Suppliers of The Company.

The survey analysis contained user profiles, usage patterns and clustering. Besides the satisfaction level analysis is done on descriptive and inferential

bases. In descriptive analysis, the 32 satisfaction items in the survey are grouped in 8 usability attributes namely; understandability, controllability, learnability, reliability, helpfulness, efficiency, effectiveness and overall satisfaction, and the implications are discussed.

In the inferential case the relations between the user clusters and the satisfaction items and the relations within the satisfaction items are investigated. User clusters formed by the Portal experience data and the Satisfaction Levels for some Satisfaction Items showed dependency. Factorial Analysis didn't find dependency within the Satisfaction Items. Multidimensional Scaling gave results that can subjectively taken as a consent that the survey Satisfaction Items are recognized by the users in accordance with the Usability Attribute grouping defined.

Additionally, it is implemented field user tests performance metrics are measured and task analysis is done based on these data. Lately the users comments and suggestions collected through the study are also included.

6.2 Future Developments in Usability Engineering

This study aimed is to form a framework and starting point to include usability studies from the beginning of systems design as a user centered process. Additionally it explored and made an evaluation study using the formal analysis methods which are not widely used in Usability studies yet.

It is convenient to depict here the technologies pointed in the literature for future developments:

- Technological Solutions: Speech Technology, User Interface Management Systems (UIMS), Intelligent help systems.
- Computer Aided Usability Engineering: Prototyping Tools

- Tools for interactive construction of screen layouts, dialog boxes, icons, etc., by direct manipulation.
- Tools for interactive manipulation and easier use of formal notations, specifications, models, and task analysis techniques in order to lower the barriers to their use.
- Hypermedia representation of user interface standards and guidelines, allowing designers to view animated examples of interaction techniques and to jump between related issues.
- Design rationale representations
- Wizard of Oz support tools that allow the human simulating the advanced interface to construct replies more easily and that constrain those replies according to the rules of the experiment.
- Logging tools for use during user test.
- Localization and translation support tools for international user interfaces.
- Keystroke or event loggers, either for use in user testing or for instrumentation of installed systems.
- Databases of user complaints and support line calls, as well as analysis tools to extract more general information from the database.

6.3 Technology Transfer

In general technology transfer proceeds through a process of innovation diffusion spreading from the center of innovation through a small group of early adopters and the majority of users do not get the technology until much later. Mahajan (1990) proposed that if N (t) is the number of users of an innovation at time t, the first zero point of the third derivative of the function N (t) indicates the inflection point where so called majority adopters start using the innovation

diffusion from general marketing theory to characterize the spread of hypertext usage. In general, initial diffusion is very slow. Only after the first inflection point of the curve do things start to move fast.

One way to speed up technology transfer is through use of change agents: people who take on explicit responsibility for transferring technology and for pushing otherwise slow-moving organizations to change. Below are some of the statements we can here more frequently nowadays, as its importance becomes clearer in minds:

- Usability provides important benefits in terms of cost, product quality, and user (customer) satisfaction.
- It can improve development productivity through more efficient design and fewer code revisions.
- It can help to eliminate over design by emphasizing the functionality required to meet the needs of real users. Design problems can be detected earlier in the development process, saving both time and money.
- It can provide further cost savings through reduced support costs, reduced training requirements, and greater user productivity.
- A usable system (product) means more satisfied users and a better reputation for the system (product) and for the organization that utilizes (developed) it.

This study has a different dimension in terms of the deployment of a usability study in one of the biggest companies of Turkey. The results of this study and implementation are expected to contribute to the systems improvement efforts in The Company which arise from the “Continuous Improvement” philosophy the Company owns.

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APPENDIX A

USER INTERFACE GUIDELINES

A.1 DESIGN CONSIDERATIONS

Establish Level of Importance

- Establish a high-to-low level of importance for each category and carry this approach throughout the design.
- Comments: Important categories should appear higher on the page so users can locate them quickly.

Reduce User's Workload:

- Automate as much of the site's function as possible. Eliminate the need for users to perform tasks like performing mental calculations, making estimations, recalling account numbers and passwords, etc.
- Comments: Let the computer perform as many tasks as possible so users can concentrate on performing tasks that actually require human processing and input.

Be consistent

- Present information and similar functions consistently throughout the site, including logos, page titles, headers, navigation elements, etc.

Also use a consistent position on all pages for logos, recurring text, buttons, and graphics.

- Comments: The more consistent a Web site is in its design, the easier it will be for users to quickly evaluate categories and match expectations on all pages. Users, particularly older users, tend to learn and remember locations of information, functions, and controls. Keep in mind that users spend most of their time on other sites, which is where they form their expectations for how the Web works on your site.

Provide feedback to users

- Provide feedback to inform users where they are in your site.
- Comments: Feedback provides users with information they need to proceed to the next activity. Feedback can be as simple as changing the color on a link after it has been clicked by a user.

Limit use of frames

- Do not include frames in Web sites, unless there is a strong (clearly defensible) reason to do so.
- Comments: Use frames only when other design solutions are not adequate. Frames may take longer to design, develop, and maintain. Splitting a page into frames can be confusing for users since frames can break the fundamental user model. Frames can yield unexpected results, particularly when using the "Back" button. Frames make a Web site difficult to use, and can prevent users from emailing a URL to others.

A.2 CONTENT/CONTENT ORGANIZATION

Establish Level of Importance

- Establish a high-to-low level of importance for each category and carry this approach throughout the design.
- Comments: Important categories should appear higher on the page so users can locate them quickly.

Provide Useful Content

Put Important Information At Top of Hierarchy

- Put as much important content as close to the top of the hierarchy as possible.
- Comments: When creating a Web site that lends itself to a hierarchical style of organization (i.e., pyramid structure with most important information on the top), it is beneficial to "flatten" the hierarchy and to provide more information sooner. The more steps (or clicks) users must take to find the desired information, the greater the likelihood they will make a wrong choice.

Use Short Sentence/Paragraph Lengths

- Write sentences with 20 or fewer words and paragraphs with fewer than five sentences. Use lists to break up long sentences.
- Comments: Readability improves when sentences and paragraphs are relatively short. Users tend to skip over text they consider nonessential.

Provide Printing Options

- Provide an alternate form of all documents, resources, or files that can be printed in their entirety.
- Comments: Many users prefer to read text from a paper copy of a document. They find this to be more convenient, and it allows them to make notes on the paper. Users sometimes print pages because they do not trust the Web site to have pages for them at a later date.

A.3 TITLES AND HEADINGS

Use Well Designed Headings

- Use many, carefully selected headings, with names that conceptually relate to the information or functions they describe.
- Comments: Headings provide strong cues that orient viewers and inform them about a page's organization and structure. Headings also help classify information on a page. Well-designed headings are an important tool for helping users scan text. Write headings and page titles that clearly explain what the page is about and that will make sense when read out-of-context. Headings are often removed from the context of the full page and used in tables of content and search engine results. This means that the headings should clearly tell users what is at the other end of the link.

A.4 PAGE LENGTH

Determine Page Length

- Use short pages for (a) home pages and all navigation pages, (b) pages that need to be quickly browsed and/or read online, and (c) pages with very long graphics.
- Use long pages to (a) simplify page maintenance (fewer Web page files to maintain), (b) match the structure of a paper counterpart, and (c) make pages more convenient to download and print.
- Comments: Determine your goals and your users' goals when making page length decisions. Short pages, those containing one or two screens of text, work well for the home page and menu pages when users are scanning for link choices. Longer pages, although they require more scrolling, may work well for destination pages where related content can be printed and read/scanned together.

Determine Scrolling vs. Paging Needs

- If reading speed is important and response time is reasonably fast, use paging (linking) rather than scrolling.
- Comments: Users should be able to move from page to page by selecting links (paging) without always scrolling to important information. This is particularly true for home pages and menu pages. One study showed that users spent about 13% of their total time scrolling within pages. Although each scrolling event takes little time, overall users can spend a considerable amount of time scrolling.

A.5 PAGE LAYOUT

Align Page Elements

- Align (vertically and horizontally) information, items, and widgets on a page, window, or screen.
- Comments: Users prefer rows and columns on page to be aligned and, as a result, are better able to read the text.

Establish Level of Importance

Be Consistent

Reduce Unused Space

- Reduce the amount of unused space on pages used for scanning and searching.
- Comments: On pages that are primarily links or categories, like a home page, the greater the density, the faster the scanning. "Density" is defined as the percent of the screen filled with categories and text. Density has no impact on user accuracy or reference. On content/text pages, using some white space to separate paragraphs and ideas is important. As a rule, use less white space than you would on paper.

Put Important Information At Top of Page

- Put important items at the top, "above the fold" (in the first screen of information), to ease scanning.
- Comments: Experienced users usually scan a Web page menu or a list from top to bottom. Users generally look at the top center of a page first, then look left, then right, and finally begin systematically moving

down the total page. All critical content and navigation options should be at the top of the page. Particularly on navigation pages, all major choices should be visible without scrolling. Users may conclude that what they see on the visible portion of the page is not of interest, and not bother scrolling down to see the rest of the page.

Format for Efficient Viewing

- Determine then design, the most efficient viewing and use of information on each page.
- Comments: Users spend about 58% of their time using information on the site (viewing, scanning, reading, printing, downloading, etc.). To allow efficient use, tradeoffs are usually required. For example, on some pages it is worthwhile to sacrifice ease of reading for ease of scanning. Developers should evaluate the most common use of each page and make design decisions that ensure the best possible performance. Structure each page to facilitate scanning and help users ignore large chunks of the page in a single glance. Studies report that between 75% and 79% of users scan any new page. Only 16% read word-by-word. Also, most users (78%) tend to focus first on text, not graphics.

A.6 FONT AND TEXT SIZE

Use Readable Font Sizes

- Use at least a 10-point font to achieve the best possible reading performance.
- Comments: Research has shown that fonts smaller than 10-point elicited slower performance from users. For people over 65, it may be

better to use at least 12 or 14 point. A rule-of-thumb is for size 3 characters on the users screen to equal a printed 12-point character of the same font.

Use Familiar Fonts

- Use either a familiar serif or sans serif font to achieve the best possible reading speed. Do not mix serif and sans serif fonts within the text, because it may decrease reading speed.
- Comments: Research shows no reliable differences in reading speed or user preferences between 10-point Times Roman, Georgia serif fonts, Helvetica, or Verdana sans serif fonts.

A.7 READING AND SCANNING

Use Reading Performance or User Preference

- If reading speed is important, use longer line lengths (100 characters per line) rather than shorter line lengths (55 characters per line).
- Comments: Users read faster when line lengths are long, although they tend to prefer shorter line lengths. When designing, first determine if performance or preference is important. If user performance is critical, use longer line lengths to increase reading speed. However, if user preference is critical, use shorter line lengths.

Enhance Scanning

- Enhance scanning by providing clear links, headings, short phrases and sentences, and short paragraphs.
- Comments: Users tend to scan, stopping only when they find something interesting. Research shows that users have difficulty

finding a specific piece of information when the page contains wall-to-wall text. Users struggle to find alternatives to reading. They resort to a modified scan strategy and usually read the first sentence and/or scan for links on the page.

Determine Scrolling vs. Paging Needs

A.8 LINKS

Position Important Links Higher

- Place important links and information high on the page (at a minimum, above the fold or scroll line).
- Comments: When pages have more than a screenful of information, users spend much more time on the top of the page and less time on the remaining screen of information. Research emphasizes that there is an 80-20 split, with 80% of time spent on the first screen and the remaining 20% on the rest of the page.

Show Links Clearly

- Use blue underlined text for all unused links when possible. Do not require users to move the mouse to see when the pointer changes to a hand (mine sweeping).
- Comments: Some links are missed by users because the links are not evident. Links must be clearly designated so that there is little (or no) uncertainty on the part of the users as they click on a link. Research has shown that when users were given visual cues to locate links, as opposed to using the pointer to search for links, they were able to find the information seven times faster.
- For text, users expect links to be blue and underlined.

- For a graphic link, the term "click here" has been shown to increase recognition that the graphic is a link. However, some automatic screen readers may have problems deciphering what "click here" refers to.

Indicate Internal vs. External Links

Use Descriptive Link Labels

- Label links descriptively so that users can discriminate between similar links.
- Comments: Users can be slowed when they must ponder the differences between similar link labels.

Use Text Links

- Use text links. Do not use image links.
- Comments: Text links generally download faster, are preferred by users, and change colors after being selected.

Avoid Mouse Overs

- Do not rely on "mouseovers" for users to identify links. Always use underlines or some other visual indicator
- (E.g. a stacked list of items) to indicate that words are links.
- Comments: Relying on mouseovers to designate links can confuse newer users and tend to slow them down because users are uncertain which links perform which functions.

Repeat Text Links

- Ensure that the most important content can be accessed from more than one related text link.

- Comments: Some users find important links easily when they have a certain label, while others may recognize the link best with an alternative name. When the information is critical to the success of the Web site, provide more than one link name (that satisfies all users) to the same content.

Present Tabs Effectively

- Place tabs that are used for links at the top of the page and ensure that they look like clickable, real world tabs.
- Comments: Research has shown that users are more likely to find and click appropriately on tabs that look like real-world tabs. Real-world tabs are those that look like the ones found in a file drawer (see the example below). Users can be confused when the tabs do not look like real-world tabs and/or the words are not underlined.

Show Used Links

- Indicate to users when a link has been clicked. If a user selects one link, and there are other links to the same target, make sure all links change colors.
- Comments: In a study of the speed with which users could find certain information, providing this type of feedback was the only aspect found to improve the speed of finding information. Make links that have not been clicked blue, and clicked links purple or red. Users continue to use link colors to understand which parts of a site they have visited. Where no evidence of link use, or non-standard colors are used, users repeatedly bounce among a set of pages not knowing that they are going back to the same page again and again.

A.9 NAVIGATION

Keep Navigation Aids Consistent

- Use the same navigation aids (navigation scheme) on all pages.
- Comments: Create a common navigational look to ensure that users can use the Web site navigation effectively.

Use Text-Based Navigation Aids

- Wherever possible, use text-based navigation aids.
- Comments: Consider tradeoffs when choosing navigation aids, especially when deciding between text and graphics.
- Text-based navigation works better than imaged-based navigation because it enables users to understand the link destinations. Another benefit is that users with text-only and deactivated graphical browsers can see the navigation options.

Group Navigation Elements

- Group navigation elements in close proximity.
- Comments: Navigation elements help users find and move to areas of the site that have the desired information. They also help users to develop a mental model of the Web site.

Place Navigation On Right

- Use the right margin for the Web site's main index.
- Comments: Research shows that users click on topics in the right margin with much more efficiency than topics placed on the left because they are located much closer to the scroll bar. This allows

users to quickly move the pointer between the scroll bar and the index items. Benefits are particularly strong for laptops.

A.10 SOFTWARE VS. HARDWARE

Determine Connection Speed

- Design for connection speeds of 56 kilobytes per second (kbps).
- Comments: Sixty percent of users use a 56 kbps connection speed or slower. The remaining users have faster connection speeds (ISDN, DSL, Cable, T1, etc.). Actual connection speeds are about 38% lower than modem speed capability. This means that users with a 56 kbps connection actually have a connection averaging about 35 kbps. If you have data indicating that most, if not all, of your users have slower or faster connection speeds than 56K, determine what is appropriate.

Reduce Downloading Time

- Create Web pages that load quickly.
- Comments: Miller and (later) Schneiderman recommended that the computer should respond to simple user entries within two seconds. Recent studies have reported that with data entry tasks there is no advantage of having response times faster than one second. Ideally, pages should download in two seconds or less.
- A study reported that Web users rated download times as follows:
    - Good - Up to 5 seconds
    - Average - From 6 to 10 seconds
    - Poor - Over 10 seconds
- The overall average time users were willing to wait before pressing an "Increase Quality" button was 8.6 seconds. Users' tolerance for delays

decreased as the length of time they spent interacting with the system increased. There was no relationship between computer response time and errors. If the delay is too long, users may not wait for pages to download. Users will wait about 10 seconds for a page to download, sometimes 15 seconds, before they lose interest. Progress indicators should be provided when users must wait over 10 seconds. Slow download times may result from too many graphics, inappropriate use of applets (when dynamic HTML would work as well), and slow server performance.

Consider Monitor Size

- Design for computers with 17-inch monitors with screen resolutions of 800 x 600 pixels.
- Comments: About 40% of users use 17-inch monitors; 26% use smaller monitors (including laptops); and 34% use larger monitors.

Identify Users' Screen Resolution

Design for Full or Partial Screen Viewing

- Consider whether a Web site will be used "full screen" or as a "partial screen" (where two or more browsers are open at once) by the majority of your users. If most users use "full screen," fill all the available design space and do not leave white space on the left or right.
- Comments: If the majority of users view their pages in full-screen mode, then designers should determine the size of the available space and make full use of it. Currently, most people view Web pages at a resolution of 800 x 600 pixels, which translates to a design space of about 780 pixels. In some cases, designers may want to provide pages that stretch to cover the entire page size (i.e., flexible pages).

A.11 ACCESIBILITY

Use Color Wisely

- Do not rely on color alone to communicate a message.
- Comments: Ensure that text and graphics are understandable when viewed without color. If designers depend on color to convey information, colorblind users and users with devices that have noncolor or nonvisual displays cannot receive the information. When foreground and background colors are close to the same hue, they may provide insufficient contrast on monochrome displays and for people with certain types of color deficits.

Design for Device Independence

- Design for device independence by using features that enable activation of page elements by a variety of input devices.
- Comments: Users should be able to interact with the Web site using a preferred input (or output) device. The input device may be a mouse, keyboard, voice, head wand, etc.

Provide Alternative Formats

- Provide equivalent alternatives to visual and auditory content for users who don't have the appropriate software or text readers.
- Comments: Some users cannot use images, movies, sounds, applets, etc. directly, but they may still use pages that include information equivalent to this visual or to the sound of auditory content.
- Use the HTML "alt" tag for giving users a simple text description of a visual element.

- Provide detailed text descriptions for visual content (for example, a chart or diagram) or auditory content
- Consider providing nontext equivalents of text for nonreaders or users who have difficulty reading.

Provide Redundant Text Links

- Provide redundant text links for each active region of an image map.
- Comments: If users' software cannot see an image, they cannot select the image itself or parts of the image.

Provide User-Controlled Content

- Allow users to control time-sensitive content changes, so they can pause or stop moving, blinking, scrolling, or auto-updating of objects or pages.
- Comments: Users with physical disabilities may not be able to read quickly or accurately enough to interact with moving text or objects. Some users with cognitive or visual disabilities are unable to read moving text quickly. For some users with cognitive disabilities, any movement can cause such distraction that the rest of the page becomes unreadable. In addition, screen readers are unable to read moving text.

APPENDIX B HEURISTIC EVALUATION SYSTEM CHECKLIST

B.1 VISIBILITY OF SYSTEM STATUS

The system should always keep user informed about what is going on, through appropriate feedback within reasonable time.

Table B.1 Visibility of system status

#	Review Checklist	Yes	No	N/A	Comments
1.1	Does every display begin with a title or header that describes screen contents?	x	O	O	
1.2	Is there a consistent icon design scheme and stylistic treatment across the system?	x	O	O	
1.3	Is a single, selected icon clearly visible when surrounded by unselected icons?	O	O	O	
1.4	Do menu instructions, prompts, and error messages appear in the same place(s) on each menu?	x	O	O	Screenshot c.2.c
1.5	In multipage data entry screens, is each page labeled to show its relation to others?	O	O	x	Screenshot c.2.f
1.6	If overtype and insert mode are both available, is there a visible indication of which one the user is in?	O	x	O	
1.7	If pop-up windows are used to display error messages, do they allow the user to see the field in error?	O	O	x	
1.8	Is there some form of system feedback for every operator action?	O	O	O	
1.9	After the user completes an action (or group of actions), does the feedback indicate that the next group of actions can be started?	O	O	O	
1.10	Is there visual feedback in menus or dialog boxes about which choices are selectable?	O	x	O	
1.11	Is there visual feedback in menus or dialog boxes about which choice the cursor is on now?	x	O	O	
1.12	If multiple options can be selected in a menu or dialog box, is there visual feedback about which options are already selected?	O	x	O	
1.13	Is there visual feedback when objects are selected or moved?	O	x	O	Screenshot c.2.d

#	Review Checklist	Yes	No	N/A	Comments
1.14	Is the current status of an icon clearly indicated?	O	x	O	
1.15	Is there feedback when function keys are pressed?	O	x	O	Screenshot c.2.e
1.16	If there are observable delays (greater than fifteen seconds) in the system's response time, is the user kept informed of the system's progress?	O	x	O	
1.17	Are response times appropriate to the task?	O	O	O	
1.18	Typing, cursor motion, mouse selection: 50-1 50 milliseconds	O	O	O	
1.19	Simple, frequent tasks: less than 1 second	O	O	O	
1.20	Common tasks: 2-4 seconds	O	O	O	
1.21	Complex tasks: 8-12 seconds	O	O	O	
1.22	Are response times appropriate to the user's cognitive processing?	O	O	O	Seems to be ok.
1.23	Continuity of thinking is required and information must be remembered throughout several responses: less than two seconds.	O	O	O	
1.24	High levels of concentration aren't necessary and remembering information is not required: two to fifteen seconds.	O	O	O	
1.25	Is the menu-naming terminology consistent with the user's task domain?	x	O	O	
1.26	Does the system provide *visibility:* that is, by looking, can the user tell the state of the system and the alternatives for action?	O	x	O	
1.27	Do GUI menus make obvious which item has been selected?	O	x	O	Screenshot c.2.i
1.28	Do GUI menus make obvious whether deselection is possible?	O	O	O	Screenshot c.2.j
1.29	If users must navigate between multiple screens, does the system use context labels, menu maps, and place markers as navigational aids?	O	x	O	Screenshot c.2.k

Table B.1 (ctd.) Visibility of system status

B.2 MATCH BETWEEN SYSTEM AND THE REAL WORLD

The system should speak the user's language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.

Table B.2 Match between system and the real world

#	Review Checklist	Yes	No	N/A	Comments
2.1	Are icons concrete and familiar?	x	O	O	
2.2	Are menu choices ordered in the most logical way, given the user, the item names, and the task variables?	x	O	O	
2.3	If there is a natural sequence to menu choices, has it been used?	O	O	O	
2.4	Do related and interdependent fields appear on the same screen?	x	O	O	
2.5	If shape is used as a visual cue, does it match cultural conventions?	x	O	O	
2.6	Do the selected colors correspond to common expectations about color codes?	x	O	O	
2.7	When prompts imply a necessary action, are the words in the message consistent with that action?	O	x	O	Screenshot c.2.e
2.8	Do keystroke references in prompts match actual key names?	x	O	O	
2.9	On data entry screens, are tasks described in terminology familiar to users?	x	O	O	
2.10	Are field-level prompts provided for data entry screens?				
2.11	For question and answer interfaces, are questions stated in clear, simple language?	x	O	O	
2.12	Do menu choices fit logically into categories that have readily understood meanings?	x	O	O	
2.13	Are menu titles parallel grammatically?	x	O	O	
2.14	Does the command language employ user jargon and avoid computer jargon?	x	O	O	
2.15	Are command names specific rather than general?	x	O	O	Screenshot c.2.m
2.16	Does the command language allow both full names and abbreviations?	x	O	O	Screenshot c.2.n

#	Review Checklist	Yes	No	N/A	Comments
2.17	Are input data codes meaningful?	x	O	O	Screenshot c.2.o
2.18	Have uncommon letter sequences been avoided whenever possible?	x	O	O	
2.19	Does the system automatically enter leading or trailing spaces to align decimal points?	O	O	O	
2.20	Does the system automatically enter a dollar sign and decimal for monetary entries?	O	O	x	
2.21	Does the system automatically enter commas in numeric values greater than 9999?	O	x	O	
2.22	Do GUI menus offer activation: that is, make obvious how to say “now do it"?	O	O	O	
2.23	Has the system been designed so that keys with similar names do not perform opposite (and potentially dangerous) actions?	x	O	O	
2.24	Are function keys labeled clearly and distinctively, even if this means breaking consistency rules?	x	O	O	

Table B.2 (ctd.) Match betwwen the system and the real world

B.3 USER CONTROL AND FREEDOM

Users should be free to select and sequence tasks (when appropriate), rather than having the system do this for them. Users often choose system functions by mistake and will need a clearly marked “emergency exit” to leave the unwanted state without having to go through an extended dialogue. Users should make their own decisions (with clear information) regarding the costs of exiting current work. The system should support undo and redo.

Table B.3 User Control and freedom

#	Review Checklist	Yes	No	N/A	Comments
3.1	If setting up windows is a low-frequency task, is it particularly easy to remember?	O	O	O	
3.2	In systems that use overlapping windows, is it easy for users to rearrange windows on the screen?	x	O	O	
3.3	In systems that use overlapping windows, is it easy for users to switch between windows?	x	O	O	
3.4	When a user's task is complete, does the system wait for a signal from the user before processing?	x	O	O	
3.5	Can users type-ahead in a system with many nested menus?	O	O	O	
3.6	Are users prompted to confirm commands that have drastic, destructive consequences?	O	O	x	
3.7	Is there an "undo" function at the level of a single action, a data entry, and a complete group of actions?	x	O	O	
3.8	Can users cancel out of operations in progress?	O	O	O	
3.9	Are character edits allowed in commands?	O	O	x	
3.10	Can users reduce data entry time by copying and modifying existing data?	O	x	O	

#	Review Checklist	Yes	No	N/A	Comments
3.11	Are character edits allowed in data entry fields?	O	O	x	
3.12	If menu lists are long (more than seven items), can users select an item either by moving the cursor or by typing a mnemonic code?	x	O	O	
3.13	If the system uses a pointing device, do users have the option of either clicking on menu items or using a keyboard shortcut?	x	O	O	
3.14	Are menus broad (many items on a menu) rather than deep (many menu levels)?	x	O	O	
3.15	If the system has multiple menu levels, is there a mechanism that allows users to go back to previous menus?	O	O	x	
3.16	If users can go back to a previous menu, can they change their earlier menu choice?	x	O	O	
3.17	Can users move forward and backward between fields or dialog box options?	x	O	O	
3.18	If the system has multipage data entry screens, can users move backward and forward among all the pages in the set?	x	O	O	
3.19	If the system uses a question and answer interface, can users go back to previous questions or skip forward to later questions?	O	x	O	
3.20	Do function keys that can cause serious consequences have an undo feature?	O	x	O	
3.21	Can users easily reverse their actions?	O	x	O	
3.22	If the system allows users to reverse their actions, is there a retracing mechanism to allow for multiple undos?	O	O	x	
3.23	Can users set their own system, session, file, and screen defaults?	O	x	O	

Table B.3 (ctd.) User Control and freedom

B.4 CONSISTENCY AND STANDARDS

Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.

Table B.4 Consistency and Standards

#	Review Checklist	Yes	No	N/A	Comments
4.1	Have industry or Company formatting standards been followed consistently in all screens within a system?	x	O	O	
4.2	Has a heavy use of all uppercase letters on a screen been avoided?	x	O	O	
4.3	Do abbreviations not include punctuation?	x	O	O	
4.4	Are integers right-justified and real numbers decimal-aligned?	O	O	O	
4.5	Are icons labeled?	x	O	O	
4.6	Are there no more than twelve to twenty icon types?	x	O	O	
4.7	Are there salient visual cues to identify the active window?	O	x	O	
4.8	Does each window have a title?	x	O	O	
4.9	Are vertical and horizontal scrolling possible in each window?	x	O	O	
4.10	Does the menu structure match the task structure?	x	O	O	
4.11	Have industry or Company standards been established for menu design, and are they applied consistently on all menu screens in the system?	x	O	O	
4.12	Are menu choice lists presented vertically?	x	O	O	

#	Review Checklist	Yes	No	N/A	Comments
4.13	If "exit" is a menu choice, does it always appear at the bottom of the list?	O	O	x	
4.14	Are menu titles either centered or left-justified?	x	O	O	
4.15	Are menu items left-justified, with the item number or mnemonic preceding the name?	O	x	O	
4.16	Do embedded field-level prompts appear to the right of the field label?	O	O	x	
4.17	Do on-line instructions appear in a consistent location across screens?	x	O	O	
4.18	Are field labels and fields distinguished typographically?	x	O	O	
4.19	Are field labels consistent from one data entry screen to another?	x	O	O	
4.20	Are fields and labels left-justified for alpha lists and right-justified for numeric lists?	x	O	O	
4.21	Do field labels appear to the left of single fields and above list fields?	x	O	O	
4.22	Are attention-getting techniques used with care?	x	O	O	
4.23	Intensity: two levels only	x	O	O	
4.24	Size: up to four sizes	x	O	O	
4.25	Font: up to three	x	O	O	
4.26	Blink: two to four hertz	x	O	O	
4.27	Color: up to four (additional colors for occasional use only)	x	O	O	
4.28	Sound: soft tones for regular positive feedback, harsh for rare critical conditions	x	O	O	
4.29	Are attention-getting techniques used only for exceptional conditions or for time-dependent information?	O	O	O	Attention getting techniques are not used, for orders for example.
4.30	Are there no more than four to seven colors, and are they far apart along the visible spectrum?	x	O	O	
4.31	Is a legend provided if color codes are numerous or not obvious in meaning?	x	O	O	
4.32	Have pairings of high-chroma, spectrally extreme colors been avoided?	x	O	O	
4.33	Are saturated blues avoided for text or other small, thin line symbols?	O	x	O	
4.34	Is the most important information placed at the beginning of the prompt?	x	O	O	
4.35	Are user actions named consistently across all prompts in the system?	O	O	O	
4.36	Are system objects named consistently across all prompts in the system?	x	O	O	
4.37	Do field-level prompts provide more information than a restatement of the field name?	O	O	O	

#	Review Checklist	Yes	No	N/A	Comments
4.38	For question and answer interfaces, are the valid inputs for a question listed?	O	x	O	
4.39	Are menu choice names consistent, both within each menu and across the system, in grammatical style and terminology?	x	O	O	
4.40	Does the structure of menu choice names match their corresponding menu titles?	x	O	O	
4.41	Are commands used the same way, and do they mean the same thing, in all parts of the system?	x	O	O	
4.42	Does the command language have a consistent, natural, and mnemonic syntax?	x	O	O	
4.43	Do abbreviations follow a simple primary rule and, if necessary, a simple secondary rule for abbreviations that otherwise would be duplicates?	x	O	O	
4.44	Is the secondary rule used only when necessary?	O	O	O	
4.45	Are abbreviated words all the same length?	O	x	O	
4.46	Is the structure of a data entry value consistent from screen to screen?	x	O	O	
4.47	Is the method for moving the cursor to the next or previous field consistent throughout the system?	x	O	O	
4.48	If the system has multipage data entry screens, do all pages have the same title?	O	x	O	
4.49	If the system has multipage data entry screens, does each page have a sequential page number?	O	x	O	
4.50	Does the system follow industry or Company standards for function key assignments?	O	O	O	
4.51	Are high-value, high-chroma colors used to attract attention?	O	x	O	

Table B.4 Consistency and standards

B.5 HELP USERS RECOGNIZE, DIAGNOSE, AND RECOVER FROM ERRORS

Error messages should be expressed in plain language (NO CODES).

