

Rochester Institute of Technology

RIT Digital Institutional Repository

Theses

2002

A Case study on the design process for mobilizing a web application

Lynn Bajowski

Follow this and additional works at: <https://repository.rit.edu/theses>

Recommended Citation

Bajowski, Lynn, "A Case study on the design process