Table B.5 Error recovery

#	Review Checklist	Yes	No	N/A	Comments
5.1	Is sound used to signal an error?	O	x	O	
5.2	Are prompts stated constructively, without overt or implied criticism of the user?	O	x	O	
5.3	Do prompts imply that the user is in control?	O	x	O	
5.4	Are prompts brief and unambiguous?	x	O	O	
5.5	Are error messages worded so that the system, not the user, takes the blame?	x	O	O	
5.6	If humorous error messages are used, are they appropriate and inoffensive to the user population?	O	O	x	
5.7	Are error messages grammatically correct?	x	O	O	
5.8	Do error messages avoid the use of exclamation points?	O	O	O	
5.9	Do error messages avoid the use of violent or hostile words?	x	O	O	
5.10	Do error messages avoid an anthropomorphic tone?	x	O	O	
5.11	Do all error messages in the system use consistent grammatical style, form, terminology, and abbreviations?	O	x	O	
5.12	Do messages place users in control of the system?	O	x	O	
5.13	Does the command language use normal action-object syntax?	x	O	O	
5.14	Does the command language avoid arbitrary, non-English use of punctuation, except for symbols that users already know?	x	O	O	

5.15	If an error is detected in a data entry field, does the system place the cursor in that field or highlight the error?	O x O	
5.16	Do error messages inform the user of the error's severity?	O x O	
5.17	Do error messages suggest the cause of the problem?	O x O	
5.18	Do error messages provide appropriate semantic information?	x O O	
5.19	Do error messages provide appropriate syntactic information?	x O O	
5.20	Do error messages indicate what action the user needs to take to correct the error?	x O O	
5.21	If the system supports both novice and expert users, are multiple levels of error-message detail available?	O O x	

B.6 ERROR PREVENTION

Even better than good error messages is a careful design which prevents a problem from occurring in the first place.

Tbale B.6 Error Prevention

#	Review Checklist	Yes	No	N/A	Comments
6.1	If the database includes groups of data, can users enter more than one group on a single screen?	O	x	O	
6.2	Have dots or underscores been used to indicate field length?	O	x	O	
6.3	Is the menu choice name on a higher-level menu used as the menu title of the lower-level menu?	x	O	O	
6.4	Are menu choices logical, distinctive, and mutually exclusive?	x	O	O	
6.5	Are data inputs case-blind whenever possible?	x	O	O	
6.6	If the system displays multiple windows, is navigation between windows simple and visible?	O	x	O	
6.7	Are the function keys that can cause the most serious consequences in hard-to-reach positions?	x	O	O	
6.8	Are the function keys that can cause the most serious consequences located far away from low-consequence and high-use keys?	x	O	O	
6.9	Has the use of qualifier keys been minimized?	O	O	O	
6.10	If the system uses qualifier keys, are they used consistently throughout the system?	O	O	O	
6.11	Does the system prevent users from making errors whenever possible?	O	x	O	
6.12	Does the system warn users if they are about to make a potentially serious error?	x	O	O	
6.13	Does the system intelligently interpret variations in user commands?	O	x	O	
6.14	Do data entry screens and dialog boxes indicate the number of character spaces available in a field?	O	x	O	
6.15	Do fields in data entry screens and dialog boxes contain default values when appropriate?	O	x	O	

B.7 RECOGNITION RATHER THAN RECALL

Make objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.

Table B.7 Recognition rather than Recall

#	Review Checklist	Yes	No	N/A	Comments
7.1	For question and answer interfaces, are visual cues and white space used to distinguish questions, prompts, instructions, and user input?	O	O	O	
7.2	Does the data display start in the upper-left corner of the screen?	x	O	O	
7.3	Are multiword field labels placed horizontally (not stacked vertically)?	x	O	O	
7.4	Are all data a user needs on display at each step in a transaction sequence?	O	O	O	
7.5	Are prompts, cues, and messages placed where the eye is likely to be looking on the screen?	x	O	O	
7.6	Have prompts been formatted using white space, justification, and visual cues for easy scanning?	O	x	O	Production plan presentation is poor
c7.7	Do text areas have "breathing space" around them?	O	x	O	Menus sre insufficient
7.8	Is there an obvious visual distinction made between "choose one" menu and "choose many" menus?	O	x	O	
7.9	Have spatial relationships between soft function keys (on-screen cues) and keyboard function keys been preserved?	O	x	O	
7.10	Does the system gray out or delete labels of currently inactive soft function keys?	O	x	O	
7.11	Is white space used to create symmetry and lead the eye in the appropriate direction?	x	O	O	
7.12	Have items been grouped into logical zones, and have headings been used to distinguish between zones?	x	O	O	

#	Review Checklist	Yes	No	N/A	Comments
7.13	Are zones no more than twelve to fourteen characters wide and six to seven lines high?	x	O	O	
7.14	Have zones been separated by spaces, lines, color, letters, bold titles, rules lines, or shaded areas?	O	O	O	Screenshot c.2.y
7.15	Are field labels close to fields, but separated by at least one space?	O	x	O	Too seperated.
7.16	Are long columnar fields broken up into groups of five, separated by a blank line?	O	O	O	Screenshot c.2.z
7.17	Are optional data entry fields clearly marked?	x	O	O	
7.18	Are symbols used to break long input strings into "chunks"?	O	O	O	?
7.19	Is reverse video or color highlighting used to get the user's attention?	O	x	O	
7.20	Is reverse video used to indicate that an item has been selected?	O	x	O	
7.21	Are size, boldface, underlining, color, shading, or typography used to show relative quantity or importance of different screen items?	x	O	O	
7.22	Are borders used to identify meaningful groups?	x	O	O	
7.23	Has the same color been used to group related elements?	x	O	O	
7.24	Is color coding consistent throughout the system?	x	O	O	
7.25	Is color used in conjunction with some other redundant cue?	x	O	O	
7.26	Is there good color and brightness contrast between image and background colors?	x	O	O	
7.27	Have light, bright, saturated colors been used to emphasize data and have darker, duller, and desaturated colors been used to de-emphasize data?	O	O	O	
7.28	Is the first word of each menu choice the most important?	x	O	O	
7.29	Does the system provide *mapping:* that is, are the relationships between controls and actions apparent to the user?	O	x	O	
7.30	Are input data codes distinctive?	O	O	O	
7.31	Have frequently confused data pairs been eliminated whenever possible?	O	O	O	
7.32	Have large strings of numbers or letters been broken into chunks?	O	O	O	
7.33	Are inactive menu items grayed out or omitted?	O	x	O	
7.34	Are there menu selection defaults?	O	O	O	
7.35	If the system has many menu levels or complex menu levels, do users have access to an on-line spatial menu map?	O	x	O	
7.36	Do GUI menus offer affordance: that is, make obvious where selection is possible?	O	x	O	

#	Review Checklist	Yes	No	N/A	Comments
7.37	Are there salient visual cues to identify the active window?	x	O	O	
7.38	Are function keys arranged in logical groups?	x	O	O	
7.39	Do data entry screens and dialog boxes indicate when fields are optional?	x	O	O	
7.40	On data entry screens and dialog boxes, are dependent fields displayed only when necessary?	O	O	O	?

B.8 FLEXIBILITY AND MINIMALIST DESIGN

Accelerators-unseen by the novice user-may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions. Provide alternative means of access and operation for users who differ from the “average” user (e.g., physical or cognitive ability, culture, language, etc.)

Table B.8 Flexibility and minimalist design

#	Review Checklist	Yes	No	N/A	Comments
8.1	If the system supports both novice and expert users, are multiple levels of error message detail available?	O	x	O	
8.2	Does the system allow novices to use a keyword grammar and experts to use a positional grammar?	O	x	O	
8.3	Can users define their own synonyms for commands?	O	x	O	
8.4	Does the system allow novice users to enter the simplest, most common form of each command, and allow expert users to add parameters?	O	x	O	
8.5	Do expert users have the option of entering multiple commands in a single string?	O	x	O	
8.6	Does the system provide function keys for high-frequency commands?	O	x	O	
8.7	For data entry screens with many fields or in which source documents may be incomplete, can users save a partially filled screen?	O	x	O	
8.8	Does the system automatically enter leading zeros?	O	x	O	
8.9	If menu lists are short (seven items or fewer), can users select an item by moving the cursor?	x	O	O	
8.10	If the system uses a type-ahead strategy, do the menu items have mnemonic codes?	O	O	O	
8.11	If the system uses a pointing device, do users have the option of either clicking on fields or using a keyboard shortcut?	O	x	O	
8.12	Does the system offer "find next" and "find previous" shortcuts for database searches?	O	x	O	
8.13	On data entry screens, do users have the option of either clicking directly on a field or using a keyboard shortcut?	O	x	O	
8.14	On menus, do users have the option of either clicking directly on a menu item or using a keyboard shortcut?	O	x	O	
8.15	In dialog boxes, do users have the option of either clicking directly on a dialog box option or using a keyboard shortcut?	O	x	O	
8.16	Can expert users bypass nested dialog boxes with either type-ahead, user-defined macros, or keyboard shortcuts?	O	x	O	

B.9 AESTHETIC AND MINIMALIST DESIGN

Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.

Table B.9 Aesthetic

#	Review Checklist	Yes	No	N/A	Comments
9.1	Is only (and all) information essential to decision making displayed on the screen?	x	O	O	
9.2	Are all icons in a set visually and conceptually distinct?	x	O	O	
9.3	Have large objects, bold lines, and simple areas been used to distinguish icons?	x	O	O	
9.4	Does each icon stand out from its background?	x	O	O	
9.5	If the system uses a standard GUI interface where menu sequence has already been specified, do menus adhere to the specification whenever possible?	x	O	O	Larger font view is not available
9.6	Are meaningful groups of items separated by white space?	x	O	O	
9.7	Does each data entry screen have a short, simple, clear, distinctive title?	x	O	O	
9.8	Are field labels brief, familiar, and descriptive?	x	O	O	
9.9	Are prompts expressed in the affirmative, and do they use the active voice?	x	O	O	
9.10	Is each lower-level menu choice associated with only one higher level menu?	x	O	O	
9.11	Are menu titles brief, yet long enough to communicate?	x	O	O	
9.12	Are there pop-up or pull-down menus within data entry fields that have many, but well-defined, entry options?	x	O	O	

B.10 HELP AND DOCUMENTATION

Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.

Table B.10 Help and documentation

#	Review Checklist	Yes	No	N/A	Comments
10.1	If users are working from hard copy, are the parts of the hard copy that go on-line marked?	O	O	O	
10.2	Are on-line instructions visually distinct?	x	O	O	
10.3	Do the instructions follow the sequence of user actions?	x	O	O	
10.4	If menu choices are ambiguous, does the system provide additional explanatory information when an item is selected?	O	x	O	
10.5	Are data entry screens and dialog boxes supported by navigation and completion instructions?	O	x	O	
10.6	If menu items are ambiguous, does the system provide additional explanatory information when an item is selected?	O	x	O	
10.7	Are there memory aids for commands, either through on-line quick reference or prompting?	O	x	O	
10.8	Is the help function visible; for example, a key labeled HELP or a special menu?	O	x	O	Screenshot c.2.za
10.9	Is the help system interface (navigation, presentation, and conversation) consistent with the navigation, presentation, and conversation interfaces of the application it supports?	x	O	O	Screenshot c.2.zb
10.10	Navigation: Is information easy to find?	O	x	O	
10.11	Presentation: Is the visual layout well designed?	O	x	O	
10.12	Conversation: Is the information accurate, complete, and understandable?	O	x	O	

#	Review Checklist	Yes	No	N/A	Comments
10.13	Is the information relevant?	O	O	O	
10.14	Goal-oriented (What can I do with this program?)	O	x	O	!!Important
10.15	Descriptive (What is this thing for?)	x	O	O	
10.16	Procedural (How do I do this task?)	x	O	O	
10.17	Interpretive (Why did that happen?)	O	x	O	
10.18	Navigational (Where am I?)	O	x	O	
10.19	Is there context-sensitive help?	O	x	O	
10.20	Can the user change the level of detail available?	O	x	O	
10.21	Can users easily switch between help and their work?	x	O	O	
10.22	Is it easy to access and return from the help system?	x	O	O	
10.23	Can users resume work where they left off after accessing help?	x	O	O	

B.11 SKILLS

The system should support, extend, supplement, or enhance the user's skills, background knowledge, and expertise ----not replace them.

Table B.11 Skills

#	Review Checklist	Yes No N/A	Comments
11.1	Can users choose between iconic and text display of information?	O x O	
11.2	Are window operations easy to learn and use?	X O O	
11.3	If users are experts, usage is frequent, or the system has a slow response time, are there fewer screens (more information per screen)?	O x O	
11.4	If users are novices, usage is infrequent, or the system has a fast response time, are there more screens (less information per screen)?	O x O	
11.5	Does the system automatically color-code items, with little or no user effort?	X O O	
11.6	If the system supports both novice and expert users, are multiple levels of detail available.	O x O	
11.7	Are users the initiators of actions rather than the responders?	x O O	
11.8	Does the system perform data translations for users?	O x O	
11.9	Do field values avoid mixing alpha and numeric characters whenever possible?	O x O	
11.10	If the system has deep (multilevel) menus, do users have the option of typing ahead?	O x x	No deep menus
11.12	When the user enters a screen or dialog box, is the cursor already positioned in the field users are most likely to need?	O x O	
11.13	Can users move forward and backward within a field?	x O O	
11.14	Is the method for moving the cursor to the next or previous field both simple and visible?	O O x	

11.15	Has auto-tabbing been avoided except when fields have fixed lengths or users are experienced?	x O O	
11.16	Do the selected input device(s) match user capabilities?	O O O	Suppliers' education
11.17	Are cursor keys arranged in either an inverted T (best for experts) or a cross configuration (best for novices)?	O O O	
11.19	Are there enough function keys to support functionality, but not so many that scanning and finding are difficult?	O O O	
11.20	Are function keys reserved for generic, high-frequency, important functions?	O O O	
11.21	Are function key assignments consistent across screens, subsystems, and related products?	x O O	
11.22	Does the system correctly anticipate and prompt for the user's probable next activity?	O x O	

B.12 PLEASURABLE AND RESPECTFUL INTERACTION WITH THE USER

The user's interactions with the system should enhance the quality of her or his work-life. The user should be treated with respect. The design should be aesthetically pleasing- with artistic as well as functional value.

Table B.12 Interaction

#	Review Checklist	Yes	No	N/A	Comments
12.1	Is each individual icon a harmonious member of a family of icons?	x	O	O	
12.2	Has excessive detail in icon design been avoided?	x	O	O	
12.3	Has color been used with discretion?	x	O	O	
12.4	Has the amount of required window housekeeping been kept to a minimum?	x	O	O	
12.5	If users are working from hard copy, does the screen layout match the paper form?	x	O	O	
12.6	Has color been used specifically to draw attention, communicate organization, indicate status changes, and establish relationships?	x	O	O	
12.7	Can users turn off automatic color-coding if necessary?	O	x	O	
12.8	Are typing requirements minimal for question and answer interfaces?	O	x	O	
12.9	Do the selected input device(s) match environmental constraints?	x	O	O	
12.13	If the system uses multiple input devices, has hand and eye movement between input devices been minimized?	O	O	x	
12.14	If the system supports graphical tasks, has an alternative-pointing device been provided?	O	x	O	
12.15	Is the numeric keypad located to the right of the alpha key area?	O	O	x	
12.16	Are the most frequently used function keys in the most accessible positions?	O	O	x	
12.17	Does the system complete unambiguous partial input on a data entry field?	O	x	O	

B.13 PRIVACY

The system should help the user to protect personal or private information- belonging to the user or the his/her clients.

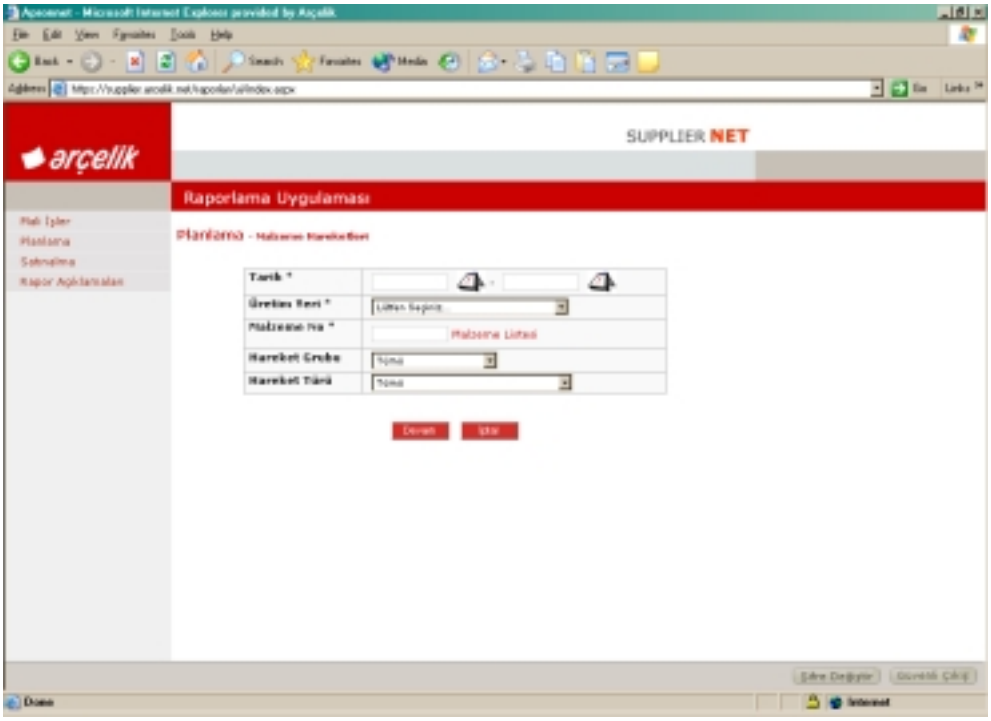
Table B.13 Privacy

#	Review Checklist	Yes	No	N/A	Comments
13.1	Are protected areas completely inaccessible?	x	O	O	
13.2	Can protected or confidential areas be accessed with certain passwords.	O	x	O	
13.3	Is this feature effective and successful.	x	O	O	

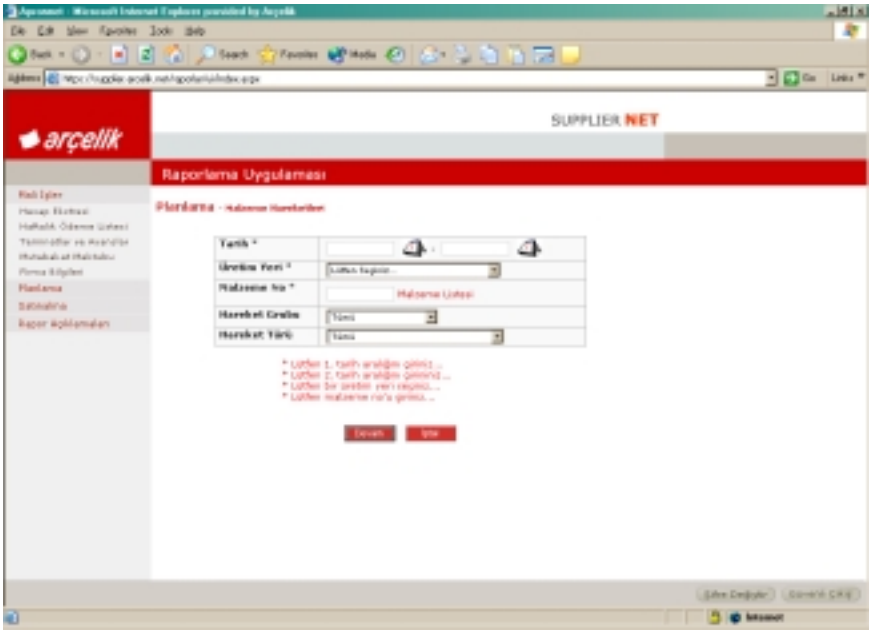
APPENDIX C

CHECKLIST SCREENSHOTS

Below is the screenshots used for the heuristic evaluation carried out with the checklist in App. B.

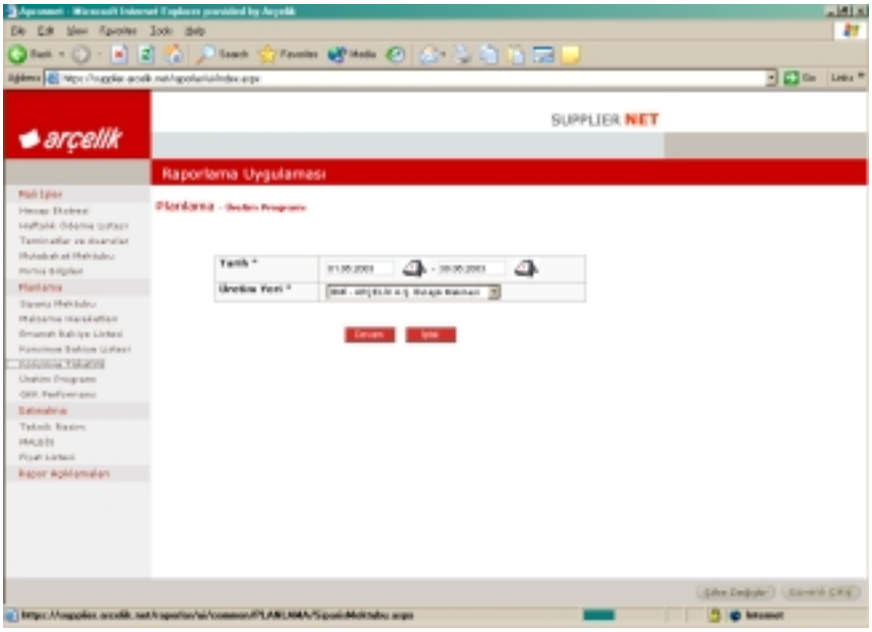


Screenshot C.2.A

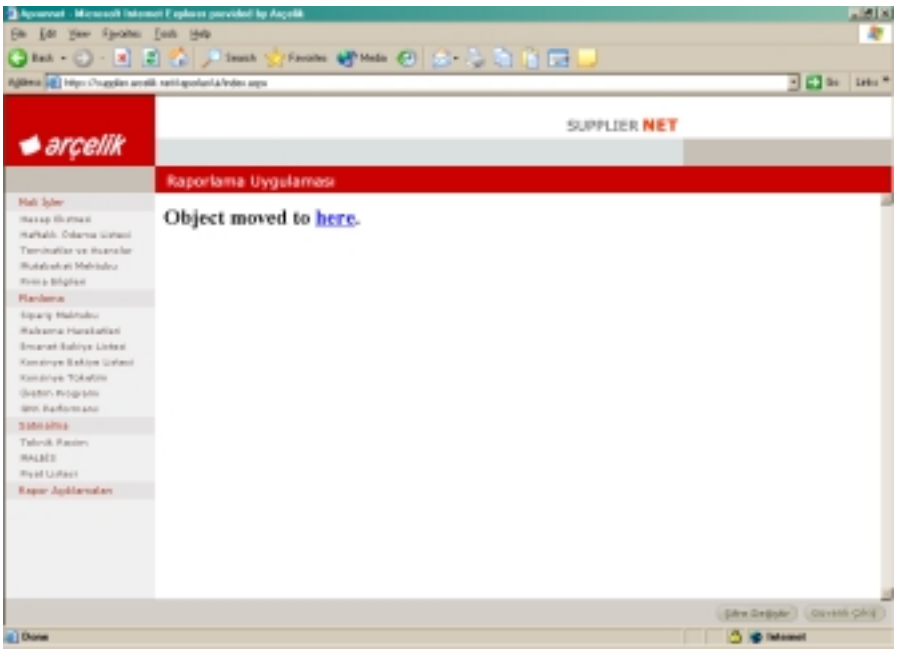


Screenshot C.2.B

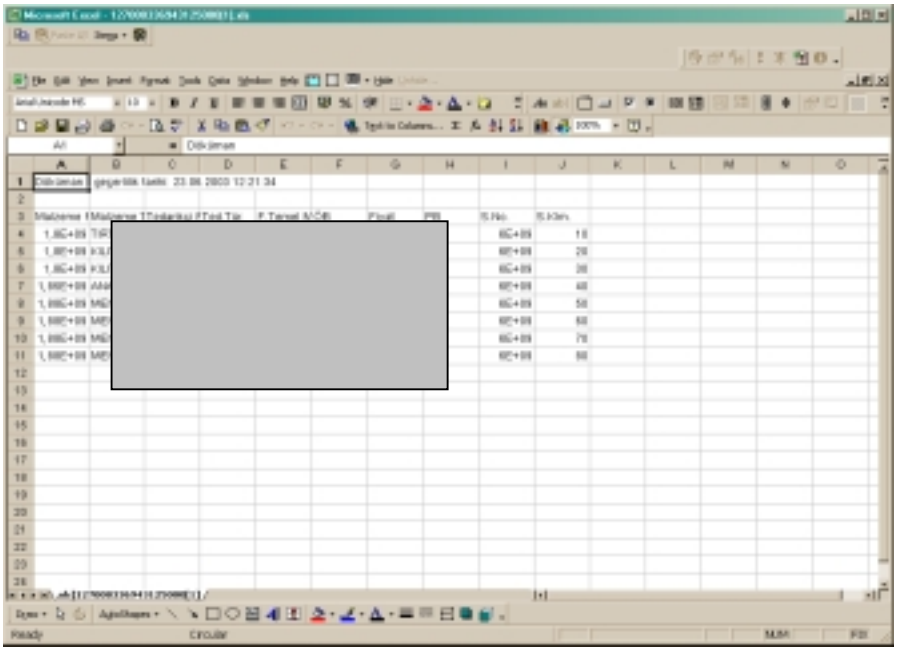
Screenshot C.2.C (1.4)



Screenshot C.2.D (1.13)



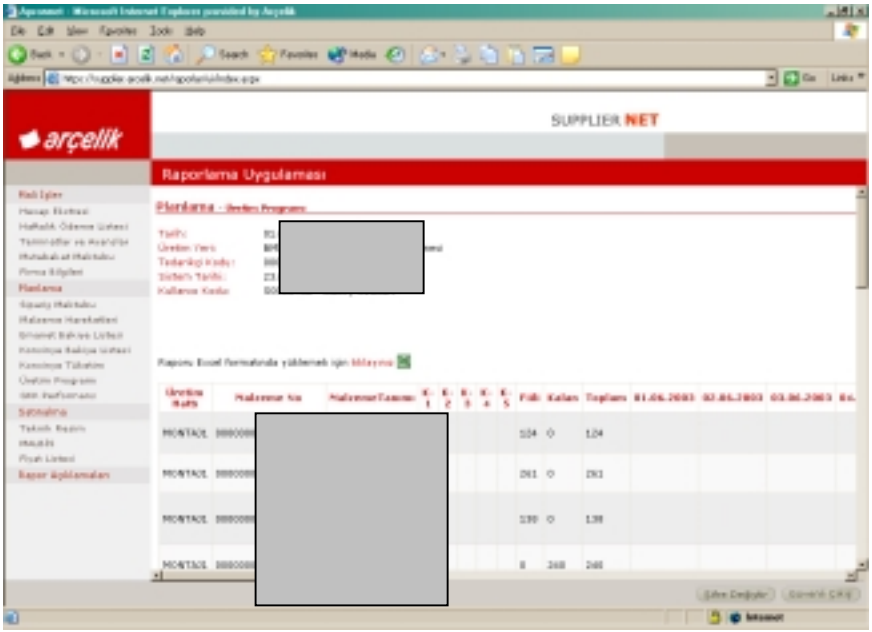
Screenshot C.2.E (1.15---2.7): what is this screen for?



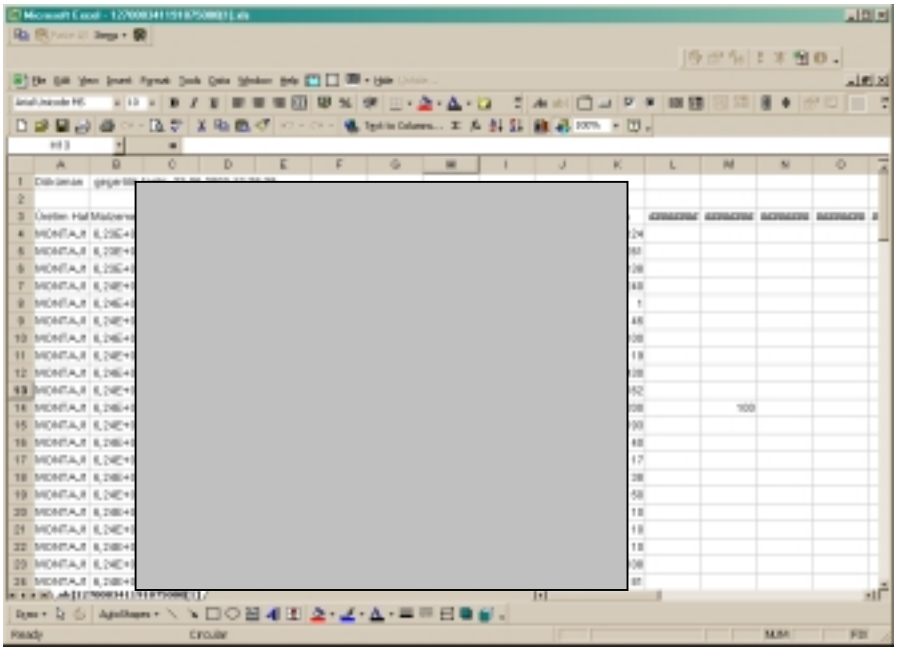
Screenshot C.2.F (1.5): labeling is missing

Screenshot C.2.G: Error warning is not in its usual place in the site.

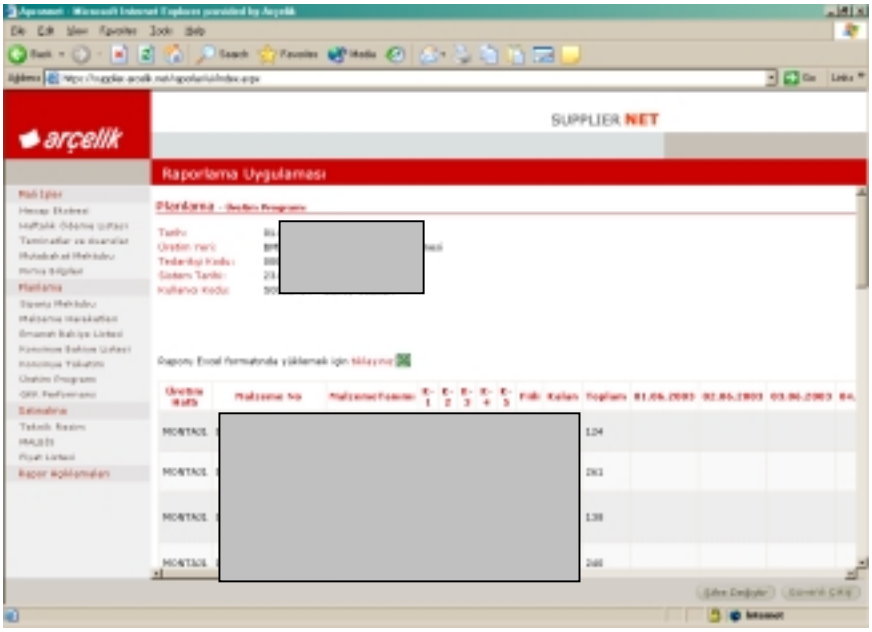
Screenshot C.2.H: no warming when pressed on “Seç”, nothing happens.



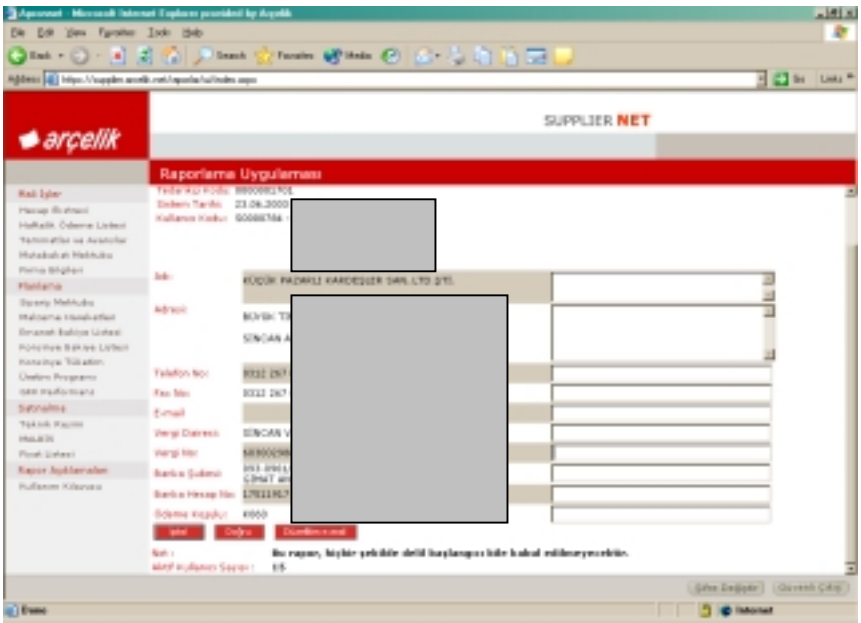
Screenshot C.2.I (1.27)



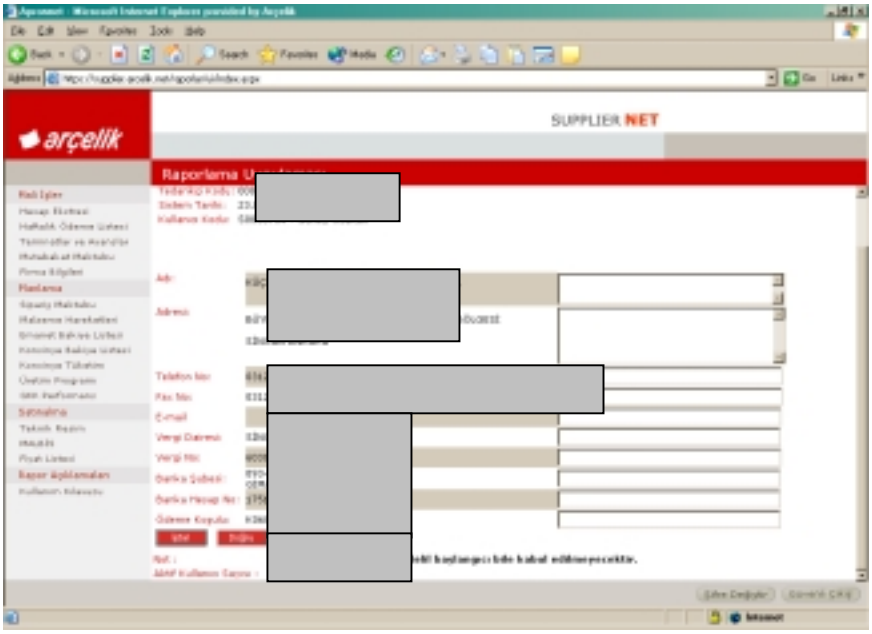
Screenshot C.2.J (1.29)



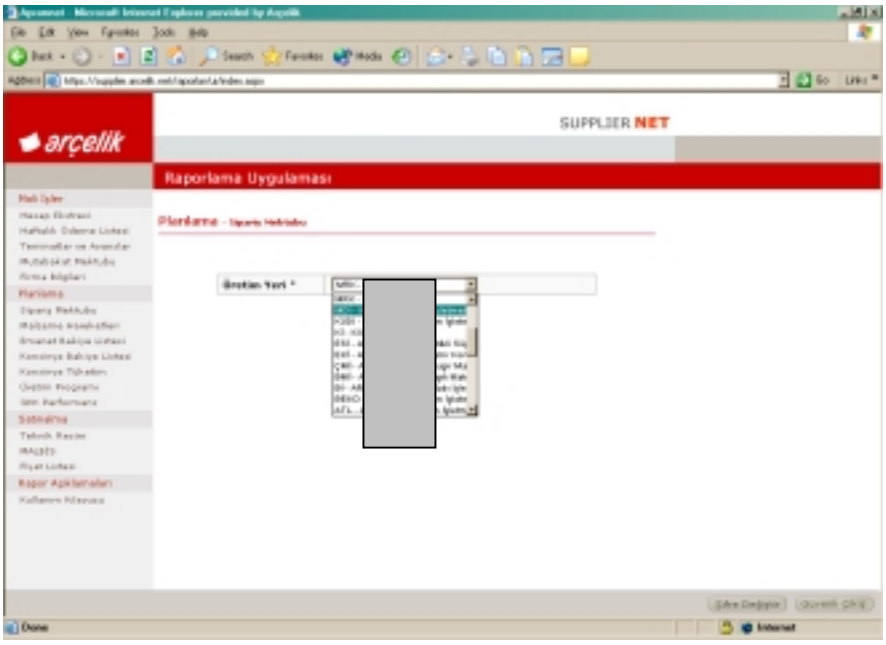
Screenshot C.2.K (1.29): Excel file is open but no indication.



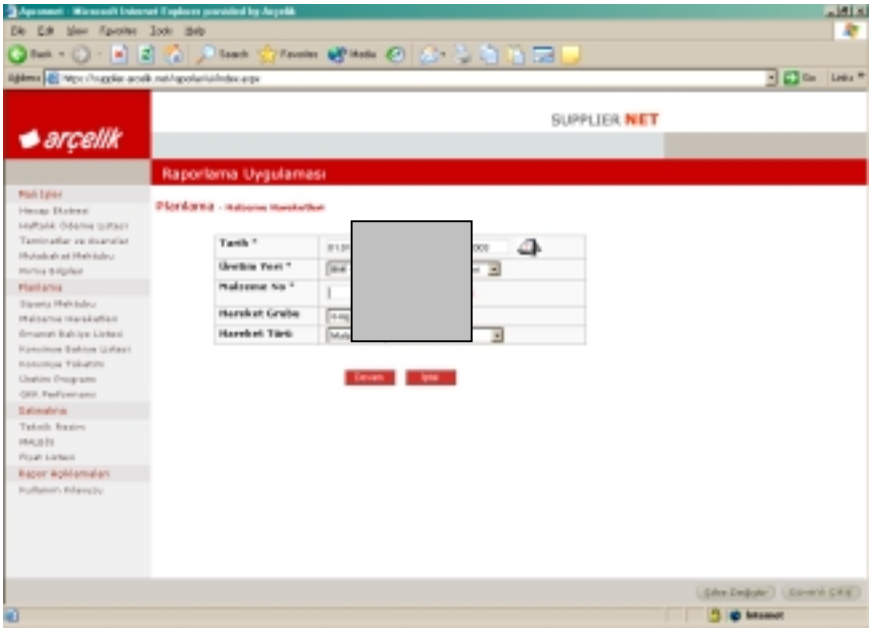
Screenshot C.2.L: what is this screen for, no indication



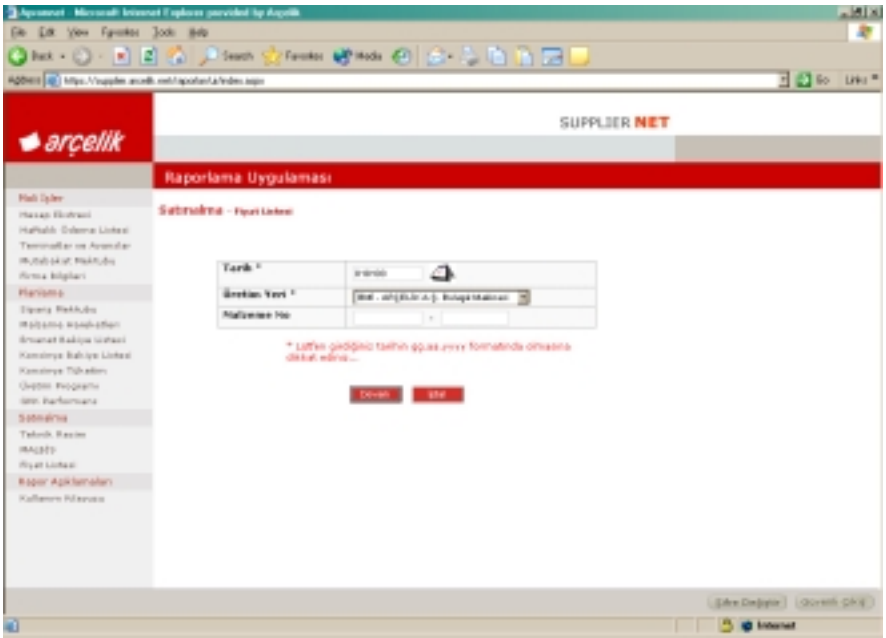
Screenshot C.2.M (2.15)



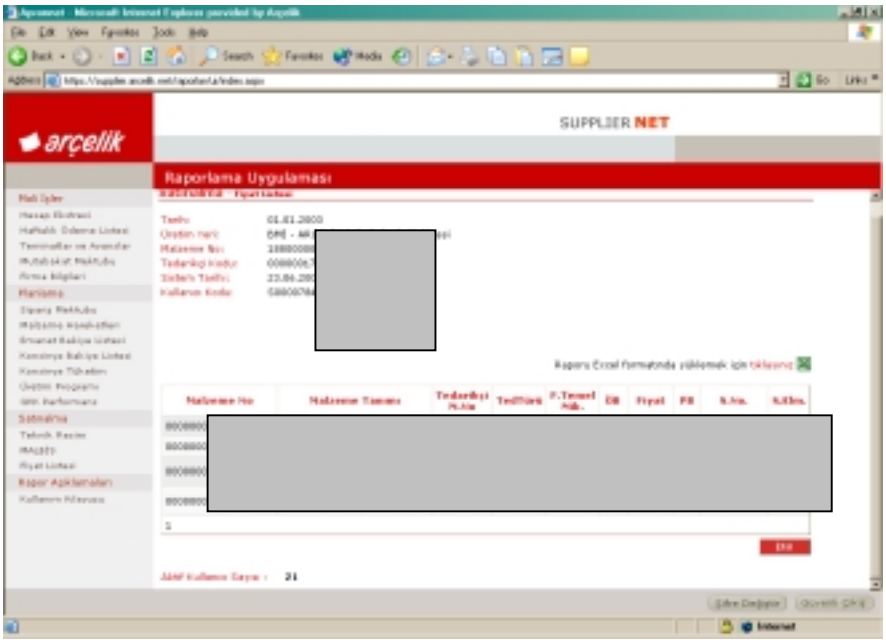
Screenshot C.2.N (2.16)



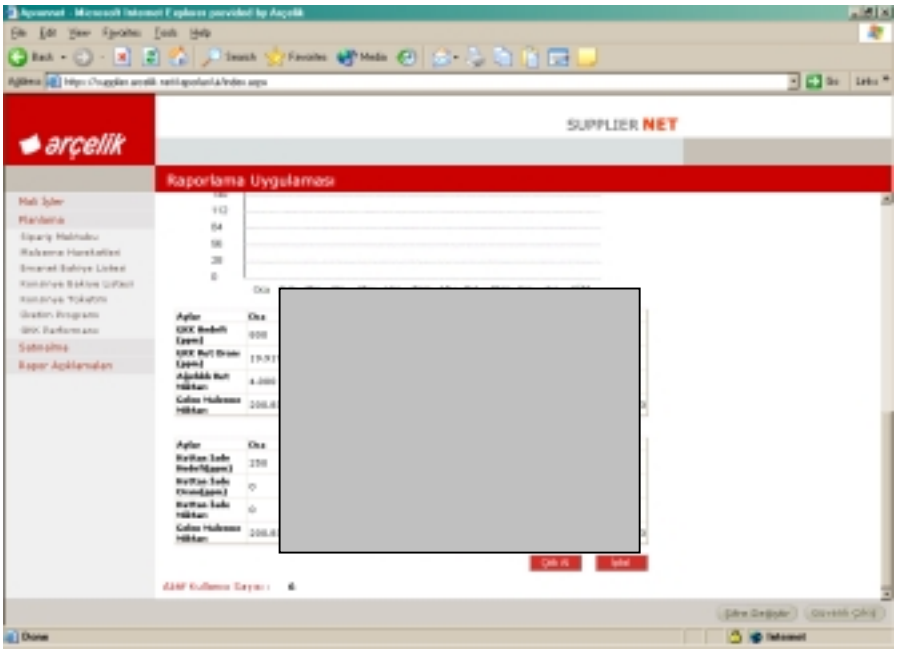
Screenshot C.2.O (2.17): material inventory numbers need to be memorized; however they are always used.



Screenshot C.2.P

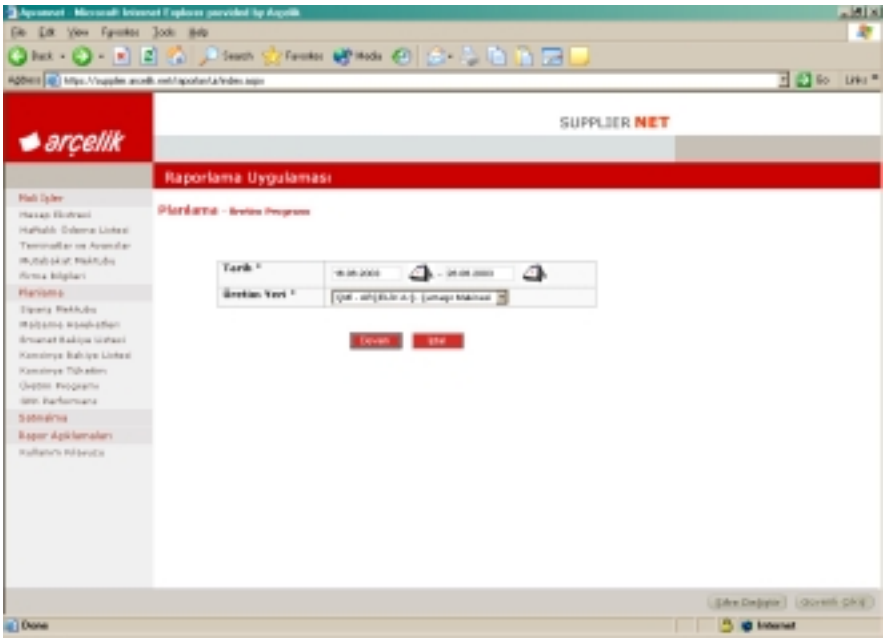


Screenshot C.2.R

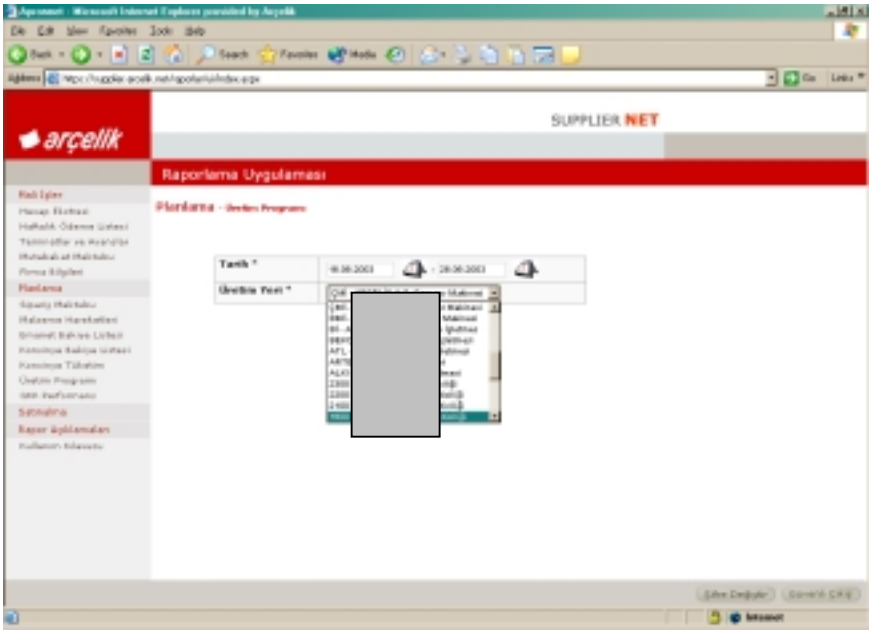


Screenshot C.2.S: When pressed on "İptal" it goes to the starting page, misleading and not expressive.

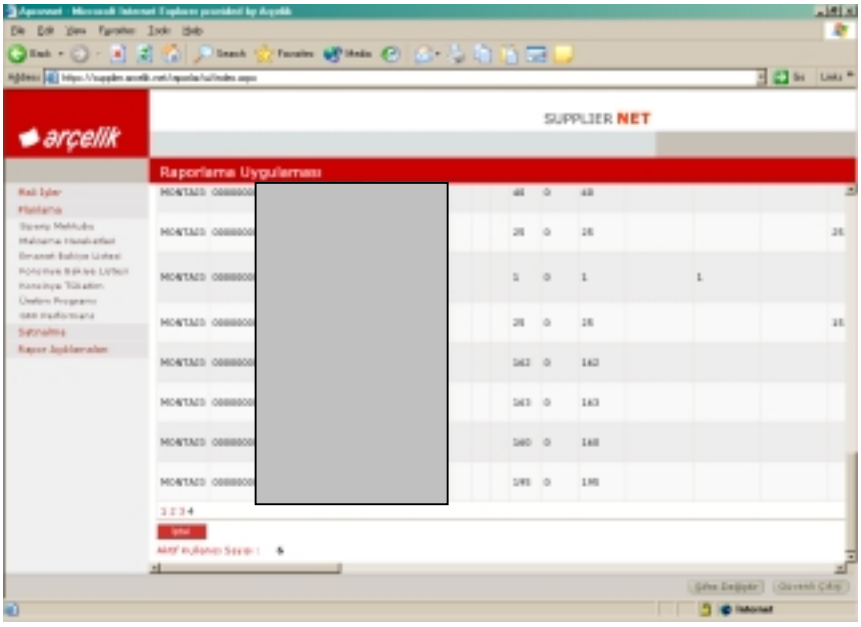
Screenshot C.2.T



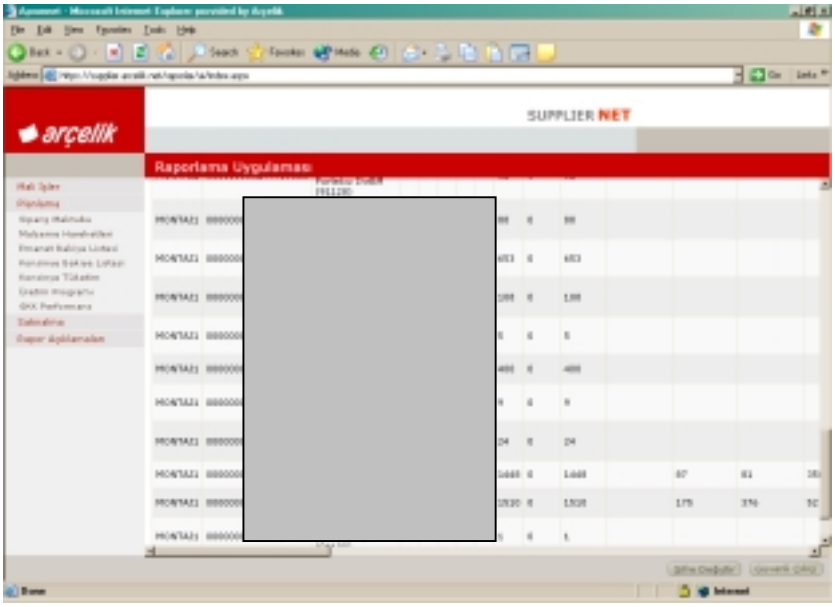
Screenshot C.2.U: nothing comes out!



Screenshot C.2.V (7.13)

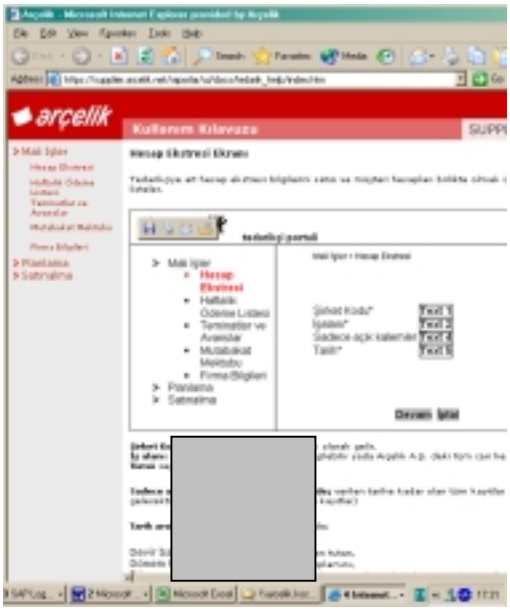


Screenshot C.2.Y

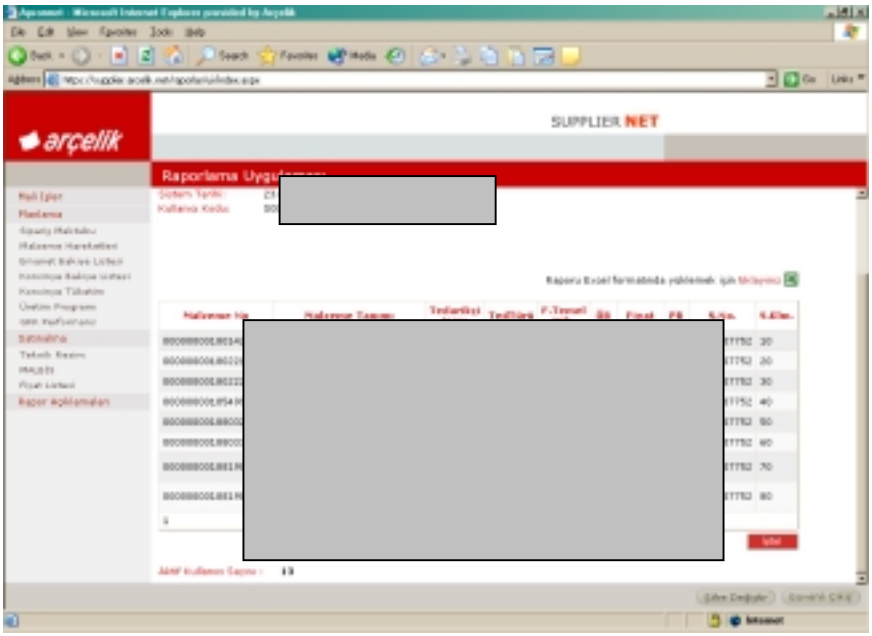


Screenshot C.2.Z (7.29)

Screenshot C.2.ZA (10.8): where is the help?



Screenshot C.2.ZB (10.19): Help function no context sensitive.

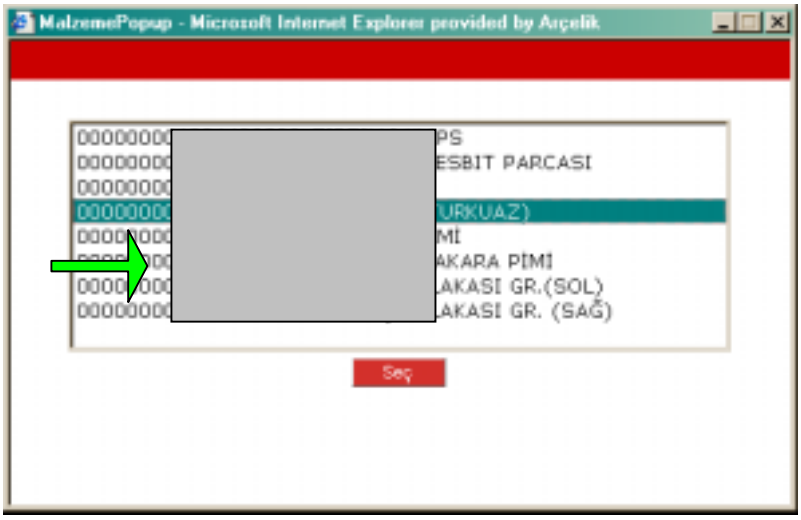


Screenshot C.2. ZC :Abbreviations; alignment is consistent, zeros are unnecessary.

APPENDIX D

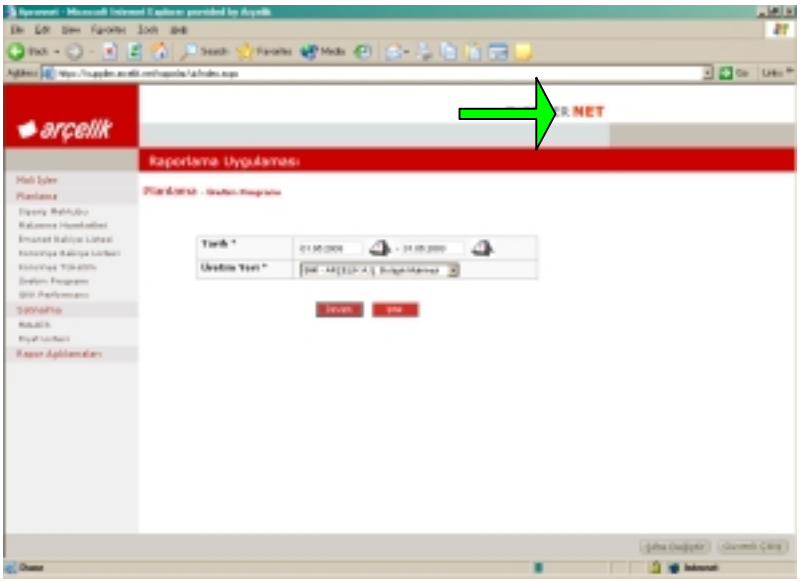
HEURISTIC EVALUATION

There is no need for the user to memorize the materials identity numbers. A menu is provided indicating the numbers and the corresponding materials. The user can select from the menu or can directly enter the identity number if he has it ready. However here there could be a search option, in case of a long list of materials. [i]



Screenshot D.8

Screenshot D.9



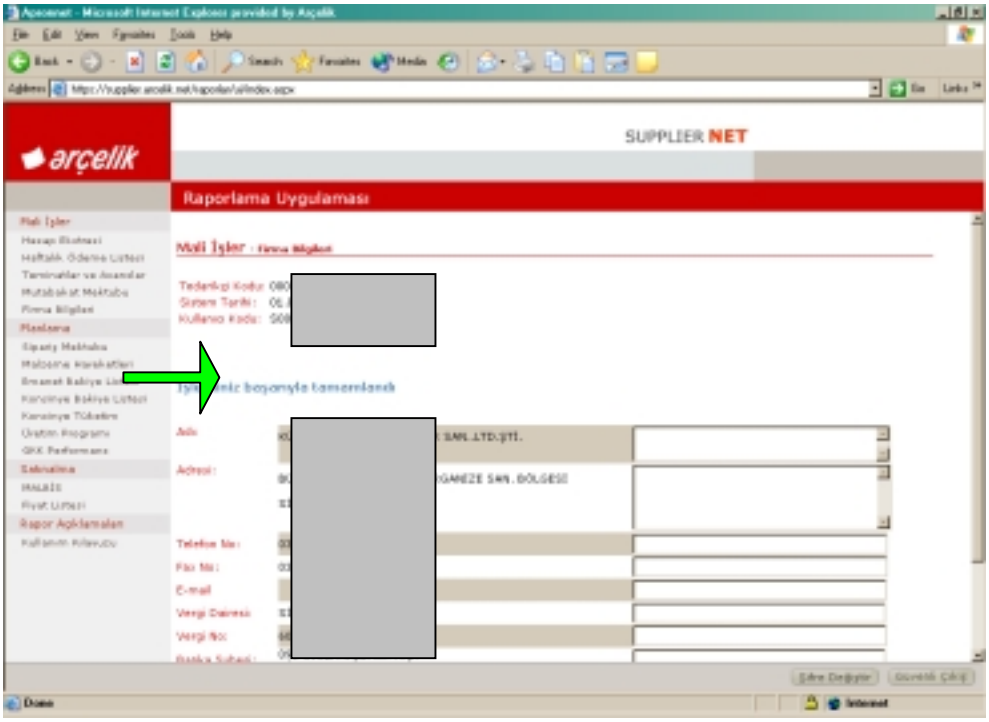
Screenshot D.10

There is consistency in the page layout controls and consistent logo placement. Maybe planning, financial, reporting functions could be in different colors to ease

categorization. The page layout must not be changed frequently since the user's learning and remembering of locations of information, functions and controls would be efficient for such and operational issue of supply chain. However one important missing point is that the entrance to the portal is at a place that cannot be guessed by the novice users easily. (Try to guess; the 'Raporlama ekranına giriş' text is the entrance link which has no differentiation and indication that it is the 'Portal', portal has a meaning of 'the big door' in English.) [ii]

Screenshot D.11

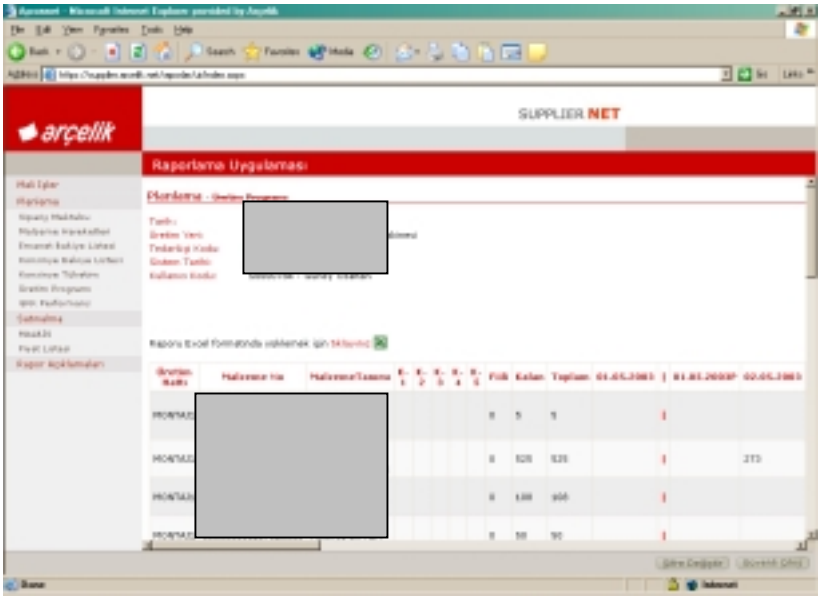
There is indication at the top of the page. Color is blue, can be good not to break concentration however no highlighting in the left menu indicating the function being used. .[iii]



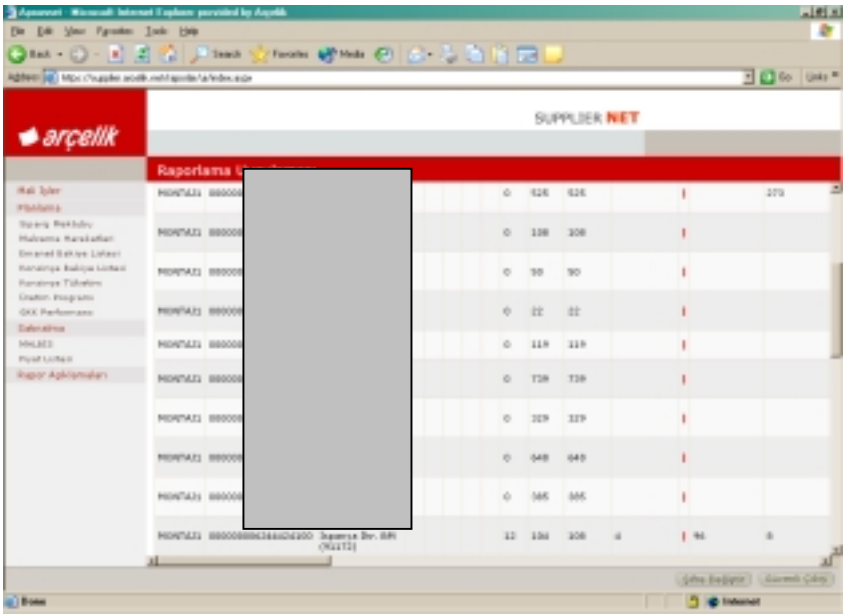
Screenshot D.12

Frame is stable and has good design. [iv]

Excel sheet showing the production plan is at the top of the list. So the users are readily directed to the more useful and needed style of information transfer object which is the excel sheet. In the production plan page, the products for which the vendor supplies material are used can be listed at the top with a distinct color. The presentation of the program cannot be interpreted for the user in terms of his/her task goal and mental model. [v]



Screenshot D.13

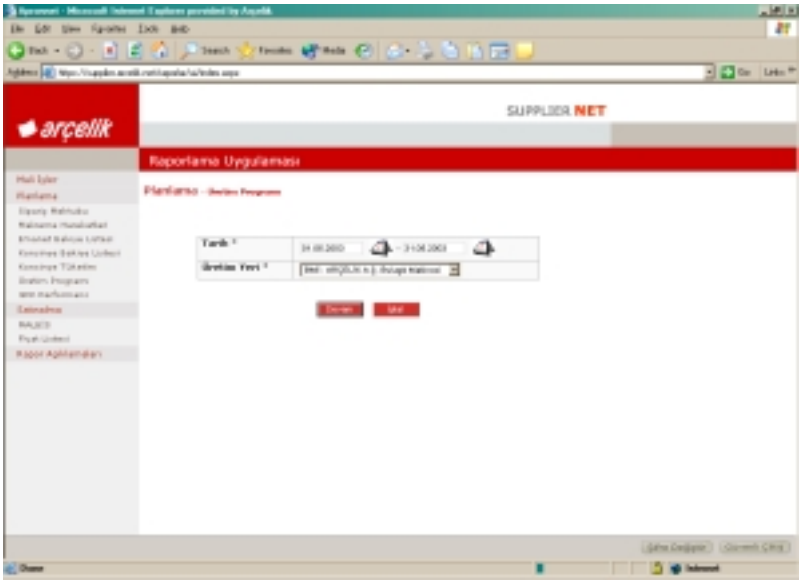


Screenshot D.14

The first page after entrance is unnecessary and increases hierarchy. The Çelik Robot can be good for marketing purposes. However this portal is for operational purposes in terms of supply chain. Maybe the page can be used at the beginning of the portal project in terms of prestige of the Company; however it would increase the task time in an important amount, must be eliminated in further periods. After this page, entering the portal, the user who wants to see the production plan can screen it on the second page where the fist page is the form, taking the required parameters such as time the plant etc. [vi]

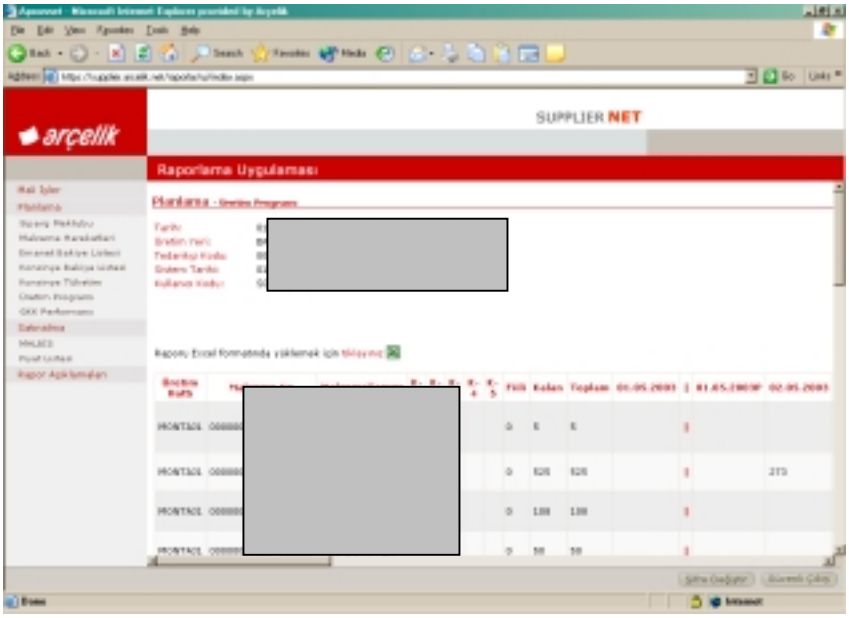
Screenshot D.15

Screenshot D.16



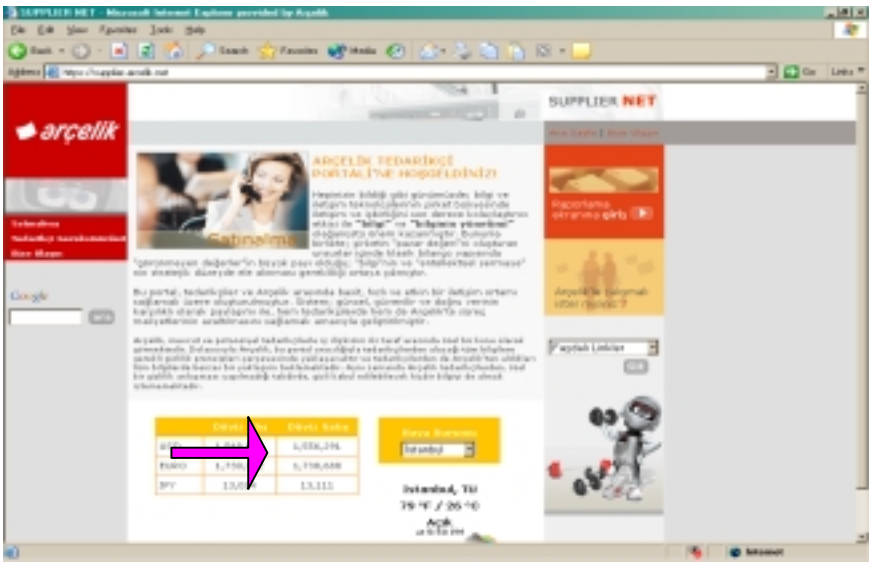
Screenshot D.17

Navigation elements are grouped together. [vii]



Screenshot D.18

The mission of the portal cannot be depicted out easily. Bulleting should be utilized. Long sentences and the long paragraph make it hard to scan for central ideas. [viii]

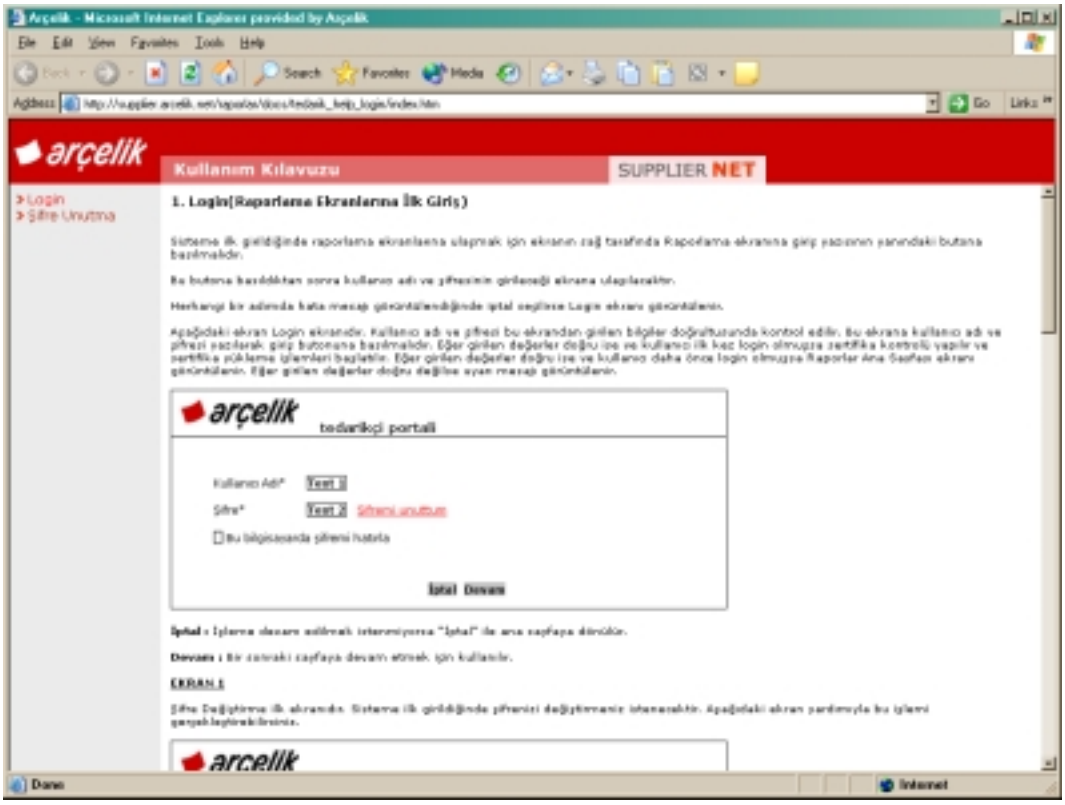


Screenshot D.19

The fonts are appropriate. [ix]

The order letter must be in printable format. One missing point is that when there is no demand for the vendor in the following period the vendor sees the warning that there is no record. But he/she cannot be sure that this is due to a break in the system or really there is no order. There must be warning that currently here is no demand. Additionally the planned period could be screened. The planning for May has been carried out info would be helpful for the vendor to be sure of the demand level. Also the user may not have access every time. Email option would be helpful. This could also be within the portal to predefined address. Additionally the vendor should have an email option to the client and the purchasing communicator for several needs about the order. This could also be to predefined people and address. [x]

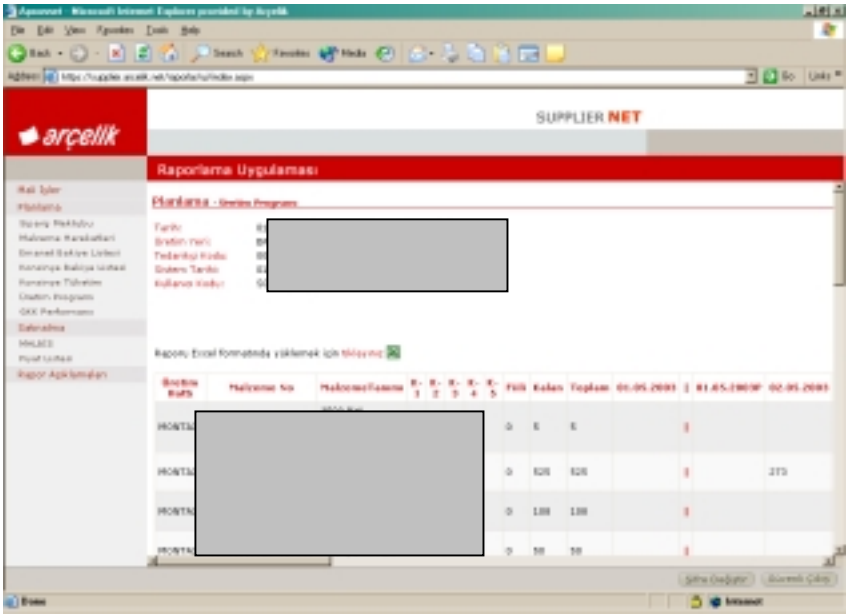
The aim of the portal is for the operational issue of order. So taking into consideration of user's goals the short page lengths are very appropriate. However the manual lacks this appropriateness. [xi]



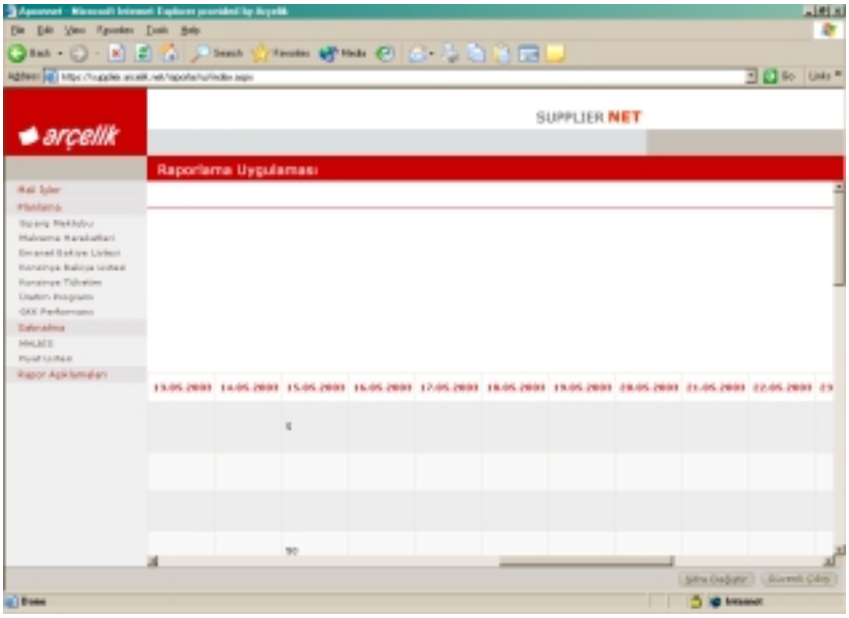
Screenshot D.12

Screenshot D.20

Although no scrolling is needed mostly on pages the production plan page suffers from the scrolling criteria. The plan cannot be directly screened for interpretation, neither horizontally nor vertically. A solution must be used for ergonomic view. [xii]

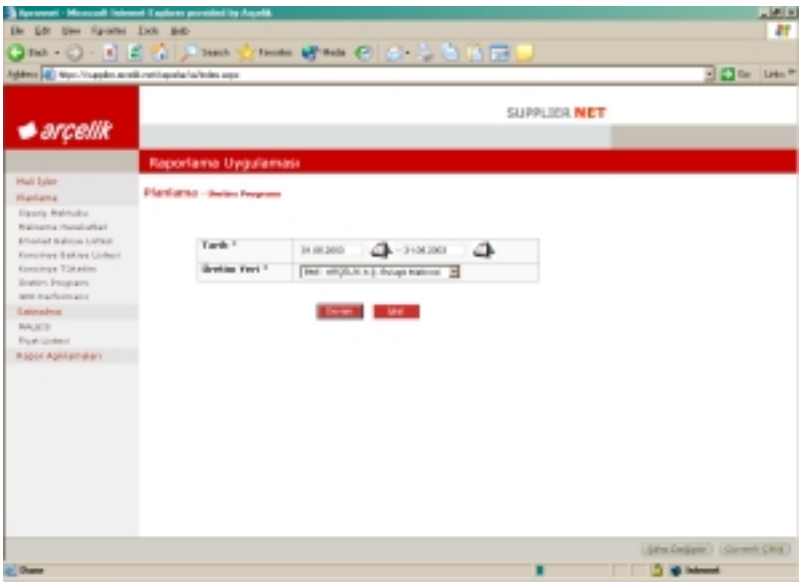


Screenshot D.21



Screenshot D.22

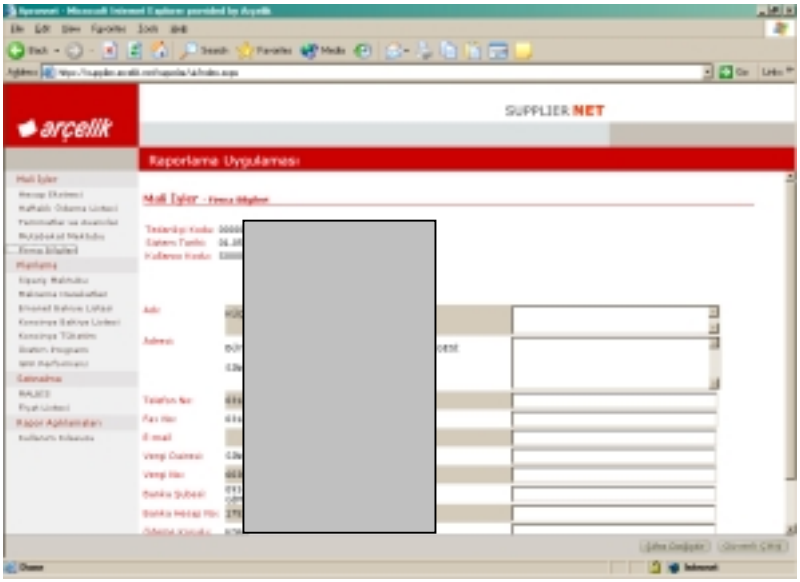
The scanning is not important for the goal of the portal. Therefore white space is not harmful. [xiii]



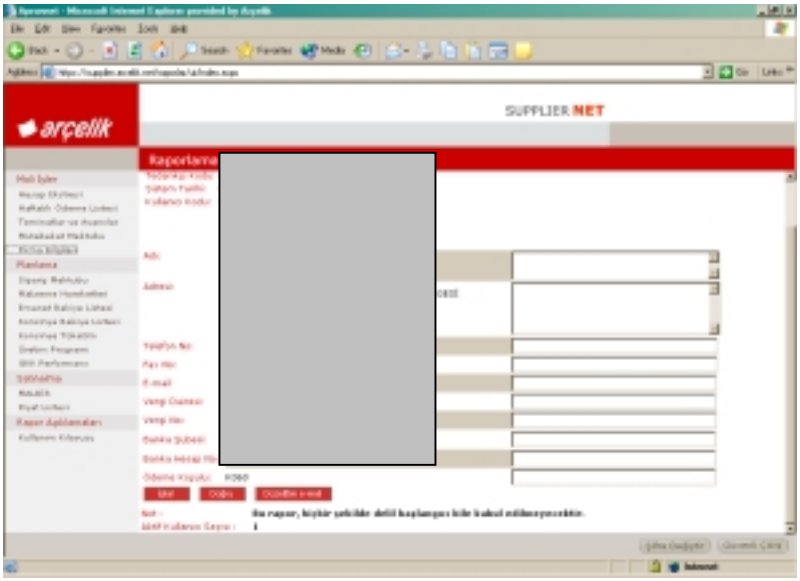
Screenshot D.23

The function keys are at left. They could be at top? This seems not to be very different than left placement. [xiv]

Headings and titles of pages are consistent. [xv]



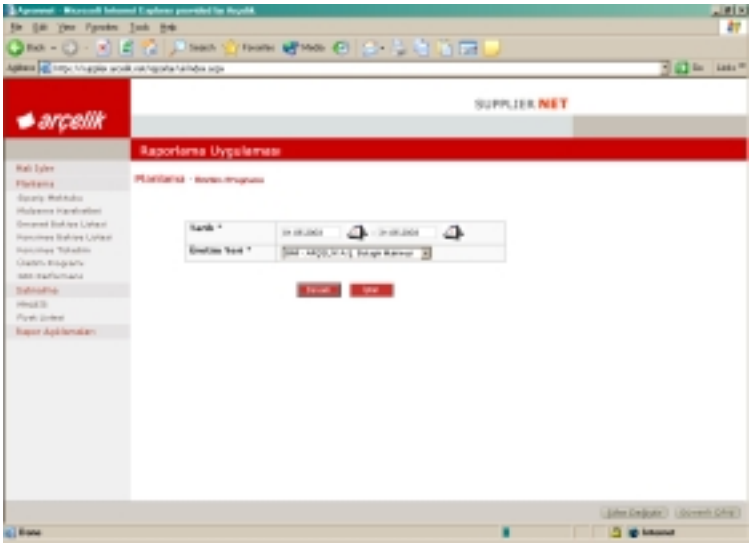
Screenshot D.24



Screenshot D.25

There is a potential for missing links of the user. The ‘change password’ and ‘sign out’ links at the right bottom of the page are very indistinctive; color and font make these buttons indistinguishable. And since the users of this system will be novice users at the first period these links should be made more evident .[xvi]

Though the mouse over, and not underlined links in the menu, the stacked list of functions is sufficient for links. The calendar is also linked by an image. Though it can be hard to realize the image links to a calendar, since the users of this portal will be regular users this links can be communicated to users .[xvii]



Screenshot D.26

Screenshot D.27

No tabbing is used. It could be utilized. However from ‘less is more’ principle, this style also seems to be sufficient. [xviii]

For the links, an indicator of previous entrance in the same session would be helpful in terms of showing the user the tasks s/he has dealed with [xix]

No alarming system warning for the change of the production program or additional demand letter. There can be warning message indicating that you have new message from the Company.

Lastly, the portal seems to be acquainted from the top ten mistakes. [xx]

[i] ***Reduce User's Workload:***
Automate as much of the site's function as possible. Eliminate the need for users to perform tasks like performing mental calculations, making estimations, recalling account numbers and passwords, etc.
Comments: Let the computer perform as many tasks as possible so users can concentrate on performing tasks that actually require human processing and input
[ii] ***Be consistent***
Present information and similar functions consistently throughout the site, including logos, page titles, headers, navigation elements, etc. Also use a consistent position on all pages for logos, recurring text, buttons, and graphics.
Comments: The more consistent a Web site is in its design, the easier it will be for users to quickly evaluate categories and match expectations on all pages. Users, particularly older users, tend to learn and remember locations of information, functions, and controls. Keep in mind that users spend most of their time on *other* sites, which is where they form their expectations for how the Web works on your site.
[iii] ***Provide feedback to users***
Provide feedback to inform users where they are in your site.
Comments: Feedback provides users with information they need to proceed to the next activity. Feedback can be as simple as changing the color on a link after it has been clicked by a user
[iv] ***Limit use of frames***
Do not include frames in Web sites, unless there is a strong (clearly defensible) reason to do so.
Comments: Use frames only when other design solutions are not adequate. Frames may take longer to design,develop, and maintain. Splitting a page into frames can be confusing for users since frames can break the fundamental user model. Frames can yield unexpected results, particularly when using the "Back" button. Frames make a Web site difficult to use, and can prevent users from emailing a URL to others.
[v] ***Establish Level of Importance***
Establish a high-to-low level of importance for each category and carry this approach throughout the design.
Comments: Important categories should appear higher on the page so users can locate them quickly
[vi] ***Put Important Information At Top of Hierarchy***
Put as much important content as close to the top of the hierarchy as possible. **Comments:** When creating a Web site that lends itself to a hierarchical style of organization (i.e., pyramid structure with most important information on the top), it is beneficial to "flatten" the hierarchy and to provide more information sooner. The more steps (or clicks) users must take to find the desired information, the greater the likelihood they will make a wrong choice
[vii] ***Group Navigation Elements***
Group navigation elements in close proximity.
Comments: Navigation elements help users find and move to areas of the site that have the desired information. They also help users to develop a mental model of the Web site.
[viii] ***Use Short Sentence/Paragraph Lengths***
Write sentences with 20 or fewer words and paragraphs with fewer than five sentences. Use lists to break up long sentences.
Comments: Readability improves when sentences and paragraphs are relatively short. Users tend to skip over text they consider nonessential
[ix] ***Use Readable Font Sizes***
Use at least a 10-point font to achieve the best possible reading performance.
Comments: Research has shown that fonts smaller than 10-point elicited slower performance from users. For people over 65, it may be better to use at least 12 or 14 point. A rule-of-thumb

is for a size 3 character on the users screen to equal a printed 12 point character of the same font.

Use Familiar Fonts

Use either a familiar serif or sans serif font to achieve the best possible reading speed. Do not mix serif and sans serif fonts within the text, because it may decrease reading speed.

Comments: Research shows no reliable differences in reading speed or user preferences between 10-point Times Roman, Georgia serif fonts, Helvetica, or Verdana sans serif fonts.

[x] ***Provide Printing Options***

Provide an alternate form of all documents, resources, or files that can be printed in their entirety.

Comments: Many users prefer to read text from a paper copy of a document. They find this to be more convenient, and it allows them to make notes on the paper. Users sometimes print pages because they do not trust the Web site to have pages for them at a later date

[xi] ***Determine Page Length***

Use short pages for (a) home pages and all navigation pages, (b) pages that need to be quickly browsed and/or read online, and (c) pages with very long graphics.

Use long pages to (a) simplify page maintenance (fewer Web page files to maintain), (b) match the structure of a paper counterpart, and (c) make pages more convenient to download and print.

Comments: Determine your goals and your users' goals when making page length decisions. Short pages, those containing one or two screens of text, work well for the home page and menu pages when users are scanning for link choices. Longer pages, although they require more scrolling, may work well for destination pages where related content can be printed and read/scanned together.

[xii] ***Determine Scrolling vs. Paging Needs***

If reading speed is important and response time is reasonably fast, use paging (linking) rather than scrolling.

Comments: Users should be able to move from page to page by selecting links (paging) without always scrolling to important information. This is particularly true for home pages and menu pages. One study showed that users spent about 13% of their total time scrolling within pages. Although each scrolling event takes little time, overall users can spend a considerable amount of time scrolling

[xiii] ***Reduce Unused Space***

Reduce the amount of unused space on pages used for scanning and searching.

Comments: On pages that are primarily links or categories, like a home page, the greater the density, the faster the scanning. "Density" is defined as the percent of the screen filled with categories and text. Density has no impact on user accuracy or reference. On content/text pages, using some white space to separate paragraphs and ideas is important. As a rule, use less white space than you would on paper.[1]

[xiv] ***Put Important Information At Top of Page***

Put important items at the top, "above the fold" (in the first screenful of information), to ease scanning.

Comments: Experienced users usually scan a Web page menu or a list from top to bottom. Users generally look at the top center of a page first, then look left, then right, and finally begin systematically moving down the total page. All critical content and navigation options should be at the top of the page. Particularly on navigation pages, all major choices should be visible without scrolling. Users may conclude that what they see on the visible portion of the page is not of interest, and not bother scrolling down to see the rest of the page.

[xv] ***Use Well Designed Headings***

Use many, carefully selected headings, with names that conceptually relate to the information or functions they describe.

Comments: *Headings provide strong cues that orient viewers and inform them about a page's organization and structure. Headings also help classify information on a page. Well-designed headings are an important tool for helping users scan text. Write headings and page titles that clearly explain what the page is about and that will make sense when read out-of-context.*

Headings are often removed from the context of the full page and used in tables of content and search engine results. This means that the headings should clearly tell users what is at the other end of the link

[xvi]***Show Links Clearly***

Use blue underlined text for all unused links when possible. Do not require users to move the mouse to see when the pointer changes to a hand (mine sweeping).

Comments: Some links are missed by users because the links are not evident. Links must be clearly designated so that there is little (or no) uncertainty on the part of the users as they click on a link. Research has shown that when users were given visual cues to locate links, as opposed to using the pointer to search for links, they were able to find the information seven times faster.

For text, users expect links to be blue and underlined.

For a graphic link, the term "click here" has been shown to increase recognition that the graphic is a link. However,some automatic screen readers may have problems deciphering what "click here" refers to.

[xvii] ***Avoid Mouse Overs***

Do not rely on "mouseovers" for users to identify links. Always use underlines or some other visual indicator (e.g. a stacked list of items) to indicate that words are links.

Comments: Relying on mouseovers to designate links can confuse newer users and tend to slow them down because users are uncertain which links perform which functions.

[xviii] ***Present Tabs Effectively***

Place tabs that are used for links at the top of the page and ensure that they look like clickable, real-world tabs.

Comments: Research has shown that users are more likely to find and click appropriately on tabs that look like real-world tabs. Real-world tabs are those that look like the ones found in a file drawer (see the example below). Users can be confused when the tabs do not look like real-world tabs and/or the words are not underlined

[xix] For the links an indicator of previous entrance in the same session would be helpful in terms of showing the user the tasks dealed.

[xx] **Top Ten Mistakes**

1. Using Frames
2. Gratuitous Use of Bleeding-Edge Technology
3. Scrolling Text, Marquees, and Constantly Running Animations
4. Complex URLs
5. Orphan Pages
6. Long Scrolling Pages
7. Lack of Navigation Support
8. Non-Standard Link Colors
9. Outdated Information
10. Overly Long Download Times

APPENDIX E

SURVEYS

E.1 SURVEY QUESTIONNAIRE IMPLEMENTED

The actual survey questionnaire which the analysis is based on can be found in the following pages.

Arçelik Tedarikçi Portali, tedarikçilerimizle güncel, güvenilir ve doğru veri akışını gerçekleştirmek üzere kurulmuştur. Portalin daha iyi hizmet edebilmesi ve hızlı ve etkin iletişimi geliştirmek için Arçelik Tedarikçi Portali hakkındaki görüşlerinizi bilmek istiyoruz.

KULLANIM BİLGİLERİ

1 Lütfen Portalde kullandığınız fonksiyonları ve kullanım sıklığınızı giriniz:

A	Mali İşler				
	Hesap Ekstresi	○ Sıklıkla	○ Bazen	○ Hiçbirzaman	○ Kullanamıyorum, kullanmak isterim
	Haftalık Ödeme Listesi	○ Sıklıkla	○ Bazen	○ Hiçbirzaman	○ Kullanamıyorum, kullanmak isterim
	Teminatlar ve Avanslar	○ Sıklıkla	○ Bazen	○ Hiçbirzaman	◉ Kullanamıyorum, kullanmak isterim
	Mutabakat Raporu	○ Sıklıkla	○ Bazen	○ Hiçbirzaman	○ Kullanamıyorum, kullanmak isterim
	Firma Bilgileri	○ Sıklıkla	○ Bazen	○ Hiçbirzaman	○ Kullanamıyorum, kullanmak isterim
B	Planlama				
	Sipariş Mektubu	○ Sıklıkla	○ Bazen	○ Hiçbirzaman	○ Kullanamıyorum, kullanmak isterim
	Malzeme Hareketleri	○ Sıklıkla	○ Bazen	○ Hiçbirzaman	○ Kullanamıyorum, kullanmak isterim
	Emanet Bakıye Listesi	○ Sıklıkla	○ Bazen	○ Hiçbirzaman	○ Kullanamıyorum, kullanmak isterim
	Konsinye Bakıye Listesi	○ Sıklıkla	○ Bazen	○ Hiçbirzaman	○ Kullanamıyorum, kullanmak isterim
	Üretim Programı	○ Sıklıkla	○ Bazen	○ Hiçbirzaman	○ Kullanamıyorum, kullanmak isterim
	GKK Performans	○ Sıklıkla	○ Bazen	○ Hiçbirzaman	○ Kullanamıyorum, kullanmak isterim
C	Satınalma				
	Teknik Resim	○ Sıklıkla	○ Bazen	○ Hiçbirzaman	○ Kullanamıyorum, kullanmak isterim
	MALBİS	○ Sıklıkla	○ Bazen	○ Hiçbirzaman	○ Kullanamıyorum, kullanmak isterim
	Fiyat Listesi	○ Sıklıkla	○ Bazen	○ Hiçbirzaman	○ Kullanamıyorum, kullanmak isterim

2

*	Tedarikçi Portalimizi ne zamandan beri kullanmaktasınız?	○ İlk kullanışım	○ 1 haftadır	○ 1 aydır		
		○ 2 aydır	○ 3 aydır	○ 4 aydır		
*	Portale giriş sıklığınız nedir?	○ Ayda bir iki kez	○ Haftada bir	○ Haftada 2-3 k	○ Günde bir kez	○ Günde birkaç kez
*	Kullandığınız işletim sistemi nedir?	○ Win 95/98	○ Win NT	○ Win XP		
		○ MacOS	○ Linux	○ Diğer		
*	İnternete nasıl bağlanmaktasınız?	◉ LAN	○ Telefon hattı	○ Linux	○ Diğer	

*	Internet bağlantınızın hızını genelde nasıl tanımlarsınız? (portal dışı uygulamalar da dahil olmak üzere)	(•) Yavaş ( ) Normal ( ) Hızlı
	Portalde ulaştığınız raporları ne şekilde kullanıyorsunuz?	( ) Bilgisayara yüklüyorum ( ) Not alıyorum ( ) Kağıt baskı alıyorum ( ) Yalnız ekranda görüntüleyerek çalışıyorum

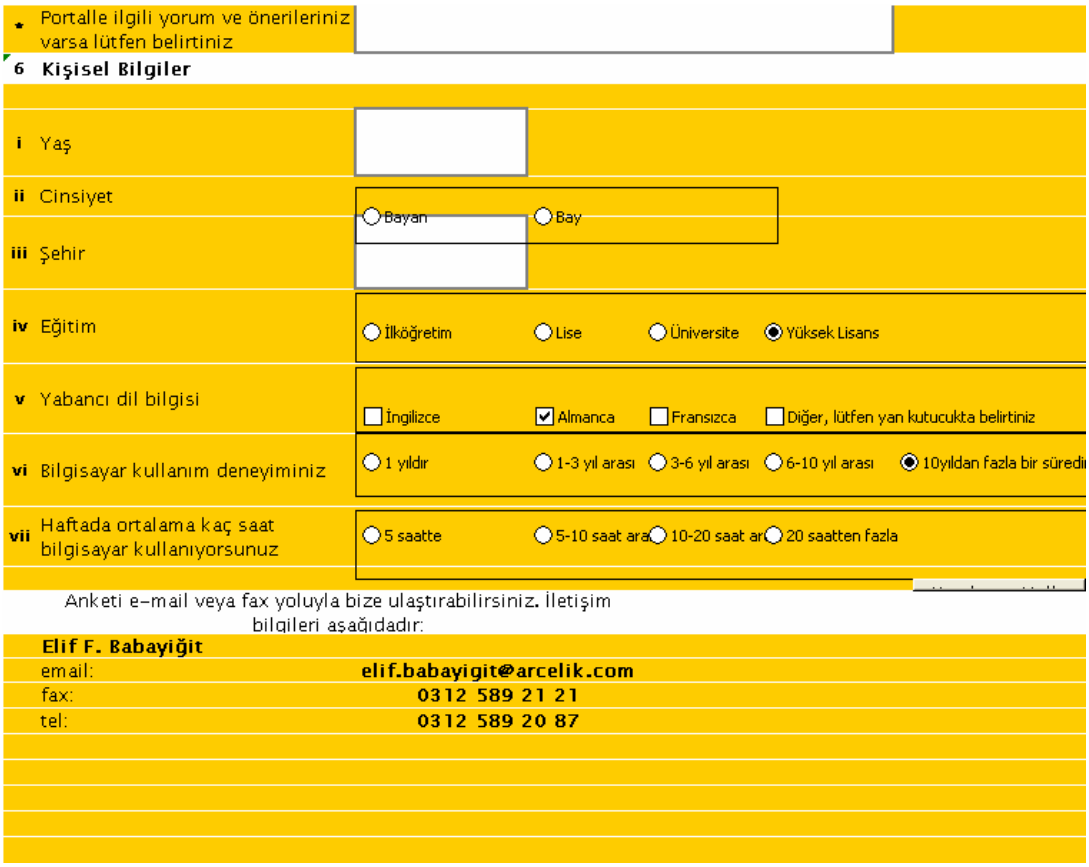
3 Lütfen aşağıdaki makine, yazılım ve sistemlerden kullanmakta olduklarınızı işaretleyiniz

[x] Bilgisayar	[ ] Disket sürücü	[ ] Printer	[ ] Dokunmatik el
[ ] Hesap çizelgesi (MS E	[ ] CD sürücü	[ ] Scanner	[ ] Dizüstü bilgisayar
[ ] Yazım editörü (Ms Wo	[ ] Memory Bar	[ ] Fax	[ ] CAD programı
[ ] Mail programı(Ms Outl	[x] Mouse	[ ] Lotus Notes	[ ] MRP modülü
[ ] Internet	[ ] Klavye	[ ] DB programla	[ ] Grafik programı

4 Lütfen Portal hakkında aşağıdaki tanımlamalara ne ölçüde katıldığınızı ilgili kutucuyu işaretleyerek

*	Menüler anlaşılır ve mantıklı bir şekilde kurulmuş	( ) Tamamen katılıyorum	( ) Katılıyorum	( ) Yorum yok	( ) Katılmıyorum	( ) Kesinlikle katılmıyorum
*	Sayfalardaki bilgi yerleşimi düzenli ve anlaşılır	( ) Tamamen katılıyorum	( ) Katılıyorum	( ) Yorum yok	( ) Katılmıyorum	( ) Kesinlikle katılmıyorum
*	Ekranda bir anda görüntülenebilen bilgi miktarı yeterli	( ) Tamamen katılıyorum	( ) Katılıyorum	( ) Yorum yok	( ) Katılmıyorum	( ) Kesinlikle katılmıyorum
*	Bir önceki sayfaya dönüş kolay	( ) Tamamen katılıyorum	( ) Katılıyorum	( ) Yorum yok	( ) Katılmıyorum	( ) Kesinlikle katılmıyorum
*	Kullanılan terimler işimle ilişkili	( ) Tamamen katılıyorum	( ) Katılıyorum	( ) Yorum yok	( ) Katılmıyorum	( ) Kesinlikle katılmıyorum
*	Bilgisayar terimleri gereğinden fazla kullanılmamış	( ) Tamamen katılıyorum	( ) Katılıyorum	( ) Yorum yok	( ) Katılmıyorum	( ) Kesinlikle katılmıyorum
*	Sistemin durumu hakkında devamlı bilgilendirme mevcut	( ) Tamamen katılıyorum	( ) Katılıyorum	( ) Yorum yok	( ) Katılmıyorum	( ) Kesinlikle katılmıyorum
*	Hata mesajları problemi net olarak belirtiyor	( ) Tamamen katılıyorum	( ) Katılıyorum	( ) Yorum yok	( ) Katılmıyorum	( ) Kesinlikle katılmıyorum
*	Yeni kullanıcı için ilk kullanımı kolay	( ) Tamamen katılıyorum	( ) Katılıyorum	( ) Yorum yok	( ) Katılmıyorum	( ) Kesinlikle katılmıyorum
*	Menüleri deneme yanılma yöntemiyle anlamak mümkün ve güvenli	( ) Tamamen katılıyorum	( ) Katılıyorum	( ) Yorum yok	( ) Katılmıyorum	( ) Kesinlikle katılmıyorum
*	Kısaltma ve menü isimlerini hatırlamak kolay	( ) Tamamen katılıyorum	( ) Katılıyorum	( ) Yorum yok	( ) Katılmıyorum	( ) Kesinlikle katılmıyorum
*	Portali kullanmayı öğrenmek kolay	( ) Tamamen katılıyorum	( ) Katılıyorum	( ) Yorum yok	( ) Katılmıyorum	( ) Kesinlikle katılmıyorum
*	Portal yeterince hızlı	( ) Tamamen katılıyorum	( ) Katılıyorum	( ) Yorum yok	( ) Katılmıyorum	( ) Kesinlikle katılmıyorum
*	Sistemdeki bilgilerin güncelliğinden emin olabiliyorum	( ) Tamamen katılıyorum	( ) Katılıyorum	( ) Yorum yok	( ) Katılmıyorum	( ) Kesinlikle katılmıyorum
*	Sistemdeki bilgilerin tam ve doğru olduğuna emin olabiliyorum	( ) Tamamen katılıyorum	( ) Katılıyorum	( ) Yorum yok	( ) Katılmıyorum	( ) Kesinlikle katılmıyorum
*	Hatalı giriş yapmayı önleyici mesajlar yeterli	( ) Tamamen katılıyorum	( ) Katılıyorum	( ) Yorum yok	( ) Katılmıyorum	( ) Kesinlikle katılmıyorum
*	Yapılan işlemi geri almak kolay	( ) Tamamen katılıyorum	( ) Katılıyorum	( ) Yorum yok	( ) Katılmıyorum	(•) Kesinlikle katılmıyorum

*	Portal işleyişinde nadiren hata oluşuyor	◯ Tamamen katılıyorum ◯ Katılıyorum ◯ Yorum yok ◯ Katılmıyorum ◯ Kesinlikle katılmıyorum
*	Deneyim arttıkça portal kullanımı rahatlaşıyor	◯ Tamamen katılıyorum ◯ Katılıyorum ◯ Yorum yok ◯ Katılmıyorum ◯ Kesinlikle katılmıyorum
*	Sistemde ihtiyacıma göre bazı düzenleme ve ayarlamalar yapabiliyorum	◯ Tamamen katılıyorum ◯ Katılıyorum ◯ Yorum yok ◯ Katılmıyorum ◯ Kesinlikle katılmıyorum
*	Sadece birkaç kural bilerek işlemler rahatça gerçekleştirilebiliyor	◯ Tamamen katılıyorum ◯ Katılıyorum ◯ Yorum yok ◯ Katılmıyorum ◯ Kesinlikle katılmıyorum
*	Kullanım kılavuzuna portalden ulaşım kolay	◯ Tamamen katılıyorum ◯ Katılıyorum ◯ Yorum yok ◯ Katılmıyorum ◯ Kesinlikle katılmıyorum
*	Kullanım kılavuzunda bilgilendirme net ve amacına yönelik	◯ Tamamen katılıyorum ◯ Katılıyorum ◯ Yorum yok ◯ Katılmıyorum ◯ Kesinlikle katılmıyorum
*	Portalde yapmak istediğim işlemleri yalnız kullanım kılavuzundan yardım alarak kolaylıkla gerçekleştirebiliyorum	◯ Tamamen katılıyorum ◯ Katılıyorum ◯ Yorum yok ◯ Katılmıyorum ◯ Kesinlikle katılmıyorum
*	Karşılaşılan problemlere yardım menüsünden çözüm bulmak kolay	◯ Tamamen katılıyorum ◯ Katılıyorum ◯ Yorum yok ◯ Katılmıyorum ◯ Kesinlikle katılmıyorum
*	Portalin bilgisayara kurulum işlemi kolay	◯ Tamamen katılıyorum ◯ Katılıyorum ◯ Yorum yok ◯ Katılmıyorum ◯ Kesinlikle katılmıyorum
*	Yükleme başarısız olduğunda açıklayıcı mesajlar veriyor	◯ Tamamen katılıyorum ◯ Katılıyorum ◯ Yorum yok ◯ Katılmıyorum ◯ Kesinlikle katılmıyorum
*	Portalle işimi verimli bir şekilde yapmama yardımcı	◯ Tamamen katılıyorum ◯ Katılıyorum ◯ Yorum yok ◯ Katılmıyorum ◯ Kesinlikle katılmıyorum
*	Portal zamandan kazanmamı sağlıyor	◯ Tamamen katılıyorum ◯ Katılıyorum ◯ Yorum yok ◯ Katılmıyorum ◯ Kesinlikle katılmıyorum
*	Portal bilgilere istediğim zaman ulaşmamı sağlıyor	◯ Tamamen katılıyorum ◯ Katılıyorum ◯ Yorum yok ◯ Katılmıyorum ◯ Kesinlikle katılmıyorum
*	Tam ve güncel bilgiye rahatça ulaşabiliyorum	◯ Tamamen katılıyorum ◯ Katılıyorum ◯ Yorum yok ◯ Katılmıyorum ◯ Kesinlikle katılmıyorum
*	Portal beklentilerime cevap veriyor	◯ Tamamen katılıyorum ◯ Katılıyorum ◯ Yorum yok ◯ Katılmıyorum ◯ Kesinlikle katılmıyorum
5		
*	Sizce portalin en yararlı özelliği?	
*	Portalde yeralmasını istediğiniz ek rapor ve bilgiler var mı?	◯ Hayır ◯ Evet (Lütfen belirtiniz)
*	Portalde olmasını istediğiniz ek işlevler var mı?	◯ Hayır ◯ Evet (Lütfen belirtiniz)
*	Portalle ilgili önerileriniz nelerdir?	☐ İhtiyacım olan ek bilgi ve raporların yayınlanması
		☐ Bilgi görüntülemeye ek işlevler
		☐ Portal erişimini kolaylaştırmak
		☐ Portale giriş ve menüler arası dolaşım için ek yardım bilgisi
		☐ Dizaynda değişiklikler
*		☐ Diğer



Anketi e-mail veya fax yoluyla bize ulaştırabilirsiniz. İletişim bilgileri aşağıdadır:

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E.2 PILOT SURVEY QUESTIONNAIRE

The pilot questionnaire that the actual questionnaire emerged from can be found in the following pages.

Arçelik Tedarikçi Portalı, tedarikçilerimizle guncel, guvenilir ve dogru veri akışını gerçekleştirmek üzere kurulmuştur. Portalin daha iyi hizmet edebilmesi ve hızlı ve etkin iletişimi geliştirmek için Arçelik Tedarikçi Portali hakkındaki görüşlerinizi bilmek istiyoruz. Aşağıdaki anketi

KULLANIM BİLGİLERİ

1	**Lütfen kullandığınız fonksiyonları ve kullanım sıklığınızı giriniz:**				
A	Mali İşler				
	Hesap Ekstresi	◯ Sıklıkla	◯ Bazen	◯ Hiçbirzaman	◯ Kullanamıyorum, kullanmak isterim
	Haftalık Ödeme Listesi	◯ Sıklıkla	◯ Bazen	◯ Hiçbirzaman	◯ Kullanamıyorum, kullanmak isterim
	Teminatlar ve Avanslar	◯ Sıklıkla	◯ Bazen	◯ Hiçbirzaman	◯ Kullanamıyorum, kullanmak isterim
	Mutabakat Raporu	◯ Sıklıkla	◯ Bazen	◯ Hiçbirzaman	◯ Kullanamıyorum, kullanmak isterim
	Firma Bilgileri	◯ Sıklıkla	◯ Bazen	◯ Hiçbirzaman	◯ Kullanamıyorum, kullanmak isterim
B	Planlama				
	Sipariş Mektubu	◯ Sıklıkla	◯ Bazen	◯ Hiçbirzaman	◯ Kullanamıyorum, kullanmak isterim
	Malzeme Hareketleri	◯ Sıklıkla	◯ Bazen	◯ Hiçbirzaman	◯ Kullanamıyorum, kullanmak isterim
	Emanet Bakıye Listesi	◯ Sıklıkla	◯ Bazen	◯ Hiçbirzaman	◯ Kullanamıyorum, kullanmak isterim
	Konsinye Bakıye Listesi	◯ Sıklıkla	◯ Bazen	◯ Hiçbirzaman	◯ Kullanamıyorum, kullanmak isterim
	Üretim Programı	◯ Sıklıkla	◯ Bazen	◯ Hiçbirzaman	◯ Kullanamıyorum, kullanmak isterim
	GKK Performans	◯ Sıklıkla	◯ Bazen	◯ Hiçbirzaman	◯ Kullanamıyorum, kullanmak isterim
C	Satınalma				
	Teknik Resim	◯ Sıklıkla	◯ Bazen	◯ Hiçbirzaman	◯ Kullanamıyorum, kullanmak isterim
	MALBİS	◯ Sıklıkla	◯ Bazen	◯ Hiçbirzaman	◯ Kullanamıyorum, kullanmak isterim
	Fiyat Listesi	◯ Sıklıkla	◯ Bazen	◯ Hiçbirzaman	◯ Kullanamıyorum, kullanmak isterim

2	Tedarikçi Portalimizi ne zamandan beri kullanmaktasınız?	◯ İlk kullanışım	◯ 1 haftadır	◯ 1 aydır		
		◯ 2 aydır	◯ 3 aydır	◯ 4 aydır		
3	Portale giriş sıklığınız nedir?	◯ Ayda bir iki kez	◯ Haftada bir	◯ Haftada 2-3 kez	◯ Günde bir kez	◯ Günde birkaç kez
4	Kullandığınız işletim sistemi nedir?	◯ Win 95/98	◯ Win NT	◯ Win XP		
		◯ MacOS	◯ Linux	◯ Diğer		
5	İnternete nasıl bağlanmaktasınız?	◯ LAN	◯ Telefon hattı	◯ Linux	◯ Diğer	

6	Internet bağlantınızın hızını genelde nasıl tanımlarsınız? (portal dışı uygulamalar da dahil olmak üzere)	○ Yavaş	○ Normal	○ Hızlı		
7	**Lütfen aşağıdaki makine, yazılım ve sistemlerden kullanmakta olduklarınızı işaretleyiniz**					
		☑ Bilgisayar	☐ Disket sürücü	☐ Printer	☐ Dokunmatik el	
		☐ Hesap çizelgesi (MS	☐ CD sürücü	☐ Scanner	☐ Dizüstü bilgisayar	
		☐ Yazım editörü (Ms W	☐ Memory Bar	☐ Fax	☐ CAD programı	
		☐ Mail programı(Ms Ou	☑ Mouse	☐ Lotus Notes	☐ MRP modülü	
		☐ Internet	☐ Klavye	☐ DB programları (M	☐ Grafik programı	
8	Portalde ulaştığınız raporları ne şekilde kullanıyorsunuz?	○ Bilgisayara yüklüyor	○ Not alıyorum	○ Kağıt baskı alıyorum	○ Yalnız ekranda görüntüleyerek çalışıyorum	
	SAYFA ORGANİZASYONU					
9	Portalde yazı karakterleri okunaklı	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
10	Sayfa düzenlemeleri işlevsel	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
10.1	Ekranda bir anda görüntülenebilen bilgi miktarı yeterli	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
10.2	Sayfalardaki bilgi yerleşimi düzenli	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
11	İstenilen sayfaya ulaşmak için gerekli adımlar tutarlı	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
11.1	Menü adımlarında bir sonraki aşama tahmin edilebiliyor	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
11.2	Bir önceki sayfaya dönüş kolay	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
11.3	Amaçlanan işlev için menüler anlaşılır ve mantıklı bir şekilde kurulmuş	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
	TERMİNOLOJİ ve BİLGİLENDİRME					
12	Portalde terimlerin kullanımı tutarlı	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
12.1	İşle ilgili terimlerin kullanımı tutarlı	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
12.2	Bilgisayar terimlerinin kullanımı tutarlı	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
12.3	Kullanılan terimler işimle ilişkili	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
12.4	Bilgisayar terimleri gereğinden fazla kullanılmamış	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
13	Mesajlar açık ve net	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
13.1	Sayfada mesajların yeri uygun	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
13.2	İşlemler için talimatlar açık ve net	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum

13.3	Hata düzeltme talimatları açık ve net	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
14	Portal sistemin durumu hakkında devamlı bilgilendirme sağlıyor	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
14.1	İşlemler arası bekleme süresinin uzunluğu kabul edilebilir durumda	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
14.2	Menü adımlarını herzaman beklenen işleve ulaştırıyor	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
14.3	İşlemin sürüp sürmediğine dair bilgilendirme yeterli	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
15	Hata mesajları problemi net olarak belirtiyor	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
15.1	Hata mesajı cümleleri düzgün	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
	KULLANMAYI ÖĞRENMEK					
16	Portali kullanmayı öğrenmek kolay	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
16.1	Yeni kullanıcı için ilk kullanımı kolay	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
16.2	Portali kullanmak kısa sürede öğrenilyor	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
17	Menüleri deneme yanılma yöntemiyle anlamak mümkün ve güvenli	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
17.1	Menülerde gezmek güvenli	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
17.2	Yeni menüleri keşfetmek kolay	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
18	Kısaltma ve menü isimlerini hatırlamak kolay	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
18.1	Kullanım kurallarını hatırlamak kolay	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
19	Ulaşmak istediğim bilgiye direk olarak ulaşabiliyorum	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
19.1	İstediğim sayfaya ulaşmak için geçtiğim sayfa sayısı gereğinden fazla değil, makul	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
19.2	İşlemin tamamlandığına dair bildiri mesajları açık ve yeterli	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
	SİSTEM KAPASİTESİ					
20	Portal yeterince hızlı	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
20.1	Sayfa görüntüleme hızı yeterli	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
20.2	Dosya yükleme hızı iyi	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
21	Sistem işleyişi sağlam	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
21.1	İşlemlerin tam ve doğru gerçekleşmesi güvenilir	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
21.2	Sistemdeki bilgilerin güncelliğinden emin olabiliyorum	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	◉ Kesinlikle katılmıyorum

21.3	Sistemdeki bilgilerin tam ve doğru olduğuna emin olabiliyorum	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
21.4	Portal işleyişinde nadiren hata oluşuyor	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
22	Yapılan hatayı düzeltmek kolay	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
22.1	Yazım hatalarını düzeltmek kolay	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
22.2	Yapılan işlemi geri almak kolay	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
22.3	Hatalı giriş yapmayı önleyici mesajlar yeterli	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
22.4	Sistem potansiyel problemler için önceden uyarıyor	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
23	Deneyim arttıkça portal kullanımı rahatlaşıyor	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
23.1	Portalde kullanımı kolaylaştırıcı kısayollar mevcut	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
23.2	Kısayolların kullanımı rahat	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
23.3	Sistemde ihtiyacıma göre bazı düzenleme ve ayarlamalar yapabiliyorum	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
23.4	Sadece birkaç kural bilerek işlemler rahatça gerçekleştirilebiliyor	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
	KULLANIM KILAVUZU					
24	Portali kullanmayı kullanım kılavuzundan öğrenmek kolay	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
24.1	Kullanım kılavuzuna portalden ulaşım kolay	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
24.2	Kullanım kılavuzunda gezmek kolay	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
24.3	Portalin çeşitli özellikleriyle ilgili bilgiler tam ve bilgilendirici	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
24.4	Bilgilendirme net ve amacına yönelik	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
24.5	Portali kullanmak için verilen talimatlar net	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
24.5	Portalde yapmak istediğim işlemleri yalnız kullanım kılavuzundan yardım alarak kolaylıkla gerceklestirebiliyorum	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
	YARDIM MENÜSÜ					
25	Teknik ve yardımcı bilgiler yeterli ve anlaşılır	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
25.1	Bilgilendirme için kullanılan terimler açık ve net	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
25.2	Karşılaşılan problemlere yardım menüsünden çözüm bulmak kolay	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
27	Yardım mesajları anlaşılır	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	○ Kesinlikle katılmıyorum
27.1	Yardım mesajlarını görmek kolay	○ Tamamen katılıyorum	○ Katılıyorum	○ Yorum yok	○ Katılmıyorum	◉ Kesinlikle katılmıyorum

28	Yardım menüsü sistemin özellikli yanlarını anlatıyor	○ Tamamen katılıyorum ○ Katılıyorum ○ Yorum yok ○ Katılmıyorum ○ Kesinlikle katılmıyorum
	KURULUM	
29	Portalin bilgisayara kurulum işlemi kolay	○ Tamamen katılıyorum ○ Katılıyorum ○ Yorum yok ○ Katılmıyorum ○ Kesinlikle katılmıyorum
29.1	Portalin kurulum işlemi hızlı	○ Tamamen katılıyorum ○ Katılıyorum ○ Yorum yok ○ Katılmıyorum ○ Kesinlikle katılmıyorum
29.2	Kurulum sırasında her aşamada yükleme durumuyla ilgili bilgilendirme var	○ Tamamen katılıyorum ○ Katılıyorum ○ Yorum yok ○ Katılmıyorum ○ Kesinlikle katılmıyorum
29.3	Yükleme başarısız olduğunda açıklayıcı mesajlar veriyor	○ Tamamen katılıyorum ○ Katılıyorum ○ Yorum yok ○ Katılmıyorum ○ Kesinlikle katılmıyorum
	İÇERİK	
30	Portalle işimi verimli bir şekilde yapmama yardımcı	○ Tamamen katılıyorum ○ Katılıyorum ○ Yorum yok ○ Katılmıyorum ○ Kesinlikle katılmıyorum
30.1	Portal zamandan kazanmamı sağlıyor	○ Tamamen katılıyorum ○ Katılıyorum ○ Yorum yok ○ Katılmıyorum ○ Kesinlikle katılmıyorum
30.2	Portal bilgilere istediğim zaman ulaşmayı sağlıyor	○ Tamamen katılıyorum ○ Katılıyorum ○ Yorum yok ○ Katılmıyorum ○ Kesinlikle katılmıyorum
31	İstediğim bilgiye etkili biçimde ulaşabiliyorum	○ Tamamen katılıyorum ○ Katılıyorum ○ Yorum yok ○ Katılmıyorum ○ Kesinlikle katılmıyorum
31.1	Eksiz ve doğru bilgiye rahatça ulaşabiliyorum	○ Tamamen katılıyorum ○ Katılıyorum ○ Yorum yok ○ Katılmıyorum ○ Kesinlikle katılmıyorum
31.2	Güncel bilgilere rahatça ulaşabiliyorum	○ Tamamen katılıyorum ○ Katılıyorum ○ Yorum yok ○ Katılmıyorum ○ Kesinlikle katılmıyorum
32	Portalde yayınlanan raporların formatı uygun	○ Tamamen katılıyorum ○ Katılıyorum ○ Yorum yok ○ Katılmıyorum ○ Kesinlikle katılmıyorum
33	Portali kullanmayı öğrenmek kolay	○ Tamamen katılıyorum ○ Katılıyorum ○ Yorum yok ○ Katılmıyorum ○ Kesinlikle katılmıyorum
34	Portal beklentilerime cevap veriyor	○ Tamamen katılıyorum ○ Katılıyorum ○ Yorum yok ○ Katılmıyorum ○ Kesinlikle katılmıyorum
35	Sizce portalin en yararlı özelliği?	
36	Portalde yeralmasını istediğiniz ek rapor ve bilgiler var mı?	○ Hayır ○ Evet (Lütfen belirtiniz)
37	Portalde olmasını istediğiniz ek işlevler var mı?	○ Hayır ○ Evet (Lütfen belirtiniz)
38	Portalle ilgili önerileriniz nelerdir?	☐ İhtiyacım olan ek bilgi ve raporların yayınlanması ☐ Bilgi görüntülemeye ek işlevler ☐ Portal erişimini kolaylaştırmak ☐ Portale giriş ve menüler arası dolaşım için ek yardım bilgisi ☐ Dizaynda değişiklikler ☐ Diğer
38	Portal için önerileriniz varsa lütfen belirtiniz	
39	Portalle ilgili ek yorumlarınız varsa lütfen belirtiniz	

i	Yaş	
ii	Cinsiyet	○ Bayan ○ Bay
iii	Şehir	
iv	Eğitim	○ İlköğretim ○ Lise ○ Üniversite ○ Yüksek Lisans
v	Yabancı dil bilgisi	☐ İngilizce ☐ Almanca ☐ Fransızca ☐ Diğer, lütfen yan kutucukta belirtiniz
vi	Bilgisayar kullanım deneyiminiz	○ 1 yıldır ○ 1-3 yıl arası ○ 3-6 yıl arası ○ 6-10 yıl arası ○ 10yıldan fazla bir süredir
vii	Haftada ortalama kaç saat bilgisayar kullanıyorsunuz	○ 5 saatte ○ 5-10 saat arası ○ 10-20 saat arası ○ 20 saatten fazla

Anketi e-mail veya fax yoluyla bize ulaştırabilirsiniz. İletişim bilgileri aşağıdadır:

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APPENDIX F

QUESTIONNAIRE ANSWERS

F.1 QUESTIONNAIRE ANSWERS RAW DATA

Questionnaire Satisfaction Items part is transferred into numerals for statistical analysis. The satisfaction items were designed to be answered according to Likert-scaled choices. The numeral transfer is done accordingly. The raw data is summarized in Table F.1.

Table F.1.1 Questionaire Answers Raw Data

Quest #	Satisfaction Item	u1	u2	u3	u4	u5	u6	u7	u8	u9	u10	u11	u12	u13	u14	u15	u16	u
q1	Menus are constructed in a logical and easily understood way	4	4	4	4	5	4	5	4	5	5	4	4	5	5	4	3	
q2	Arrangement of information on pages is consistent and helps to undertsand	4	4	4	4	5	4	5	4	5	5	4	4	5	2	4	4	
q3	Amount of information that can be displayed on the screen is adequate	4	3	4	3	5	4	5	2	4	2	3	4	4	2	2	1	
q4	Going back to the previous screen is easy	4	3	3	2	4	2	4	3	4	4	3	2	4	3	4	2	
q5	Terminology relates well to my work	4	4	4	2	4	4	4	5	5	5	4	2	4	4	4	4	
q6	Computer terminology is not used too frequently	4	2	3	3	5	2	4	4	4	4	4	2	4	4	2	3	
q7	There is continuous information feedback about what the system is doing	4	3	3	2	4	2	3	2	3	2	2	3	3	4	1	1	
q8	Error messages indicate the problem clearly	4	5	3	2	2	2	2	2	2	4	3	2	3	4	1	4	
q9	Is easy to get started with for the novice users	4	5	2	1	4	2	4	2	4	3	4	2	4	4	1	3	
q10	Exploration of menus by trial and error is encouraging and safe	4	5	3	4	4	4	4	2	4	3	4	2	3	4	4	3	
q11	Remembering abbreviations and menu names is easy	4	4	3	2	4	4	4	3	4	5	4	4	4	4	4	3	
q12	It is easy to learn using the Portal	4	5	4	4	4	4	4	2	4	4	4	2	3	4	2	3	
q13	Portal is fast enough	4	4	4	2	4	2	2	4	4	2	4	4	4	4	3	2	
q14	I can always be sure of the actuality of the information displayed	4	5	4	3	2	2	2	2	2	4	4	1	4	2	4	4	
q15	I can be sure that the inforamation diplayed is always complete and true	4	5	4	3	4	2	4	2	4	4	4	2	4	2	2	4	
q16	Error prevention messages are sufficient	4	4	4	3	3	2	4	4	4	4	4	4	4	4	4	4	
q17	Ability to undo operations is adequate	3	3	3	4	3	3	3	3	4	3	3	3	3	2	3	3	
q18	System failures occur seldomly	4	3	3	4	4	3	2	2	4	4	4	4	4	4	2	2	
q19	Ease of operation increases with experience with the system	4	4	3	4	3	4	4	3	4	4	4	4	4	4	3	5	
q20	I can make some arrangements and shortcuts based on my needs	3	3	3	3	3	4	3	3	3	3	3	3	4	1	3	2	
q21	I can accomplish tasks knowing only a few commands	4	4	3	4	4	4	4	4	4	5	4	4	4	5	4	5	
q22	Accessing the online tutorial is easy	4	3	3	3	3	3	2	2	4	4	4	3	3	4	4	3	
q23	Tutorial informs clearly based on task goals	4	4	3	3	3	3	3	3	4	4	3	3	3	4	4	3	
q24	Completing tasks using only online tutorial is possible	4	2	3	3	3	3	3	2	2	3	3	3	3	2	4	3	
q25	It is easy to get solutions for problems from the help menu	4	3	3	3	3	3	2	2	2	3	2	2	3	3	2	3	
q26	Installation of the Supplier Portal to computer is easy	4	4	2	2	4	4	2	3	3	2	2	2	3	4	3	3	
q27	Gives informative messages when installatipn failes	4	4	2	2	3	4	2	3	3	2	2	2	3	4	3	3	
q28	Portal helps me do my job efficiently	4	2	3	4	4	4	4	3	5	4	4	4	4	4	2	4	
q29	Portal saves time	5	2	3	4	3	2	3	3	4	4	4	4	4	4	1	4	
q30	Portal enables me to reach the information I need whenever I want	5	3	3	2	4	2	2	2	4	5	4	4	2	2	1	4	
q31	I can reach the complete and actual information comfotably	5	2	4	4	4	2	4	2	4	4	4	2	4	4	2	3	
q32	Portal meets my expectations	5	2	3	4	4	2	4	2	4	4	4	3	4	4	2	3	

F.2 USER PROFILES DATA

The demographic data utilized in the usability analysis is summarized in Table F.2.1.

Table F.2.1 User Profiles Data

User	Title	Title Level	Branch	Age	Education	Gender	Computer Experience	Computer Usage (hrs/wk)	Foreign Language	Portal Experience	Portal Access Freq	City	Portal Experience#	Portal Access Freq #	Account Summary	Weekly Payment List	Guarantees and Advances												
u1	Facility Manager/Owner	Manager	Facility	40	University	M	5-10 years	Betw 5-10 hrs	English	4 months	Few/ a day	Eskişehir	16	30	2	3	1												
u2	Sales Engineer	Engineer	Sales	23	University	F	5-10 years	More than 20 hrs	English, Italish	2 months	Few/ a month	İstanbul	8	1	1	1	1												
u3	Arçelik Customer Representative	Engineer	Sales	28	University	F	3-5 years	More than 20 hrs	English	3 months	Few/ a month	İstanbul	12	1	1	1	1												
u4	Finance Responsible	Engineer	Finance	28	University	M	5-10 years	More than 20 hrs		4 months	Few / a week	Ankara	16	4	3	3	2												
u5	Facility Manager/Owner	Manager	Facility	33	University	M	More than 10 years	Betw 10-20 hrs	English	4 months	Few / a week	Ankara	16	4	1	1	1												
u6	Planning Engineer	Engineer	Production Planning	27	M.Sc.	M	More than 10 years	More than 20 hrs	English, German	3 months	Few / a month	Ankara	12	1	1	1	1												
u7	Technical Manager	Manager	Production, Sales	42	University	M	5-10 years	Betw 5-10 hrs		4 months	Few / a month		16	1	2	3	2												
u8	Accounting Responsible	Engineer	Finance	27	University	F	5-10 years	More than 20 hrs		1 month	Few / a month	İstanbul	4	1	1	2	1												
u9	Finance Manager	Manager	Accounting	34	University	F	5-10 years	More than 20 hrs		4 months	Few / a week	İzmit	16	4	1	2	1												
u10	Sales Representative	Engineer	Sales	34	University	F	5-10 years	More than 20 hrs	English	4 months	Few / a week	İstanbul	16	4	3	2	1												
u11	Sales Manager	Manager	Sales	27	University	F	5-10 years	Betw 10-20 hrs	English	4 months	Few / a week	İstanbul	16	4	2	2	1												
u12	Facility Manager/Owner	Manager	Facility	34	University	M	3-5 years	Betw 5-10 hrs		4 months	Once/ a week	Ankara	16	3	2	3	2												
u13	Productin Planning Manager	Manager	Facility	41	University	M	5-10 years	Betw 10-20 hrs		4 months	Few / a week	İzmit	16	4	2	3	2												
u14	Sales Engineer	Engineer	Sales	26	University	M	More than 10 years	More than 20 hrs	English	4 months	Few / a month	İstanbul	16	1	1	1	1												
u15	Finance Responsible	Engineer	Finance	24	University	F	5-10 years	More than 20 hrs	English	1 week	Few / a month	İstanbul	1	1	1	1	1												
u16	Production Manager	Manager	Production, Sales	37	University	M	5-10 years	Betw 10-20 hrs	English	3 months	Few / a week	Ankara	12	4	2	2	2												
u17	Sales Executive	Manager	Sales	31	University	M	More than 10 years	Betw 10-20 hrs	English	4 months	Few/ a week	İzmir	16	4	2	1	1												
u18	Planning and Quality Assurance Executive	Manager	Production Planning	33	University	F	5-10 years	More than 20 hrs		3 months	Few/ a week	Ankara	12	4	2	3	2												
u19	Planning Chief	Manager	Production Planning	29	University	F	5-10 years	More than 20 hrs		4 months	Few/ a week	Bursa	16	4	1	2	1												
u20	Production Manager	Manager	Production, Sales	33	University	M	5-10 years	Betw 10-20 hrs	English	4 months	Few/ a week	İstanbul	16	4	2	2	1												

APPENDIX G

DESCRIPTIVE ANALYSIS

G.1 DESCRIPTIVE STATISTICS FOR SATISFACTION ITEMS

The descriptive statistics of the satisfaction items, utilized in the satisfaction data analysis is summarized in Table G.1.1.

Table G.1.1 SI Descriptive Statistics XLSTAT output

Quantitative data description

Data: workbook = Kitap2devam4.xls / sheet = Sayfa1 / range = $B$3:$AG$22 / 20 rows and 32 columns

Uniform weighting (default)

No missing values

Confidence interval (%): 95,00

	q1	q2	q3	q4	q5	q6	q7	q8	q9	q10	q11	q12	q13	q14	q15	q16
No. of values used	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
No. of values ignored	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
No. of min. val.	1	2	1	4	2	4	2	1	2	2	1	3	6	1	6	2
% of min. val.	5,000	10,000	5,000	20,000	10,000	20,000	10,000	5,000	10,000	10,000	5,000	15,000	30,000	5,000	30,000	10,000
Minimum	3,000	2,000	1,000	2,000	2,000	2,000	1,000	1,000	1,000	2,000	2,000	2,000	2,000	1,000	2,000	2,000
1st quartile	4,000	4,000	2,000	3,000	4,000	3,000	2,000	2,000	2,000	3,000	4,000	3,500	2,000	2,000	2,000	4,000
Median	4,000	4,000	4,000	3,000	4,000	4,000	3,000	3,000	4,000	4,000	4,000	4,000	4,000	3,000	4,000	4,000
3rd quartile	5,000	5,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
Maximum	5,000	5,000	5,000	4,000	5,000	5,000	4,000	5,000	5,000	5,000	5,000	5,000	4,000	5,000	5,000	4,000
Range	2,000	3,000	4,000	2,000	3,000	3,000	3,000	4,000	4,000	3,000	3,000	3,000	2,000	4,000	3,000	2,000
Sum	86,000	82,000	67,000	65,000	80,000	70,000	57,000	58,000	65,000	71,000	76,000	73,000	67,000	60,000	68,000	74,000
Mean	4,300	4,100	3,350	3,250	4,000	3,500	2,850	2,900	3,250	3,550	3,800	3,650	3,350	3,000	3,400	3,700
Geometric mean	4,263	3,991	3,108	3,149	3,902	3,362	2,648	2,700	2,979	3,462	3,742	3,542	3,203	2,779	3,239	3,626
Harmonic mean	4,225	3,846	2,817	3,038	3,774	3,209	2,400	2,490	2,626	3,361	3,670	3,409	3,038	2,542	3,061	3,529
Kurtosis	−0,824	1,060	−1,187	−1,347	1,513	−1,048	−1,084	−1,233	−0,989	−0,446	1,813	−0,006	−1,533	−1,496	−1,407	1,648
Skewness	−0,032	−1,144	−0,295	−0,424	−1,195	−0,354	−0,341	0,186	−0,654	−0,502	−1,183	−1,021	−0,691	0,000	−0,500	−1,778
Kurtosis	−0,395	2,326	−0,919	−1,152	2,980	−0,719	−0,770	−0,987	−0,633	0,151	3,415	0,786	−1,419	−1,366	−1,238	3,176
Skewness	−0,038	−1,338	−0,345	−0,496	−1,398	−0,415	−0,399	0,217	−0,764	−0,587	−1,384	−1,194	−0,808	0,000	−0,585	−2,079
CV (standard deviation/mean)	0,133	0,208	0,353	0,242	0,199	0,270	0,347	0,369	0,358	0,214	0,162	0,223	0,279	0,375	0,293	0,178
Sample variance	0,310	0,690	1,328	0,588	0,600	0,850	0,928	1,090	1,288	0,548	0,360	0,628	0,828	1,200	0,940	0,410
Estimated variance	0,326	0,726	1,397	0,618	0,632	0,895	0,976	1,147	1,355	0,576	0,379	0,661	0,871	1,263	0,989	0,432
Sample standard deviation	0,557	0,831	1,152	0,766	0,775	0,922	0,963	1,044	1,135	0,740	0,600	0,792	0,910	1,095	0,970	0,640
Estimated standard deviation	0,571	0,852	1,182	0,786	0,795	0,946	0,988	1,071	1,164	0,759	0,616	0,813	0,933	1,124	0,995	0,657
Mean absolute deviation	0,490	0,540	1,015	0,675	0,400	0,800	0,795	0,910	1,000	0,640	0,420	0,625	0,845	1,000	0,880	0,480
Median absolute deviation	0,000	0,000	1,000	1,000	0,000	0,500	1,000	1,000	0,000	0,000	0,000	0,000	0,000	1,000	0,000	0,000
Standard-error	0,128	0,191	0,264	0,176	0,178	0,212	0,221	0,240	0,260	0,170	0,138	0,182	0,209	0,251	0,222	0,147
Lower bound. Mean IC	4,033	3,701	2,797	2,882	3,628	3,057	2,388	2,399	2,705	3,195	3,512	3,270	2,913	2,474	2,934	3,393
Upper bound. Mean IC	4,567	4,499	3,903	3,618	4,372	3,943	3,312	3,401	3,795	3,905	4,088	4,030	3,787	3,526	3,866	4,007

Note: The standard deviation and confidence interval of the mean are valid only if the sample results from simple random sampling

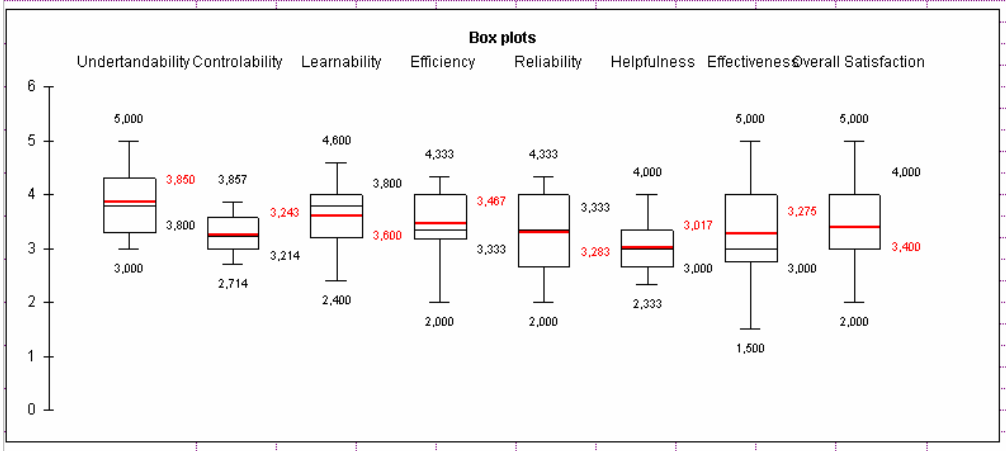
G.2 DESCRIPTIVE STATISTICS FOR USABILITY ATTRIBUTES

The descriptive statistics of the satisfaction items, utilized in the satisfaction data analysis is summarized in Table G.2.1.

Table G.2.1 Descriptive Statistics for Usability Attributes

XLSTAT 6.1.9 – Descriptive statistics –
Quantitative data description
Data: workbook = satfa 1 with attr.xls / sheet = Sayfa1 / range
Uniform weighting (default)
No missing values
Confidence interval (%): 95,00

	Undertandability	Controlability	Learnability	Efficiency	Reliability	Helpfulness	Effectiveness	Overall Satisfaction
No. of values used	20	20	20	20	20	20	20	20
No. of values ignored	0	0	0	0	0	0	0	0
No. of min. val.	1	1	1	1	1	1	1	4
% of min. val.	5,000	5,000	5,000	5,000	5,000	5,000	5,000	20,000
Minimum	3,000	2,714	2,400	2,000	2,000	2,333	1,500	2,000
1st quartile	3,300	3,000	3,200	3,167	2,667	2,667	2,750	3,000
Median	3,800	3,214	3,800	3,333	3,333	3,000	3,000	4,000
3rd quartile	4,300	3,571	4,000	4,000	4,000	3,333	4,000	4,000
Maximum	5,000	3,857	4,600	4,333	4,333	4,000	5,000	5,000
Range	2,000	1,143	2,200	2,333	2,333	1,667	3,500	3,000
Sum	77,000	64,857	72,000	69,333	65,667	60,333	65,500	68,000
Mean	3,850	3,243	3,600	3,467	3,283	3,017	3,275	3,400
Geometric mean	3,807	3,227	3,557	3,405	3,210	2,991	3,140	3,277
Harmonic mean	3,766	3,212	3,510	3,337	3,133	2,966	2,993	3,141
Kurtosis	-1,146	-1,226	-0,639	-0,677	-1,311	-0,324	-0,916	-1,076
Skewness	0,364	0,174	-0,518	-0,507	-0,256	0,402	-0,028	-0,367
Kurtosis	-0,860	-0,976	-0,128	-0,183	-1,098	0,327	-0,529	-0,760
Skewness	0,425	0,204	-0,605	-0,593	-0,299	0,470	-0,032	-0,429
CV (standard deviation/mean)	0,154	0,100	0,153	0,183	0,209	0,135	0,282	0,260
Sample variance	0,336	0,100	0,288	0,382	0,448	0,158	0,812	0,740
Estimated variance	0,353	0,105	0,303	0,402	0,471	0,166	0,855	0,779
Sample standard deviation	0,579	0,317	0,537	0,618	0,669	0,398	0,901	0,860
Estimated standard deviation	0,594	0,325	0,551	0,634	0,686	0,408	0,924	0,883
Mean absolute deviation	0,480	0,271	0,440	0,513	0,565	0,305	0,753	0,760
Median absolute deviation	0,500	0,286	0,200	0,667	0,667	0,333	0,750	0,500
Standard-error	0,133	0,073	0,123	0,142	0,153	0,091	0,207	0,197
Lower bound. Mean IC	3,572	3,091	3,342	3,170	2,962	2,826	2,842	2,987
Upper bound. Mean IC	4,128	3,395	3,858	3,764	3,605	3,208	3,708	3,813



G.3 SATISFACTION ITEMS DISSIMILARITIES MATRIX

The dissimilarities matrix for the satisfaction items, used for MDS study is presented in Table G.3.1.

Table G.3.1 SI Dissimilarities Matrix

Data: workbook = Kitap2devam5.xls / sheet = Sayfa1 / range = $B$3:$AG$22 / 20 rows and 32 columns
The calculations are made by crossing columns
No missing values
Euclidean distance
Matrix (Euclidean distance):

	q1	q2	q3	q4	q5	q6	q7	q8	q9	q10	q11	q12	q13	q14	q15	q16	q17	q18	q19	q20	q21	q22	q23
q1	0	3,742	6,245	5,385	3,742	4,899	7,550	8,246	6,708	5,000	3,464	4,796	6,083	8,367	6,164	4,472	6,164	5,196	4,583	7,416	3,317	5,657	4,899
q2	3,742	0	5,568	5,385	4,472	5,657	8,307	8,367	7,280	5,745	4,472	5,568	6,856	8,000	5,657	5,099	5,477	6,083	5,000	6,245	4,123	6,325	5,657
q3	6,245	5,568	0	5,099	7,000	5,745	5,099	7,810	6,164	5,831	5,745	5,477	6,000	8,544	6,083	6,708	5,000	5,292	6,633	5,099	7,071	6,403	6,083
q4	5,385	5,385	5,099	0	4,583	3,873	4,899	6,083	4,690	4,472	3,873	4,899	4,899	5,745	4,359	4,583	3,873	4,690	5,657	4,690	5,477	3,873	3,317
q5	3,742	4,472	7,000	4,583	0	4,472	7,416	7,071	5,916	5,000	3,464	4,796	5,745	7,071	5,477	4,243	5,657	5,916	4,796	6,856	3,873	5,099	4,243
q6	4,899	5,657	5,745	3,873	4,472	0	5,000	6,164	4,796	5,196	4,690	4,796	4,796	7,071	5,099	4,472	4,690	4,359	5,000	6,083	5,196	4,690	4,472
q7	7,550	8,307	5,099	4,899	7,416	5,000	0	5,196	4,472	5,831	6,083	5,477	4,472	7,280	6,083	6,245	5,000	4,472	6,633	5,657	7,616	5,196	5,000
q8	8,246	8,367	7,810	6,083	7,071	6,164	5,196	0	4,796	5,916	6,325	5,385	5,745	4,899	5,477	5,657	5,477	5,745	5,568	6,083	6,856	5,099	4,899
q9	6,708	7,280	6,164	4,690	5,916	4,796	4,472	4,796	0	5,099	5,000	4,472	5,292	6,708	4,359	5,745	5,745	5,099	5,831	6,633	6,481	5,385	5,000
q10	5,000	5,745	5,831	4,472	5,000	5,196	5,831	5,916	5,099	0	4,123	2,828	5,292	5,385	4,359	4,583	4,123	4,690	4,000	5,477	4,690	3,606	3,000
q11	3,464	4,472	5,745	3,873	3,464	4,690	6,083	6,325	5,000	4,123	0	4,123	5,000	6,633	5,099	3,742	4,899	4,123	3,873	5,745	3,317	3,742	3,162
q12	4,796	5,568	5,477	4,899	4,796	4,796	5,477	5,385	4,472	2,828	4,123	0	5,657	6,083	3,873	5,000	4,583	4,000	4,243	6,000	4,690	4,359	3,873
q13	6,083	6,856	6,000	4,899	5,745	4,796	4,472	5,745	5,292	5,292	5,000	5,657	0	6,403	5,916	3,873	4,796	4,472	5,292	5,477	6,164	4,359	4,123
q14	8,367	8,000	8,544	5,745	7,071	7,071	7,280	4,899	6,708	5,385	6,633	6,083	6,403	0	4,690	5,657	5,292	6,708	6,083	5,568	7,280	4,899	4,899
q15	6,164	5,657	6,083	4,359	5,477	5,099	6,083	5,477	4,359	4,359	5,099	3,873	5,916	4,690	0	5,099	4,472	5,196	5,196	5,745	5,916	4,899	4,472
q16	4,472	5,099	6,708	4,583	4,243	4,472	6,245	5,657	5,745	4,583	3,742	5,000	3,873	5,657	5,099	0	4,472	5,000	3,000	5,745	3,873	4,000	3,162
q17	6,164	5,477	5,000	3,873	5,657	4,690	5,000	5,477	5,745	4,123	4,899	4,583	4,796	5,292	4,472	4,472	0	4,123	4,359	3,000	5,385	3,464	3,162
q18	5,196	6,083	5,292	4,690	5,916	4,359	4,472	5,745	5,099	4,690	4,123	4,000	4,472	6,708	5,196	5,000	4,123	0	4,690	5,477	5,099	3,317	3,873
q19	4,583	5,000	6,633	5,657	4,796	5,000	6,633	5,568	5,831	4,000	3,873	4,243	5,292	6,083	5,196	3,000	4,359	4,690	0	5,657	3,162	4,123	3,606
q20	7,416	6,245	5,099	4,690	6,856	6,083	5,657	6,083	6,633	5,477	5,745	6,000	5,477	5,568	5,745	5,745	3,000	5,477	5,657	0	6,782	5,000	4,796
q21	3,317	4,123	7,071	5,477	3,873	5,196	7,616	6,856	6,481	4,690	3,317	4,690	6,164	7,280	5,916	3,873	5,385	5,099	3,162	6,782	0	4,796	4,123
q22	5,657	6,325	6,403	3,873	5,099	4,690	5,196	5,099	5,385	3,606	3,742	4,359	4,359	4,899	4,899	4,000	3,464	3,317	4,123	5,000	4,796	0	2,000
q23	4,899	5,657	6,083	3,317	4,243	4,472	5,000	4,899	5,000	3,000	3,162	3,873	4,123	4,899	4,472	3,162	3,162	3,873	3,606	4,796	4,123	2,000	0
q24	7,550	6,708	5,657	4,243	7,000	5,916	5,477	5,745	6,633	5,292	5,568	6,000	5,831	5,196	5,745	5,568	3,317	5,292	5,657	3,162	6,325	4,123	4,359
q25	8,000	7,616	6,083	4,796	7,211	5,831	4,359	4,000	5,745	5,385	6,164	5,385	5,745	5,099	5,477	6,164	3,742	5,000	5,916	3,873	6,708	4,472	4,472
q26	7,280	7,550	6,325	4,899	6,245	5,568	4,472	4,796	5,292	4,472	5,568	5,477	4,690	5,916	6,083	5,745	4,359	5,477	5,477	4,690	6,325	4,359	3,873
q27	7,483	7,746	6,557	4,796	6,325	6,000	4,583	4,690	5,196	4,583	5,477	5,385	5,000	5,657	6,000	5,831	4,243	5,385	5,568	4,583	6,245	4,243	3,742
q28	4,243	4,899	5,568	5,000	4,899	4,000	6,083	6,928	5,745	4,796	4,000	4,359	5,745	7,483	5,099	4,690	4,243	3,606	3,606	5,916	3,873	4,243	4,243
q29	6,245	6,708	6,782	5,657	6,403	4,123	5,477	5,385	5,831	5,831	5,568	5,477	5,099	6,557	5,385	4,359	4,583	4,000	4,000	6,000	5,477	4,359	4,583
q30	7,616	7,211	7,000	6,083	6,782	5,292	5,745	5,099	5,745	6,557	5,831	5,916	5,745	6,782	5,477	5,657	5,292	5,000	5,568	6,403	6,856	4,899	5,292
q31	5,745	6,403	6,000	4,243	5,916	3,606	5,292	6,083	5,477	4,690	5,385	4,472	5,657	5,916	4,123	5,000	4,583	4,243	5,099	6,000	5,831	4,123	4,359
q32	5,292	6,000	5,568	4,123	5,831	3,162	4,796	5,831	5,000	4,583	4,690	4,359	5,196	6,325	4,472	4,472	4,243	3,317	4,359	5,745	5,196	3,742	4,000

APPENDIX H

INFERENTIAL ANALYSIS

H.1 TASKMOTIV CLUSTER ANALYSIS

The Clustering Analysis that the TaskMotiv clusters formed accordingly is carried out in the XLSTAT data analysis module. The XLSTAT output containing the details of the analysis follows.

Table H.1.1 TaskMotiv Cluster Analysis XLSTAT output

XLSTAT 6.1.9
Data: workbook = Kitap2devam4.xls / sheet =
Data have been standardized by columns
Uniform weighting of observations (by default)
Uniform weighting of variables (by default)
Note: Because there is only a single active variable,
Number of clusters: 5
Repetitions: 10
Seed of the pseudo-random numbers generator:
Iterations: 50
Convergence: 0,0001
Number of partitions used in order to identify the

Decomposition of the inertia for the best solution among repetitions:

Inertia	Values
Within-groups	0,25
Between-groups	19,75
Total	20,00

Best partition obtained:

Observation	Cluster	Stable group
u1	5	
u2	1	
u3	2	
u4	5	
u5	5	
u6	4	1
u7	5	
u8	3	2
u9	5	3
u10	5	3
u11	5	3
u12	5	3
u13	5	3
u14	5	3
u15	3	2
u16	4	1
u17	5	3
u18	4	1
u19	5	3
u20	5	3

Composition of the clusters:

Cluster	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5
Within-groups inertia	0,00	0,00	0,25	0,00	0,00
Size	1	1	2	3	13
	u2	u3	u8	u6	u1
			u15	u16	u4
				u18	u5
					u7
					u9
					u10
					u11
					u12
					u13
					u14
					u17
					u19
					u20

Cluster centroids:

Cluster	Portal Experience –num
Cluster1	–1,272
Cluster2	–0,339
Cluster3	–2,556
Cluster4	–0,339
Cluster5	0,595

Central observations:

Cluster	Portal Experience –num
Cluster1 (u2)	–1,272
Cluster2 (u3)	–0,339
Cluster3 (u15)	–2,907
Cluster4 (u6)	–0,339
Cluster5 (u1)	0,595

H.2 CORRRESPONDENCY ANALYSIS SATISFACTION ITEM 1 & CLUSTER TASKMOTIV

The Correspondence Analysis for the investigation of the dependency between SI 1 and the TaskMotiv clusters is carried out in the XLSTAT data analysis module. The XLSTAT output containing the details of the analysis follows.

Table H.2.1 CA XLSTAT output TaskMotiv-q1

XLSTAT 6.1.9

Contingency table: workbook = Kitap2devam3.xls / sheet = Cluster answers / range =

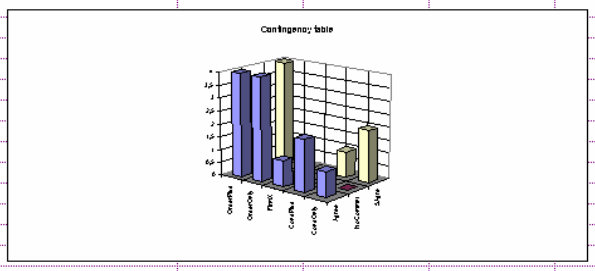
Number of factors associated with non trivial eigenvalues: 2

List of the removed column categories:

Categories
Dsgr
SDsgr

Contingency table:

	Agree	NoCommnt	SAgre
ConsOnly	1	0	2
ConsPlus	2	0	1
FirmX	1	1	0
OrderOnly	4	0	0
OrderPlus	4	0	4



Chi-square independence test:	
Chi-square (observed value)	14,087
Chi-square (critical value) (df = 8)	15,507
One-tailed p-value	0,080
Alpha	0,050

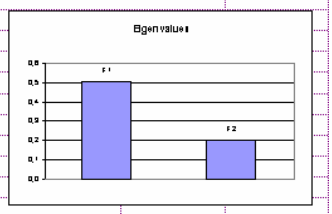
Decision:

At the level of significance alpha=0,050 the decision is to not reject the null hypothesis of

In other words, the dependence between the rows and the columns is not significant.

Eigenvalues and variance percentages:

	F1	F2
Eigenvalue	0,503	0,201
% variance	71,457	28,543
% cumulative	71,457	100,000



Weights, distances from the origin and inertia of the points-

	Weight	Distance d	d²	Inertia	Normed inertia
Agree	0,600	0,366	0,134	0,081	0,114
NoCommnt	0,050	3,000	9,000	0,450	0,639
SAgre	0,350	0,705	0,497	0,174	0,247

Coordinates of the points-columns:

	F1	F2
Agree	0,019	-0,366
NoCommnt	2,937	0,612
SAgre	-0,453	0,540

Contributions of the points–columns (%):

	F1	F2
Agree	0,045	39,955
NoCommnt	85,686	9,314
SAgre	14,268	50,732

Squared cosines of the points–columns:

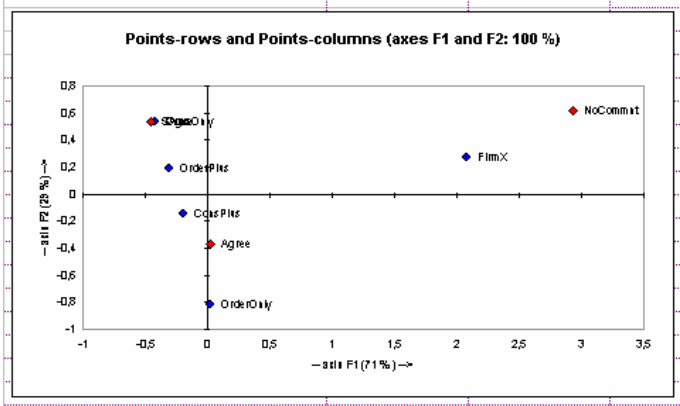
	F1	F2
Agree	0,003	0,997
NoCommnt	0,958	0,042
SAgre	0,413	0,587

Weights, distances from the origin and inertia of the points–rows:

	Weight	Distance d	d²	Inertia	Normed inertia
ConsOnly	0,150	0,675	0,455	0,068	0,097
ConsPlus	0,150	0,241	0,058	0,009	0,012
FirmX	0,100	2,102	4,417	0,442	0,627
OrderOnly	0,200	0,816	0,667	0,133	0,189
OrderPlus	0,400	0,362	0,131	0,052	0,074

Coordinates of the points–rows:

	F1	F2
ConsOnly	–0,417	0,531
ConsPlus	–0,195	–0,143
FirmX	2,084	0,274
OrderOnly	0,027	–0,816
OrderPlus	–0,306	0,194



Contributions of the points–rows (%):

	F1	F2
ConsOnly	5,170	21,007
ConsPlus	1,128	1,519
FirmX	86,255	3,745
OrderOnly	0,030	66,245
OrderPlus	7,418	7,484

H.3 CORRRESPONDENCY ANALYSIS SATISFACTION ITEM 19 & CLUSTER PORTALEXPER

The Correspondence Analysis for the investigation of the dependency between SI 19 and the Portal Exper clusters is carried out in the XLSTAT data analysis module. The XLSTAT output containing the details of the analysis follows.

Table H.3.1 CA Analysis XLSTAT Output--Portal

Sayı Quest #	q19				
Portal Experience -num	2	3	4	5	Genel Toplam
1	0	1	0	0	1
4	0	1	0	0	1
8	0	0	1	0	1
12	1	1	1	1	4
16	0	1	12	0	13

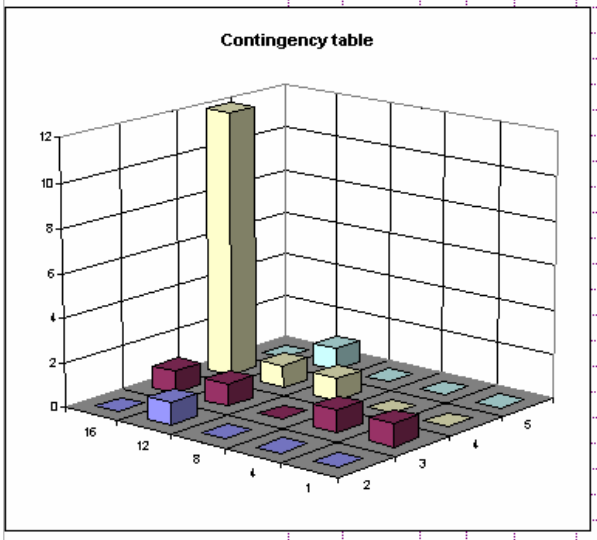
XLSTAT 6.1.9

Contingency table: workbook = Kitap2devam4.xls / sheet = Sayfa7 / range = $B$15:$E$19 / 5 rows and 4 columns

Number of factors associated with non trivial eigenvalues: 2

Contingency table:

	2	3	4	5
1	0	1	0	0
4	0	1	0	0
8	0	0	1	0
12	1	1	1	1
16	0	1	12	0



Chi-square independence test:

Chi-square (observed value)	19,245
Chi-square (critical value) (df = 12)	21,026
One-tailed p-value	0,083
Alpha	0,050

Decision:

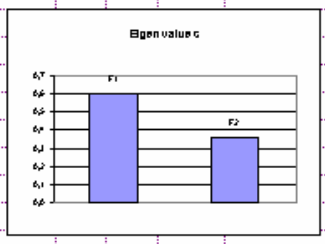
At the level of significance alpha=0,050 the decision is to not reject the null hypothesis of independence between the rows

In other words, the dependence between the rows and the columns is not significant.

Eigenvalues and variance percentages:

	F1	F2
Eigenvalue	0,604	0,358
% variance	62,780	37,220
% cumulative	62,780	100,000

Number of removed trivial eigenvalues: 1



Weights, distances from the origin and inertia of the points-columns:

	Weight	Distance d	d^2	Inertia	Normed inertia
2	0,050	2,000	4,000	0,200	0,208
3	0,200	1,382	1,909	0,382	0,397
4	0,700	0,508	0,258	0,180	0,188
5	0,050	2,000	4,000	0,200	0,208

Coordinates of the points-columns:

	F1	F2
2	1,381	-1,446
3	1,081	0,860
4	-0,506	-0,039
5	1,381	-1,446

Contributions of the points-columns (%):

	F1	F2
2	15,791	29,209
3	38,715	41,285
4	29,702	0,298
5	15,791	29,209

Squared cosines of the points-columns:

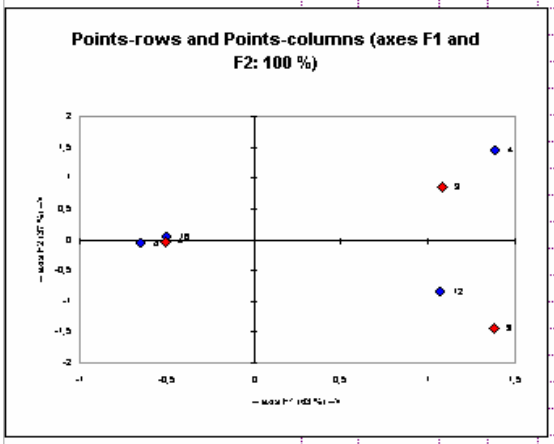
	F1	F2
2	0,477	0,523
3	0,613	0,387
4	0,994	0,006
5	0,477	0,523

Weights, distances from the origin and inertia of the points-rows:

	Weight	Distance d	d^2	Inertia	Normed inertia
1	0,050	2,000	4,000	0,200	0,208
4	0,050	2,000	4,000	0,200	0,208
8	0,050	0,655	0,429	0,021	0,022
12	0,200	1,379	1,902	0,380	0,395
16	0,650	0,497	0,247	0,160	0,167

Coordinates of the points-rows:

	F1	F2
1	1,391	1,437
4	1,391	1,437
8	-0,651	-0,065
12	1,074	-0,866
16	-0,494	0,050



Contributions of the points-rows (%):

	F1	F2
1	16,022	28,819
4	16,022	28,819
8	3,512	0,059
12	38,157	41,843
16	26,286	0,460

Squared cosines of the points-rows:

	F1	F2
1	0,484	0,516
4	0,484	0,516
8	0,990	0,010
12	0,606	0,394
16	0,990	0,010

H.4 CORRRESPONDENCY ANALYSIS SATISFACTION ITEM 28 & CLUSTER PORTALEXPER

The Correspondence Analysis for the investigation of the dependency between SI 19 and the PortalExper clusters is carried out in the XLSTAT data analysis module. The XLSTAT output containing the details of the analysis follows.

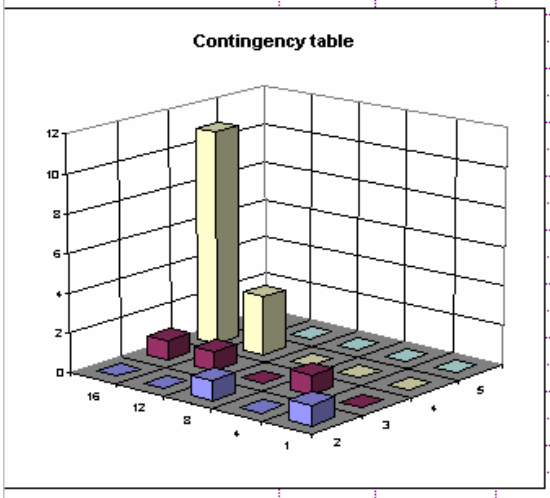
Table H.4.1 CA Analysis XLSTAT Output--Portal Exper-q28

Sayı Quest #	q28			
Portal Experience –num	2	3	4	5
1	1	0	0	0
4	0	1	0	0
8	1	0	0	0
12	0	1	3	0
16	0	1	11	1

XLSTAT 6.1.9 – Correspondence Analysis (CA) –
Contingency table: workbook = Kitap2devam4.xls / sheet =
Number of factors associated with non trivial eigenvalues: 3

Contingency table:

	2	3	4	5
1	1	0	0	0
4	0	1	0	0
8	1	0	0	0
12	0	1	3	0
16	0	1	11	1



Chi-square independence test:

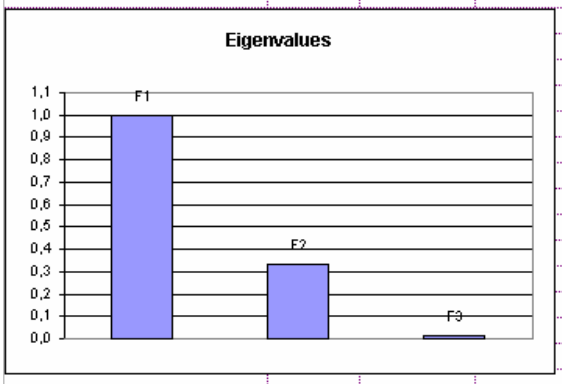
Chi-square (observed value)	26,896
Chi-square (critical value) (df = 12)	21,026
One-tailed p-value	0,008
Alpha	0,050

Decision:

At the level of significance alpha=0,050 the decision is to reject the null hypothesis of independence between the rows and the columns.

In other words, the dependence between the rows and the columns is significant.

Eigenvalues and variance percentages:					
	F1	F2	F3		
Eigenvalue	1,000	0,332	0,012		
% variance	74,362	24,716	0,922		
% cumulative	74,362	99,078	100,000		



Weights, distances from the origin and inertia of the points–

	Weight	Distance d	d²	Inertia	Normed inertia
2	0,100	3,162	10,000	1,000	0,744
3	0,150	1,356	1,838	0,276	0,205
4	0,700	0,261	0,068	0,048	0,036
5	0,050	0,654	0,427	0,021	0,016

Coordinates of the points-columns:

	F1	F2	F3
2	3,162	0,000	0,000
3	0,000	1,355	0,019
4	0,000	–0,258	–0,038
5	0,000	–0,448	0,476

Contributions of the points–columns (%):

	F1	F2	F3
2	100,000	0,000	0,000
3	0,000	82,913	0,420
4	0,000	14,068	8,154
5	0,000	3,018	91,426

Squared cosines of the points–columns:

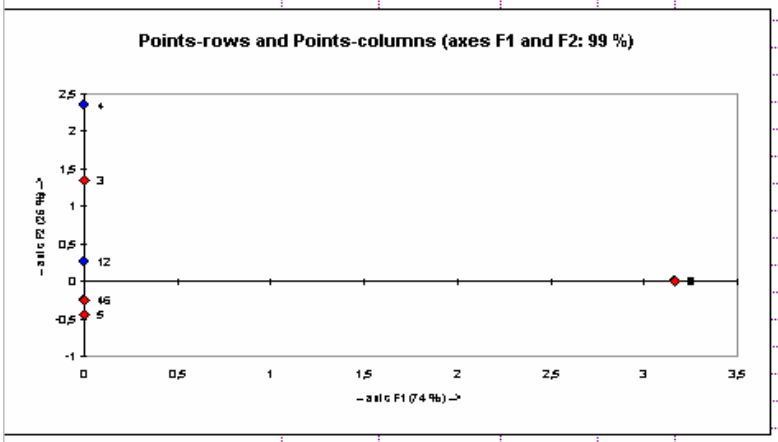
	F1	F2	F3
2	1,000	0,000	0,000
3	0,000	1,000	0,000
4	0,000	0,979	0,021
5	0,000	0,470	0,530

Weights, distances from the origin and inertia of the points–rows:

	Weight	Distance d	d^2	Inertia	Normed inertia
1	0,050	3,162	10,000	0,500	0,372
4	0,050	2,357	5,556	0,278	0,207
8	0,050	3,162	10,000	0,500	0,372
12	0,200	0,330	0,109	0,022	0,016
16	0,650	0,264	0,070	0,045	0,034

Coordinates of the points–rows:

	F1	F2	F3
1	3,162	0,000	0,000
4	0,000	2,351	0,167
8	3,162	0,000	0,000
12	0,000	0,252	–0,214
16	0,000	–0,258	0,053



Contributions of the points–rows (%):

	F1	F2	F3
1	50,000	0,000	0,000
4	0,000	83,151	11,294
8	50,000	0,000	0,000
12	0,000	3,807	73,971
16	0,000	13,042	14,736

Squared cosines of the points–rows:

	F1	F2	F3
1	1,000	0,000	0,000
4	0,000	0,995	0,005
8	1,000	0,000	0,000
12	0,000	0,580	0,420
16	0,000	0,960	0,040

H.5 MULTIDIMENSIONAL SCALING ANALYSIS

The Multi Dimensional Scaling for the investigation of the perceive of the SI according to the Usability Attributes determined by the users is carried out in the XLSTAT data analysis module. The XLSTAT output containing the details of the analysis follows.

Table H.5.1 Multidimensional Scaling

XLSTAT 6.1.9

Dissimilarity matrix: workbook = Kitap2devam5.xls / sheet = Sim. Dissim. Mat._1 / range =

Uniform weighting (default)

No missing values

Metric Multidimensional Scaling

Multidimensional Scaling model: absolute

Stress used for the results: Kruskal's stress-1

Dimension of the representation space: from 2 to 4

Number of repetitions: 10

Seed of the pseudo-random numbers generator: 2867885274

Iterations: 50

Convergence: 0,0001

Best stress value for each dimension:

Dimension	2	3	4
Stress	0,296	0,205	0,155

Best stress value obtained for the representation space with 4 Dimensions

Space with 4 Dimensions:

Model: Dij= Pij

Observation coordinates:

Observation	Dim1	Dim2	Dim3	Dim4
q1	-2,100	-3,182	-1,993	-1,887
q2	-1,637	-4,638	-1,021	-0,400
q3	1,770	0,257	-3,607	-2,860
q4	0,662	0,232	-2,446	0,173
q5	-2,649	-1,996	-2,436	1,081
q6	-2,536	1,078	-1,401	-0,892
q7	2,425	2,646	-2,366	0,040
q8	0,993	1,048	1,070	4,205
q9	-0,739	0,849	-2,266	3,198
q10	0,711	-2,398	0,727	1,443
q11	-0,803	-1,762	-2,076	0,036
q12	1,060	-2,840	-0,190	0,437
q13	-1,208	2,948	-1,806	0,592
q14	-0,733	1,831	3,894	2,608
q15	-1,263	-1,262	1,847	2,450
q16	-3,018	0,501	0,557	0,341
q17	1,885	-0,462	1,449	-0,575
q18	1,417	-0,602	-0,913	-2,069
q19	-2,156	-1,221	1,926	-0,531
q20	4,124	-0,289	0,665	-0,300
q21	-2,737	-2,811	0,527	-0,819
q22	0,451	0,097	0,886	0,383
q23	-0,384	0,002	0,173	0,926
q24	2,820	0,982	2,538	-0,540
q25	2,831	1,471	1,916	1,241
q26	2,231	1,991	-0,650	2,236
q27	2,214	2,361	0,227	2,001
q28	-1,531	-0,777	-0,159	-2,780
q29	-1,379	1,406	2,210	-2,156
q30	-0,547	3,962	0,611	-2,130
q31	0,236	-0,088	1,497	-2,948
q32	-0,409	0,663	0,610	-2,505

In the case of the absolute model, the disparities are equal than the dissimilarities

Comparative table:

Pair	Dissimilarity	Disparity	Distance	Dissimilarity rank	Disparity rank	Distance rank
q31 - q32	1,732	1,732	1,401	1	1	3
q26 - q27	1,732	1,732	0,980	1	1	1
q22 - q23	2,000	2,000	1,229	2	2	2
q29 - q32	2,646	2,646	2,044	3	3	9
q10 - q12	2,828	2,828	1,473	4	4	4
q17 - q20	3,000	3,000	2,394	5	5	14
q24 - q25	3,000	3,000	1,948	5	5	6
q10 - q23	3,000	3,000	2,744	5	5	27
q16 - q19	3,000	3,000	2,519	5	5	18
q20 - q24	3,162	3,162	2,623	6	6	20
q19 - q21	3,162	3,162	2,215	6	6	12
q11 - q23	3,162	3,162	3,023	6	6	44
q6 - q32	3,162	3,162	3,368	6	6	74
q17 - q23	3,162	3,162	3,040	6	6	45
q16 - q23	3,162	3,162	2,771	6	6	29
q28 - q32	3,162	3,162	2,000	6	6	7
q25 - q27	3,162	3,162	2,146	6	6	10
q11 - q21	3,317	3,317	3,514	7	7	89
q18 - q22	3,317	3,317	3,266	7	7	66
q1 - q21	3,317	3,317	2,835	7	7	30
q4 - q23	3,317	3,317	2,928	7	7	38
q18 - q32	3,317	3,317	2,728	7	7	24
q17 - q24	3,317	3,317	2,036	7	7	8
q5 - q11	3,464	3,464	2,164	8	8	11
q29 - q31	3,464	3,464	2,444	8	8	16
q17 - q22	3,464	3,464	1,898	8	8	5
q1 - q11	3,464	3,464	2,721	8	8	22
q25 - q26	3,606	3,606	2,864	9	9	33
q19 - q28	3,606	3,606	3,161	9	9	58
q19 - q23	3,606	3,606	3,135	9	9	54
q6 - q31	3,606	3,606	4,654	9	9	206
q28 - q29	3,606	3,606	3,285	9	9	69
q10 - q22	3,606	3,606	2,728	9	9	23
q18 - q28	3,606	3,606	3,129	9	9	53
q17 - q25	3,742	3,742	2,854	10	10	32
q1 - q5	3,742	3,742	3,272	10	10	68
q22 - q32	3,742	3,742	3,078	10	10	48
q11 - q16	3,742	3,742	4,129	10	10	149
q1 - q2	3,742	3,742	2,343	10	10	13
q23 - q27	3,742	3,742	3,671	10	10	106
q11 - q22	3,742	3,742	3,731	10	10	110
q4 - q11	3,873	3,873	2,506	11	11	17
q4 - q22	3,873	3,873	3,348	11	11	72
q4 - q17	3,873	3,873	4,208	11	11	156
q5 - q21	3,873	3,873	3,614	11	11	100
q28 - q31	3,873	3,873	2,523	11	11	19
q11 - q19	3,873	3,873	4,296	11	11	166
q12 - q23	3,873	3,873	3,245	11	11	65
q12 - q15	3,873	3,873	4,011	11	11	134
q16 - q21	3,873	3,873	3,521	11	11	91
q4 - q6	3,873	3,873	3,629	11	11	102
q13 - q16	3,873	3,873	3,861	11	11	122
q20 - q25	3,873	3,873	2,951	11	11	40
q21 - q28	3,873	3,873	3,148	11	11	55
q23 - q26	3,873	3,873	3,632	11	11	103
q18 - q23	3,873	3,873	3,709	11	11	108
q10 - q19	4,000	4,000	3,865	12	12	123
q18 - q29	4,000	4,000	4,649	12	12	205
q12 - q18	4,000	4,000	3,455	12	12	82
q11 - q28	4,000	4,000	3,620	12	12	101
q19 - q29	4,000	4,000	3,197	12	12	61

Pair	Dissimilarity	Disparity	Distance	Dissimilarity rank	Disparity rank	Distance rank	
q16 - q22	4,000	4,000	3,509	12	12	88	
q8 - q25	4,000	4,000	3,614	12	12	99	
q6 - q28	4,000	4,000	3,091	12	12	49	
q23 - q32	4,000	4,000	3,522	12	12	92	
q21 - q23	4,123	4,123	4,077	13	13	140	
q6 - q29	4,123	4,123	4,010	13	13	132	
q4 - q32	4,123	4,123	4,224	13	13	157	
q22 - q31	4,123	4,123	3,398	13	13	77	
q10 - q17	4,123	4,123	3,118	13	13	51	
q10 - q11	4,123	4,123	3,540	13	13	94	
q22 - q24	4,123	4,123	3,158	13	13	56	
q11 - q18	4,123	4,123	3,472	13	13	84	
q11 - q12	4,123	4,123	2,890	13	13	36	
q2 - q21	4,123	4,123	2,669	13	13	21	
q19 - q22	4,123	4,123	3,233	13	13	64	
q13 - q23	4,123	4,123	3,659	13	13	105	
q15 - q31	4,123	4,123	5,734	13	13	336	
q17 - q18	4,123	4,123	2,837	13	13	31	
q1 - q28	4,243	4,243	3,204	14	14	62	
q17 - q32	4,243	4,243	3,310	14	14	70	
q22 - q28	4,243	4,243	3,973	14	14	128	
q17 - q28	4,243	4,243	4,384	14	14	177	
q17 - q27	4,243	4,243	4,026	14	14	136	
q4 - q31	4,243	4,243	5,057	14	14	249	
q4 - q24	4,243	4,243	5,529	14	14	310	
q5 - q23	4,243	4,243	3,995	14	14	131	
q5 - q16	4,243	4,243	3,984	14	14	130	
q23 - q28	4,243	4,243	3,971	14	14	127	
q12 - q19	4,243	4,243	4,287	14	14	163	
q18 - q31	4,243	4,243	2,870	14	14	35	
q22 - q27	4,243	4,243	3,360	14	14	73	
q12 - q28	4,359	4,359	4,617	15	15	199	
q12 - q22	4,359	4,359	3,187	15	15	60	
q23 - q24	4,359	4,359	4,355	15	15	175	
q12 - q32	4,359	4,359	4,871	15	15	230	
q17 - q26	4,359	4,359	4,294	15	15	165	
q23 - q31	4,359	4,359	4,141	15	15	151	
q29 - q30	4,359	4,359	3,128	15	15	52	
q19 - q32	4,359	4,359	3,497	15	15	86	
q24 - q27	4,359	4,359	3,750	15	15	111	
q10 - q15	4,359	4,359	2,730	15	15	25	
q7 - q25	4,359	4,359	4,618	15	15	201	
q16 - q29	4,359	4,359	3,532	15	15	93	
q9 - q15	4,359	4,359	4,712	15	15	213	
q22 - q29	4,359	4,359	3,641	15	15	104	
q13 - q22	4,359	4,359	4,263	15	15	161	
q6 - q18	4,359	4,359	4,480	15	15	186	
q17 - q19	4,359	4,359	4,140	15	15	150	
q22 - q26	4,359	4,359	3,543	15	15	95	
q4 - q15	4,359	4,359	5,436	15	15	298	
q22 - q25	4,472	4,472	3,057	16	16	47	
q16 - q17	4,472	4,472	5,158	16	16	265	
q16 - q32	4,472	4,472	3,866	16	16	124	
q10 - q26	4,472	4,472	4,909	16	16	233	
q6 - q16	4,472	4,472	2,433	16	16	15	
q1 - q16	4,472	4,472	5,086	16	16	253	
q23 - q25	4,472	4,472	3,953	16	16	126	
q9 - q12	4,472	4,472	5,364	16	16	291	
q15 - q32	4,472	4,472	5,524	16	16	309	
q15 - q17	4,472	4,472	4,456	16	16	184	
q15 - q23	4,472	4,472	2,737	16	16	26	
q13 - q18	4,472	4,472	5,232	16	16	275	
q6 - q23	4,472	4,472	3,402	16	16	78	
q7 - q13	4,472	4,472	3,730	16	16	109	

Pair	Dissimilarity	Disparity	Distance	Dissimilarity rank	Disparity rank	Distance rank	
q4 - q10	4,472	4,472	4,312	16	16	168	
q7 - q9	4,472	4,472	4,819	16	16	226	
q2 - q5	4,472	4,472	3,493	16	16	85	
q7 - q18	4,472	4,472	4,257	16	16	160	
q7 - q26	4,472	4,472	2,870	16	16	34	
q5 - q6	4,472	4,472	3,798	16	16	117	
q2 - q11	4,472	4,472	3,205	16	16	63	
q1 - q19	4,583	4,583	4,588	17	17	196	
q7 - q27	4,583	4,583	3,270	17	17	67	
q17 - q29	4,583	4,583	4,150	17	17	154	
q20 - q27	4,583	4,583	4,019	17	17	135	
q17 - q31	4,583	4,583	2,914	17	17	37	
q10 - q27	4,583	4,583	5,047	17	17	246	
q12 - q17	4,583	4,583	3,169	17	17	59	
q10 - q32	4,583	4,583	5,121	17	17	259	
q10 - q16	4,583	4,583	4,853	17	17	228	
q4 - q16	4,583	4,583	4,761	17	17	218	
q4 - q5	4,583	4,583	4,093	17	17	143	
q23 - q29	4,583	4,583	4,075	17	17	139	
q4 - q20	4,690	4,690	4,707	18	18	212	
q6 - q17	4,690	4,690	5,490	18	18	305	
q13 - q26	4,690	4,690	4,097	18	18	144	
q10 - q31	4,690	4,690	5,043	18	18	245	
q4 - q9	4,690	4,690	3,395	18	18	76	
q11 - q32	4,690	4,690	4,439	18	18	181	
q12 - q21	4,690	4,690	4,064	18	18	138	
q6 - q22	4,690	4,690	4,092	18	18	142	
q20 - q26	4,690	4,690	4,116	18	18	146	
q16 - q28	4,690	4,690	3,755	18	18	113	
q14 - q15	4,690	4,690	3,750	18	18	112	
q10 - q18	4,690	4,690	4,330	18	18	172	
q24 - q26	4,690	4,690	4,385	18	18	178	
q8 - q27	4,690	4,690	2,964	18	18	42	
q4 - q18	4,690	4,690	2,940	18	18	39	
q18 - q19	4,690	4,690	4,855	18	18	229	
q10 - q21	4,690	4,690	4,149	18	18	153	
q6 - q11	4,690	4,690	3,519	18	18	90	
q7 - q32	4,796	4,796	5,224	19	19	273	
q8 - q26	4,796	4,796	3,042	19	19	46	
q8 - q9	4,796	4,796	3,896	19	19	125	
q13 - q17	4,796	4,796	5,758	19	19	337	
q10 - q28	4,796	4,796	5,126	19	19	260	
q1 - q12	4,796	4,796	4,331	19	19	173	
q6 - q13	4,796	4,796	2,762	19	19	28	
q4 - q27	4,796	4,796	4,175	19	19	155	
q21 - q22	4,796	4,796	4,494	19	19	188	
q6 - q9	4,796	4,796	4,557	19	19	193	
q5 - q19	4,796	4,796	4,741	19	19	215	
q6 - q12	4,796	4,796	5,613	19	19	325	
q5 - q12	4,796	4,796	4,464	19	19	185	
q4 - q25	4,796	4,796	5,139	19	19	263	
q20 - q23	4,796	4,796	4,706	19	19	211	
q14 - q23	4,899	4,899	4,488	20	20	187	
q2 - q28	4,899	4,899	4,618	20	20	200	
q30 - q32	4,899	4,899	3,323	20	20	71	
q1 - q6	4,899	4,899	4,435	20	20	179	
q4 - q12	4,899	4,899	3,841	20	20	121	
q8 - q14	4,899	4,899	3,758	20	20	115	
q14 - q22	4,899	4,899	4,291	20	20	164	
q4 - q13	4,899	4,899	3,385	20	20	75	
q15 - q22	4,899	4,899	3,159	20	20	57	
q5 - q28	4,899	4,899	4,778	20	20	223	
q11 - q17	4,899	4,899	4,660	20	20	208	
q22 - q30	4,899	4,899	4,725	20	20	214	

Pair	Dissimilarity	Disparity	Distance	Dissimilarity rank	Disparity rank	Distance rank
q1 - q23	4,899	4,899	5,068	20	20	250
q4 - q7	4,899	4,899	2,993	20	20	43
q8 - q23	4,899	4,899	3,814	20	20	118
q9 - q23	5,000	5,000	3,458	21	21	83
q24 - q32	5,000	5,000	4,255	21	21	159
q9 - q32	5,000	5,000	6,399	21	21	392
q16 - q31	5,000	5,000	4,758	21	21	217
q6 - q7	5,000	5,000	5,373	21	21	294
q16 - q18	5,000	5,000	5,372	21	21	293
q18 - q25	5,000	5,000	5,026	21	21	244
q4 - q28	5,000	5,000	4,447	21	21	182
q11 - q13	5,000	5,000	4,767	21	21	220
q7 - q23	5,000	5,000	4,703	21	21	210
q18 - q30	5,000	5,000	5,198	21	21	270
q12 - q16	5,000	5,000	5,326	21	21	286
q6 - q19	5,000	5,000	4,077	21	21	141
q7 - q17	5,000	5,000	4,988	21	21	240
q13 - q27	5,000	5,000	4,264	21	21	162
q5 - q10	5,000	5,000	4,646	21	21	204
q2 - q19	5,000	5,000	4,544	21	21	192
q3 - q17	5,000	5,000	5,596	21	21	321
q20 - q22	5,000	5,000	3,762	21	21	116
q1 - q10	5,000	5,000	5,196	21	21	269
q9 - q11	5,000	5,000	4,105	21	21	145
q9 - q18	5,099	5,099	6,027	22	22	362
q15 - q28	5,099	5,099	5,629	22	22	327
q5 - q22	5,099	5,099	5,052	22	22	247
q25 - q32	5,099	5,099	5,185	22	22	268
q11 - q15	5,099	5,099	4,655	22	22	207
q3 - q20	5,099	5,099	5,536	22	22	312
q15 - q16	5,099	5,099	3,507	22	22	87
q14 - q25	5,099	5,099	4,314	22	22	169
q13 - q29	5,099	5,099	5,108	22	22	256
q18 - q21	5,099	5,099	5,077	22	22	252
q3 - q7	5,099	5,099	4,010	22	22	133
q6 - q15	5,099	5,099	5,367	22	22	292
q8 - q22	5,099	5,099	3,980	22	22	129
q3 - q4	5,099	5,099	3,432	22	22	80
q8 - q30	5,099	5,099	7,156	22	22	449
q2 - q16	5,099	5,099	5,600	22	22	323
q19 - q31	5,099	5,099	3,609	22	22	96
q9 - q10	5,099	5,099	4,967	22	22	238
q21 - q32	5,196	5,196	4,510	23	23	190
q7 - q8	5,196	5,196	5,810	23	23	343
q14 - q24	5,196	5,196	5,009	23	23	242
q13 - q32	5,196	5,196	4,614	23	23	198
q6 - q21	5,196	5,196	4,345	23	23	174
q7 - q22	5,196	5,196	4,592	23	23	197
q6 - q10	5,196	5,196	5,709	23	23	331
q25 - q31	5,196	5,196	5,185	23	23	267
q15 - q19	5,196	5,196	3,113	23	23	50
q1 - q18	5,196	5,196	4,497	23	23	189
q9 - q27	5,196	5,196	4,319	23	23	170
q15 - q18	5,196	5,196	5,971	23	23	358
q13 - q19	5,292	5,292	5,785	24	24	339
q7 - q31	5,292	5,292	6,010	24	24	361
q10 - q24	5,292	5,292	4,805	24	24	225
q3 - q18	5,292	5,292	2,957	24	24	41
q6 - q30	5,292	5,292	4,226	24	24	158
q9 - q13	5,292	5,292	3,410	24	24	79
q18 - q24	5,292	5,292	4,327	24	24	171
q23 - q30	5,292	5,292	5,024	24	24	243
q24 - q31	5,292	5,292	3,835	24	24	119

Pair	Dissimilarity	Disparity	Distance	Dissimilarity rank	Disparity rank	Distance rank
q1 - q32	5,292	5,292	4,980	24	24	239
q10 - q13	5,292	5,292	6,276	24	24	385
q14 - q17	5,292	5,292	5,312	24	24	284
q17 - q30	5,292	5,292	5,349	24	24	290
q9 - q26	5,292	5,292	3,696	24	24	107
q18 - q27	5,385	5,385	5,224	25	25	272
q17 - q21	5,385	5,385	5,272	25	25	277
q12 - q27	5,385	5,385	5,568	25	25	317
q8 - q12	5,385	5,385	5,559	25	25	316
q15 - q29	5,385	5,385	5,336	25	25	288
q12 - q25	5,385	5,385	5,177	25	25	266
q9 - q22	5,385	5,385	4,455	25	25	183
q8 - q29	5,385	5,385	6,893	25	25	434
q10 - q25	5,385	5,385	4,574	25	25	195
q11 - q31	5,385	5,385	5,054	25	25	248
q25 - q29	5,385	5,385	5,418	25	25	296
q1 - q4	5,385	5,385	4,872	25	25	231
q2 - q4	5,385	5,385	5,600	25	25	324
q15 - q30	5,477	5,477	7,093	26	26	443
q19 - q26	5,477	5,477	6,622	26	26	408
q13 - q20	5,477	5,477	6,768	26	26	426
q2 - q17	5,477	5,477	5,998	26	26	359
q21 - q29	5,477	5,477	4,924	26	26	236
q18 - q20	5,477	5,477	3,612	26	26	98
q15 - q25	5,477	5,477	5,069	26	26	251
q3 - q12	5,477	5,477	5,713	26	26	332
q12 - q26	5,477	5,477	5,306	26	26	283
q18 - q26	5,477	5,477	5,098	26	26	254
q12 - q29	5,477	5,477	6,038	26	26	363
q7 - q24	5,477	5,477	5,225	26	26	274
q7 - q29	5,477	5,477	6,463	26	26	399
q7 - q12	5,477	5,477	6,070	26	26	366
q4 - q21	5,477	5,477	5,535	26	26	311
q8 - q15	5,477	5,477	3,756	26	26	114
q9 - q31	5,477	5,477	7,332	26	26	457
q5 - q15	5,477	5,477	4,762	26	26	219
q8 - q17	5,477	5,477	5,105	26	26	255
q10 - q20	5,477	5,477	4,375	26	26	176
q11 - q27	5,477	5,477	5,939	26	26	357
q2 - q3	5,568	5,568	6,950	27	27	435
q11 - q26	5,568	5,568	5,492	27	27	306
q16 - q24	5,568	5,568	6,247	27	27	381
q8 - q19	5,568	5,568	6,183	27	27	376
q3 - q28	5,568	5,568	4,864	27	27	232
q6 - q26	5,568	5,568	5,823	27	27	345
q2 - q12	5,568	5,568	3,450	27	27	81
q3 - q32	5,568	5,568	4,777	27	27	222
q11 - q24	5,568	5,568	6,502	27	27	401
q19 - q27	5,568	5,568	6,421	27	27	394
q19 - q30	5,568	5,568	5,809	27	27	342
q14 - q20	5,568	5,568	6,853	27	27	431
q30 - q31	5,568	5,568	4,298	27	27	167
q11 - q29	5,568	5,568	5,791	27	27	340
q16 - q30	5,657	5,657	4,919	28	28	235
q8 - q16	5,657	5,657	5,619	28	28	326
q12 - q13	5,657	5,657	6,424	28	28	396
q14 - q16	5,657	5,657	4,824	28	28	227
q24 - q29	5,657	5,657	4,531	28	28	191
q14 - q27	5,657	5,657	4,773	28	28	221
q5 - q17	5,657	5,657	6,384	28	28	390
q13 - q31	5,657	5,657	5,894	28	28	352
q2 - q15	5,657	5,657	5,281	28	28	278
q28 - q30	5,657	5,657	4,944	28	28	237
q7 - q20	5,657	5,657	4,561	28	28	194

Pair	Dissimilarity	Disparity	Distance	Dissimilarity rank	Disparity rank	Distance rank
q3 - q24	5,657	5,657	6,691	28	28	419
q4 - q29	5,657	5,657	5,714	28	28	333
q19 - q24	5,657	5,657	5,476	28	28	303
q19 - q20	5,657	5,657	6,477	28	28	400
q2 - q23	5,657	5,657	5,127	28	28	261
q4 - q19	5,657	5,657	5,447	28	28	300
q2 - q6	5,657	5,657	5,819	28	28	344
q1 - q22	5,657	5,657	5,541	28	28	314
q15 - q20	5,745	5,745	6,238	29	29	379
q15 - q24	5,745	5,745	5,578	29	29	319
q20 - q32	5,745	5,745	5,130	29	29	262
q9 - q16	5,745	5,745	4,631	29	29	203
q9 - q17	5,745	5,745	6,053	29	29	364
q1 - q31	5,745	5,745	5,322	29	29	285
q8 - q13	5,745	5,745	5,457	29	29	301
q7 - q30	5,745	5,745	4,913	29	29	234
q2 - q10	5,745	5,745	4,121	29	29	147
q4 - q14	5,745	5,745	7,115	29	29	446
q8 - q18	5,745	5,745	6,797	29	29	427
q3 - q6	5,745	5,745	5,287	29	29	279
q8 - q24	5,745	5,745	5,292	29	29	280
q16 - q20	5,745	5,745	7,215	29	29	450
q16 - q26	5,745	5,745	5,901	29	29	353
q24 - q28	5,745	5,745	5,858	29	29	349
q9 - q28	5,745	5,745	6,592	29	29	406
q13 - q30	5,745	5,745	3,837	29	29	120
q13 - q28	5,745	5,745	5,297	29	29	282
q11 - q20	5,745	5,745	5,837	29	29	347
q3 - q11	5,745	5,745	4,629	29	29	202
q9 - q30	5,745	5,745	6,812	29	29	428
q13 - q25	5,745	5,745	5,725	29	29	334
q5 - q13	5,745	5,745	5,210	29	29	271
q26 - q32	5,745	5,745	5,727	29	29	335
q27 - q32	5,831	5,831	5,497	30	30	307
q13 - q24	5,831	5,831	6,343	30	30	389
q21 - q31	5,831	5,831	4,661	30	30	209
q11 - q30	5,831	5,831	6,689	30	30	418
q16 - q27	5,831	5,831	5,806	30	30	341
q10 - q29	5,831	5,831	5,830	30	30	346
q9 - q19	5,831	5,831	6,146	30	30	370
q7 - q10	5,831	5,831	6,317	30	30	387
q3 - q10	5,831	5,831	6,743	30	30	423
q9 - q29	5,831	5,831	7,030	30	30	439
q5 - q32	5,831	5,831	5,850	30	30	348
q25 - q30	5,831	5,831	5,540	30	30	313
q6 - q25	5,831	5,831	6,672	30	30	413
q8 - q32	5,831	5,831	6,881	30	30	433
q14 - q31	5,916	5,916	6,421	31	31	395
q14 - q26	5,916	5,916	5,440	31	31	299
q13 - q15	5,916	5,916	5,875	31	31	351
q15 - q21	5,916	5,916	4,123	31	31	148
q5 - q18	5,916	5,916	5,542	31	31	315
q19 - q25	5,916	5,916	5,938	31	31	356
q5 - q31	5,916	5,916	6,607	31	31	407
q6 - q24	5,916	5,916	6,658	31	31	412
q12 - q30	5,916	5,916	7,489	31	31	465
q20 - q28	5,916	5,916	6,249	31	31	382
q5 - q9	5,916	5,916	4,032	31	31	137
q8 - q10	5,916	5,916	4,438	31	31	180
q20 - q29	6,000	6,000	6,244	32	32	380
q12 - q20	6,000	6,000	4,143	32	32	152
q26 - q29	6,000	6,000	6,391	32	32	391
q3 - q13	6,000	6,000	5,592	32	32	320
q6 - q27	6,000	6,000	5,936	32	32	355

Pair	Dissimilarity	Disparity	Distance	Dissimilarity rank	Disparity rank	Distance rank
q6 - q25	5,831	5,831	6,672	30	30	413
q8 - q32	5,831	5,831	6,881	30	30	433
q14 - q31	5,916	5,916	6,421	31	31	395
q14 - q26	5,916	5,916	5,440	31	31	299
q13 - q15	5,916	5,916	5,875	31	31	351
q15 - q21	5,916	5,916	4,123	31	31	148
q5 - q18	5,916	5,916	5,542	31	31	315
q19 - q25	5,916	5,916	5,938	31	31	356
q5 - q31	5,916	5,916	6,607	31	31	407
q6 - q24	5,916	5,916	6,658	31	31	412
q12 - q30	5,916	5,916	7,489	31	31	465
q20 - q28	5,916	5,916	6,249	31	31	382
q5 - q9	5,916	5,916	4,032	31	31	137
q8 - q10	5,916	5,916	4,438	31	31	180
q20 - q29	6,000	6,000	6,244	32	32	380
q12 - q20	6,000	6,000	4,143	32	32	152
q26 - q29	6,000	6,000	6,391	32	32	391
q3 - q13	6,000	6,000	5,592	32	32	320
q6 - q27	6,000	6,000	5,936	32	32	355
q25 - q28	6,000	6,000	6,675	32	32	416
q15 - q27	6,000	6,000	5,295	32	32	281
q3 - q31	6,000	6,000	5,341	32	32	289
q26 - q31	6,000	6,000	6,308	32	32	386
q12 - q24	6,000	6,000	5,109	32	32	257
q27 - q28	6,000	6,000	6,847	32	32	430
q2 - q32	6,000	6,000	6,058	32	32	365
q20 - q31	6,000	6,000	4,781	32	32	224
q12 - q14	6,083	6,083	6,814	33	33	429
q6 - q20	6,083	6,083	7,130	33	33	447
q4 - q30	6,083	6,083	5,480	33	33	304
q7 - q11	6,083	6,083	5,471	33	33	302
q7 - q15	6,083	6,083	7,240	33	33	452
q3 - q15	6,083	6,083	8,333	33	33	487
q8 - q31	6,083	6,083	7,294	33	33	454
q27 - q29	6,083	6,083	5,920	33	33	354
q24 - q30	6,083	6,083	5,144	33	33	264
q14 - q19	6,083	6,083	5,007	33	33	241
q26 - q28	6,083	6,083	6,871	33	33	432
q8 - q20	6,083	6,083	5,661	33	33	328
q15 - q26	6,083	6,083	5,391	33	33	295
q2 - q18	6,083	6,083	5,330	33	33	287
q4 - q8	6,083	6,083	5,421	33	33	297
q1 - q13	6,083	6,083	6,674	33	33	415
q27 - q31	6,083	6,083	6,002	33	33	360
q3 - q25	6,083	6,083	7,065	33	33	441
q7 - q28	6,083	6,083	6,339	33	33	388
q11 - q25	6,164	6,164	6,407	34	34	393
q3 - q9	6,164	6,164	6,719	34	34	420
q13 - q21	6,164	6,164	6,552	34	34	403
q6 - q8	6,164	6,164	6,673	34	34	414
q1 - q15	6,164	6,164	6,159	34	34	374
q16 - q25	6,164	6,164	6,149	34	34	372
q1 - q17	6,164	6,164	6,070	34	34	367
q1 - q29	6,245	6,245	6,269	35	35	384
q2 - q20	6,245	6,245	7,413	35	35	461
q26 - q30	6,245	6,245	5,680	35	35	329
q5 - q26	6,245	6,245	6,651	35	35	411
q7 - q16	6,245	6,245	6,547	35	35	402
q1 - q3	6,245	6,245	5,510	35	35	308
q21 - q27	6,245	6,245	7,702	35	35	470
q21 - q24	6,325	6,325	7,028	36	36	438
q21 - q26	6,325	6,325	7,646	36	36	469
q5 - q27	6,325	6,325	7,112	36	36	445
q2 - q22	6,325	6,325	5,570	36	36	318
q14 - q32	6,325	6,325	6,197	36	36	378
q3 - q26	6,325	6,325	6,159	36	36	373
q8 - q11	6,325	6,325	6,196	36	36	377
q13 - q14	6,403	6,403	6,167	37	37	375
q3 - q22	6,403	6,403	5,698	37	37	330
q2 - q31	6,403	6,403	6,085	37	37	368

Pair	Dissimilarity	Disparity	Distance	Dissimilarity rank	Disparity rank	Distance rank
q25 - q28	6,000	6,000	6,675	32	32	416
q15 - q27	6,000	6,000	5,295	32	32	281
q3 - q31	6,000	6,000	5,341	32	32	289
q26 - q31	6,000	6,000	6,308	32	32	386
q12 - q24	6,000	6,000	5,109	32	32	257
q27 - q28	6,000	6,000	6,847	32	32	430
q2 - q32	6,000	6,000	6,058	32	32	365
q20 - q31	6,000	6,000	4,781	32	32	224
q12 - q14	6,083	6,083	6,814	33	33	429
q6 - q20	6,083	6,083	7,130	33	33	447
q4 - q30	6,083	6,083	5,480	33	33	304
q7 - q11	6,083	6,083	5,471	33	33	302
q7 - q15	6,083	6,083	7,240	33	33	452
q3 - q15	6,083	6,083	8,333	33	33	487
q8 - q31	6,083	6,083	7,294	33	33	454
q27 - q29	6,083	6,083	5,920	33	33	354
q24 - q30	6,083	6,083	5,144	33	33	264
q14 - q19	6,083	6,083	5,007	33	33	241
q26 - q28	6,083	6,083	6,871	33	33	432
q8 - q20	6,083	6,083	5,661	33	33	328
q15 - q26	6,083	6,083	5,391	33	33	295
q2 - q18	6,083	6,083	5,330	33	33	287
q4 - q8	6,083	6,083	5,421	33	33	297
q1 - q13	6,083	6,083	6,674	33	33	415
q27 - q31	6,083	6,083	6,002	33	33	360
q3 - q25	6,083	6,083	7,065	33	33	441
q7 - q28	6,083	6,083	6,339	33	33	388
q11 - q25	6,164	6,164	6,407	34	34	393
q3 - q9	6,164	6,164	6,719	34	34	420
q13 - q21	6,164	6,164	6,552	34	34	403
q6 - q8	6,164	6,164	6,673	34	34	414
q1 - q15	6,164	6,164	6,159	34	34	374
q16 - q25	6,164	6,164	6,149	34	34	372
q1 - q17	6,164	6,164	6,070	34	34	367
q1 - q29	6,245	6,245	6,269	35	35	384
q2 - q20	6,245	6,245	7,413	35	35	461
q26 - q30	6,245	6,245	5,680	35	35	329
q5 - q26	6,245	6,245	6,651	35	35	411
q7 - q16	6,245	6,245	6,547	35	35	402
q1 - q3	6,245	6,245	5,510	35	35	308
q21 - q27	6,245	6,245	7,702	35	35	470
q21 - q24	6,325	6,325	7,028	36	36	438
q21 - q26	6,325	6,325	7,646	36	36	469
q5 - q27	6,325	6,325	7,112	36	36	445
q2 - q22	6,325	6,325	5,570	36	36	318
q14 - q32	6,325	6,325	6,197	36	36	378
q3 - q26	6,325	6,325	6,159	36	36	373
q8 - q11	6,325	6,325	6,196	36	36	377
q13 - q14	6,403	6,403	6,167	37	37	375
q3 - q22	6,403	6,403	5,698	37	37	330
q2 - q31	6,403	6,403	6,085	37	37	368
q5 - q29	6,403	6,403	6,727	37	37	421
q20 - q30	6,403	6,403	6,576	37	37	405
q9 - q21	6,481	6,481	6,429	38	38	397
q14 - q29	6,557	6,557	5,112	39	39	258
q3 - q27	6,557	6,557	6,554	39	39	404
q10 - q30	6,557	6,557	7,404	39	39	460
q9 - q24	6,633	6,633	7,052	40	40	440
q9 - q20	6,633	6,633	6,765	40	40	425
q3 - q19	6,633	6,633	7,324	40	40	455
q27 - q30	6,633	6,633	5,235	40	40	276
q7 - q19	6,633	6,633	7,395	40	40	459
q11 - q14	6,633	6,633	7,427	40	40	462
q21 - q25	6,708	6,708	7,451	41	41	463

Pair	Dissimilarity	Disparity	Distance	Dissimilarity rank	Disparity rank	Distance rank
q3 - q16	6,708	6,708	7,111	41	41	444
q9 - q14	6,708	6,708	6,266	41	41	383
q2 - q29	6,708	6,708	7,079	41	41	442
q2 - q24	6,708	6,708	8,088	41	41	479
q1 - q9	6,708	6,708	6,635	41	41	409
q14 - q18	6,708	6,708	7,451	41	41	464
q20 - q21	6,782	6,782	7,330	42	42	456
q5 - q30	6,782	6,782	7,714	42	42	472
q3 - q29	6,782	6,782	6,751	42	42	424
q14 - q30	6,782	6,782	6,149	42	42	371
q6 - q21	6,856	6,856	7,371	43	43	458
q21 - q30	6,856	6,856	7,239	43	43	451
q5 - q20	6,856	6,856	7,766	43	43	475
q2 - q13	6,856	6,856	7,702	43	43	471
q8 - q28	6,928	6,928	7,746	44	44	473
q3 - q30	7,000	7,000	6,117	45	45	369
q3 - q5	7,000	7,000	6,442	45	45	398
q5 - q8	7,071	7,071	6,677	46	46	417
q6 - q14	7,071	7,071	6,641	46	46	410
q5 - q14	7,071	7,071	7,793	46	46	476
q3 - q21	7,071	7,071	7,141	46	46	448
q5 - q25	7,211	7,211	7,811	47	47	477
q2 - q30	7,211	7,211	8,989	47	47	494
q2 - q9	7,280	7,280	6,739	48	48	422
q1 - q26	7,280	7,280	8,020	48	48	480
q7 - q14	7,280	7,280	7,511	48	48	466
q14 - q21	7,280	7,280	6,975	48	48	437
q5 - q7	7,416	7,416	6,956	49	49	436
q1 - q20	7,416	7,416	7,529	49	49	467
q14 - q28	7,483	7,483	7,273	50	50	453
q1 - q27	7,483	7,483	8,330	50	50	486
q1 - q24	7,550	7,550	7,980	51	51	478
q2 - q26	7,550	7,550	8,124	51	51	483
q1 - q7	7,550	7,550	7,635	51	51	468
q7 - q21	7,616	7,616	8,095	52	52	482
q2 - q25	7,616	7,616	8,283	52	52	485
q1 - q30	7,616	7,616	7,764	52	52	474
q2 - q27	7,746	7,746	8,435	53	53	489
q3 - q8	7,810	7,810	8,545	54	54	491
q2 - q14	8,000	8,000	8,711	55	55	493
q1 - q25	8,000	8,000	8,428	55	55	488
q1 - q8	8,246	8,246	8,599	56	56	492
q2 - q7	8,307	8,307	8,459	57	57	490
q2 - q8	8,367	8,367	8,051	58	58	481
q1 - q14	8,367	8,367	9,047	58	58	495
q3 - q14	8,544	8,544	9,742	59	59	496

In the case of the absolute mode, the disparities are equal than the dissimilarities

Summary of repetitions:

Repetition	No. of iter.	Ini. stress	Fin. stress
1	50	0,409	0,172
2	50	0,398	0,179
3	50	0,367	0,180
4	50	0,419	0,166
5	50	0,410	0,178
6	50	0,400	0,166
7	50	0,392	0,170
8	50	0,387	0,172
9	50	0,385	0,166
10	50	0,379	0,155

H.6 FACTOR ANALYSIS

The purpose of factor analysis is to describe a set of variables using a linear combination of common underlying factors, and a variable representing the specific part of the original variables. The variance of an original variable may be broken down into a part shared with other variables (explained by the factors) called the communality of the variable, and a specific part called the specific variance.

Table H.6.1 Factor Analysis

XLSTAT 6.1.9

Obs/Variables: workbook = Kitap2.xls / sheet = Sayfa1 / range = $B$3:$AG$22 / 20 rows and 32 columns

No missing values

Pearson correlation coefficient

Varimax rotation of axes

Iterations: 200

Convergence: 0,001

Number of factors used for the analysis 12

Number of performed iterations: 19

Note: The estimation of the factor scores is

Means and standard deviations of the variables:

	Mean	Standard deviation
q1	4,300	0,571
q2	4,100	0,852
q3	3,350	1,182
q4	3,250	0,786
q5	4,000	0,795
q6	3,500	0,946
q7	2,850	0,988
q8	2,900	1,071
q9	3,250	1,164
q10	3,550	0,759
q11	3,800	0,616
q12	3,650	0,813
q13	3,350	0,933
q14	3,000	1,124
q15	3,400	0,995
q16	3,700	0,657
q17	3,100	0,447
q18	3,450	0,826
q19	3,750	0,639
q20	2,850	0,671
q21	4,050	0,510
q22	3,300	0,657
q23	3,400	0,503
q24	2,850	0,587
q25	2,700	0,571
q26	2,950	0,826
q27	2,900	0,718
q28	3,700	0,733
q29	3,350	0,988
q30	3,200	1,240
q31	3,350	0,988
q32	3,400	0,883

Correlation matrix:

Eigenvalues:

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
Eigenvalue	7,523	4,061	3,248	2,565	2,423	1,919	1,739	1,566	1,364	1,118	0,851	0,563
total % variance	23,509	12,691	10,150	8,015	7,572	5,998	5,435	4,895	4,262	3,495	2,659	1,760
% cumulative	23,509	36,200	46,350	54,365	61,937	67,936	73,371	78,266	82,528	86,023	88,682	90,442
common % variance	25,994	14,032	11,222	8,862	8,373	6,632	6,009	5,412	4,713	3,864	2,940	1,946
% cumulative	25,994	40,026	51,248	60,110	68,483	75,115	81,124	86,537	91,250	95,114	98,054	100,000

Number of removed trivial eigenvalues: 18

Total % variance after Varimax rotation:

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
total % variance	16,822	8,935	9,944	5,575	8,453	7,615	8,573	7,612	5,581	6,032	8,311	6,494
% cumulative	16,822	25,757	35,701	41,276	49,729	57,344	65,918	73,530	79,111	85,143	93,454	99,948

Eigenvectors:

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
q1	0,204	-0,173	-0,193	-0,099	0,187	0,162	0,033	-0,047	0,146	-0,063	-0,277	0,397
q2	0,029	-0,314	-0,176	0,326	0,054	0,116	-0,315	-0,004	0,084	0,013	0,043	0,126
q3	0,102	-0,310	-0,278	-0,080	-0,172	-0,130	-0,166	0,108	0,022	0,080	-0,183	-0,041
q4	0,191	-0,111	-0,309	0,130	0,260	0,099	0,137	0,004	-0,186	-0,141	0,002	-0,009
q5	0,138	0,087	-0,210	0,118	0,278	0,130	-0,089	-0,197	0,042	-0,148	0,369	-0,099
q6	0,254	-0,145	0,004	-0,100	0,153	0,029	-0,074	-0,129	-0,054	-0,284	0,112	-0,007
q7	0,249	-0,021	-0,125	-0,338	-0,079	-0,203	-0,066	0,060	-0,121	0,015	-0,084	0,071
q8	0,207	0,272	0,119	0,104	-0,097	-0,048	-0,290	-0,112	-0,185	0,133	0,028	0,264
q9	0,273	0,083	-0,130	-0,067	-0,010	-0,048	-0,120	-0,288	-0,069	0,183	-0,063	-0,237
q10	0,151	0,154	-0,168	0,164	-0,213	-0,071	0,269	-0,028	0,336	-0,038	-0,330	-0,019
q11	0,167	0,055	-0,213	-0,006	0,228	0,259	-0,020	0,109	-0,079	0,529	-0,120	-0,229
q12	0,217	0,051	-0,103	0,065	-0,329	-0,087	0,110	-0,265	0,056	0,187	-0,035	0,187
q13	0,140	0,085	-0,048	-0,213	0,203	-0,393	-0,160	0,226	-0,017	-0,073	0,032	-0,015
q14	0,075	0,209	0,064	0,446	-0,004	-0,200	0,113	0,009	-0,149	-0,044	-0,007	-0,074
q15	0,204	-0,045	-0,034	0,313	-0,085	-0,178	0,061	-0,311	-0,078	0,075	0,091	-0,185
q16	0,106	0,113	0,198	0,111	0,424	-0,231	-0,184	0,054	-0,027	-0,095	-0,285	0,111
q17	0,036	-0,238	0,015	0,217	-0,077	-0,158	-0,004	0,094	0,421	-0,057	0,338	0,207
q18	0,225	-0,110	0,067	-0,199	-0,144	-0,022	0,101	0,222	-0,040	0,280	0,156	0,240

Eigenvectors:

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
q19	0,100	0,113	0,329	0,124	-0,060	0,064	-0,291	0,007	0,355	0,084	-0,333	-0,140
q20	-0,056	-0,199	-0,167	0,227	-0,042	-0,097	-0,268	0,220	0,157	0,049	-0,072	-0,057
q21	0,026	0,111	0,136	0,045	0,038	0,564	-0,158	-0,104	0,001	-0,003	-0,083	0,250
q22	0,202	0,141	0,089	0,078	0,089	0,094	0,331	0,386	0,103	0,154	0,182	0,024
q23	0,190	0,246	-0,052	0,095	0,172	0,047	0,216	0,185	0,192	0,005	0,060	0,200
q24	-0,047	-0,133	-0,031	0,268	-0,102	0,157	0,020	0,442	-0,315	-0,056	-0,180	-0,217
q25	0,132	0,085	-0,033	0,095	-0,419	0,158	-0,173	0,145	-0,347	-0,195	0,106	0,239
q26	0,128	0,268	-0,214	-0,099	-0,125	0,073	-0,214	0,188	0,228	-0,311	0,029	-0,155
q27	0,072	0,333	-0,218	-0,130	-0,174	0,130	-0,104	0,105	0,114	-0,206	0,082	-0,231
q28	0,164	-0,255	0,197	-0,160	-0,091	0,255	0,057	-0,087	0,218	0,017	0,141	-0,323
q29	0,222	-0,100	0,388	-0,067	0,009	-0,001	-0,122	0,069	0,010	-0,126	0,028	-0,070
q30	0,233	-0,031	0,167	0,079	0,025	-0,050	-0,211	0,132	-0,021	0,238	0,306	-0,109
q31	0,270	-0,160	0,138	0,075	-0,049	0,004	0,243	-0,053	-0,105	-0,298	-0,112	-0,086
q32	0,289	-0,186	0,189	-0,022	-0,034	0,058	0,141	0,046	-0,078	-0,147	-0,191	-0,086

Factor loadings:

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
q1	0,560	-0,349	-0,348	-0,158	0,291	0,224	0,043	-0,059	0,170	-0,067	-0,255	0,298
q2	0,079	-0,632	-0,316	0,521	0,083	0,160	-0,414	-0,005	0,098	0,013	0,039	0,094
q3	0,281	-0,625	-0,501	-0,128	-0,267	-0,180	-0,219	0,135	0,025	0,084	-0,169	-0,031
q4	0,523	-0,224	-0,557	0,208	0,405	0,138	0,180	0,005	-0,218	-0,149	0,002	-0,006
q5	0,379	0,175	-0,379	0,189	0,432	0,180	-0,117	-0,247	0,049	-0,156	0,341	-0,074
q6	0,697	-0,293	0,006	-0,160	0,237	0,041	-0,098	-0,161	-0,063	-0,301	0,103	-0,005
q7	0,683	-0,043	-0,225	-0,542	-0,124	-0,281	-0,087	0,076	-0,142	0,016	-0,078	0,053
q8	0,567	0,548	0,215	0,167	-0,151	-0,066	-0,383	-0,140	-0,216	0,140	0,026	0,198
q9	0,748	0,167	-0,234	-0,108	-0,015	-0,066	-0,158	-0,360	-0,080	0,194	-0,058	-0,178
q10	0,413	0,311	-0,302	0,263	-0,331	-0,098	0,355	-0,035	0,392	-0,040	-0,304	-0,014
q11	0,457	0,111	-0,383	-0,009	0,353	0,357	-0,026	0,136	-0,093	0,558	-0,110	-0,171
q12	0,596	0,103	-0,185	0,104	-0,513	-0,121	0,145	-0,332	0,065	0,198	-0,033	0,140
q13	0,385	0,171	-0,087	-0,342	0,316	-0,545	-0,211	0,283	-0,020	-0,077	0,029	-0,012
q14	0,207	0,421	0,115	0,714	-0,006	-0,277	0,149	0,012	-0,174	-0,047	-0,006	-0,055
q15	0,559	-0,092	-0,061	0,501	-0,133	-0,247	0,081	-0,389	-0,091	0,080	0,084	-0,139
q16	0,291	0,228	0,357	0,177	0,660	-0,320	-0,242	0,068	-0,032	-0,101	-0,263	0,084
q17	0,099	-0,479	0,026	0,347	-0,119	-0,219	-0,006	0,118	0,492	-0,060	0,312	0,156
q18	0,617	-0,222	0,121	-0,319	-0,224	-0,031	0,133	0,277	-0,047	0,296	0,144	0,180
q19	0,275	0,228	0,593	0,198	-0,093	0,089	-0,383	0,009	0,414	0,088	-0,307	-0,105
q20	-0,153	-0,402	-0,301	0,364	-0,065	-0,135	-0,353	0,275	0,184	0,052	-0,066	-0,043
q21	0,070	0,225	0,245	0,073	0,059	0,781	-0,209	-0,130	0,001	-0,003	-0,077	0,188
q22	0,555	0,284	0,161	0,126	0,139	0,130	0,437	0,483	0,120	0,163	0,168	0,018
q23	0,521	0,497	-0,094	0,153	0,267	0,065	0,285	0,232	0,224	0,005	0,055	0,150
q24	-0,128	-0,267	-0,055	0,430	-0,159	0,217	0,027	0,553	-0,368	-0,059	-0,166	-0,163
q25	0,363	0,172	-0,059	0,153	-0,652	0,219	-0,228	0,182	-0,405	-0,206	0,098	0,179
q26	0,352	0,540	-0,385	-0,158	-0,194	0,102	-0,282	0,235	0,267	-0,329	0,027	-0,116
q27	0,198	0,670	-0,392	-0,208	-0,270	0,180	-0,138	0,131	0,133	-0,218	0,076	-0,173
q28	0,451	-0,514	0,355	-0,256	-0,142	0,353	0,076	-0,109	0,254	0,018	0,130	-0,242
q29	0,609	-0,201	0,700	-0,107	0,014	-0,002	-0,160	0,086	0,012	-0,134	0,026	-0,053
q30	0,640	-0,062	0,300	0,127	0,039	-0,070	-0,278	0,166	-0,025	0,251	0,282	-0,082
q31	0,742	-0,322	0,248	0,121	-0,076	0,005	0,321	-0,066	-0,122	-0,315	-0,103	-0,064
q32	0,792	-0,375	0,341	-0,035	-0,054	0,081	0,186	0,058	-0,091	-0,155	-0,176	-0,064

Factor loadings after Varimax rotation:

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
q1	0,322	0,034	-0,060	-0,752	0,362	-0,010	-0,180	0,101	0,112	0,208	-0,017	-0,071
q2	0,047	-0,169	-0,022	-0,148	0,332	0,187	-0,842	-0,217	-0,170	0,107	0,000	0,064
q3	0,205	0,068	-0,119	-0,391	0,005	-0,452	-0,533	-0,298	-0,141	0,232	0,276	0,044
q4	0,128	-0,006	-0,177	-0,349	0,785	-0,136	-0,116	0,161	-0,255	0,225	0,003	-0,059
q5	-0,005	0,235	-0,084	0,053	0,780	0,114	-0,084	0,121	0,216	0,162	-0,121	0,012
q6	0,851	0,066	-0,024	-0,226	0,497	-0,140	-0,031	-0,050	0,135	0,026	-0,134	0,098
q7	0,401	0,274	-0,113	-0,366	0,054	-0,616	0,140	-0,022	0,148	0,243	0,023	0,290
q8	0,115	0,221	-0,343	0,124	0,005	0,095	0,166	0,092	0,163	0,180	-0,439	0,710
q9	0,301	0,245	-0,478	-0,083	0,293	-0,173	0,122	-0,099	0,256	0,490	-0,113	0,219
q10	-0,027	0,394	-0,759	-0,223	-0,085	-0,005	-0,035	0,325	-0,025	-0,027	0,029	-0,154
q11	0,010	0,080	-0,044	-0,178	0,285	0,041	0,007	0,287	-0,072	0,888	-0,025	0,011
q12	0,188	0,122	-0,767	-0,151	-0,024	-0,076	-0,009	0,075	0,204	0,109	0,212	0,337
q13	0,107	0,242	0,150	-0,069	0,103	-0,686	0,048	0,139	0,169	0,094	-0,429	0,089
q14	-0,160	-0,041	-0,556	0,360	0,141	0,040	0,042	0,298	-0,284	-0,144	-0,415	0,163
q15	0,255	-0,152	-0,744	0,186	0,325	-0,071	-0,169	-0,017	0,015	0,073	-0,086	0,155
q16	0,104	-0,109	0,055	-0,030	0,137	-0,089	0,073	0,146	0,053	0,026	-0,949	-0,012
q17	0,198	-0,141	-0,116	0,062	-0,009	-0,072	-0,731	0,213	0,153	-0,322	0,104	-0,074
q18	0,541	-0,061	-0,028	-0,199	-0,160	-0,322	-0,021	0,358	0,080	0,233	0,229	0,355
q19	0,356	0,220	-0,162	0,146	-0,468	0,402	-0,141	0,046	0,147	0,106	-0,555	0,033
q20	-0,165	0,008	0,026	-0,021	-0,045	-0,101	-0,739	-0,147	-0,239	0,051	-0,028	-0,065
q21	0,116	0,130	0,177	-0,126	0,046	0,806	0,151	0,039	0,023	0,154	-0,078	0,229
q22	0,289	0,103	-0,103	0,052	0,044	-0,021	0,117	0,888	-0,120	0,164	-0,069	0,041
q23	0,020	0,287	-0,218	-0,120	0,232	0,028	0,127	0,738	0,075	0,095	-0,249	0,019
q24	-0,007	-0,080	0,092	0,061	-0,048	0,076	-0,242	0,046	-0,866	0,036	0,083	0,055
q25	0,171	0,374	-0,201	-0,004	-0,008	0,095	0,003	-0,032	-0,380	-0,111	0,188	0,764
q26	-0,025	0,948	-0,059	-0,067	0,098	-0,068	-0,010	0,132	0,048	0,036	-0,062	0,131
q27	-0,164	0,888	-0,087	0,041	0,069	-0,002	0,214	0,111	0,041	0,089	0,107	0,138
q28	0,871	-0,042	0,039	-0,008	-0,051	0,177	-0,111	-0,013	0,173	0,131	0,296	-0,140
q29	0,875	-0,049	0,063	0,083	-0,122	0,011	0,016	0,089	0,066	-0,051	-0,343	0,202
q30	0,520	-0,016	-0,056	0,265	0,059	-0,108	-0,235	0,254	0,094	0,301	-0,245	0,379
q31	0,790	-0,096	-0,393	-0,167	0,230	-0,064	0,074	0,128	-0,215	-0,160	-0,058	0,026
q32	0,898	-0,087	-0,233	-0,231	0,069	-0,065	0,043	0,135	-0,185	0,033	-0,097	0,068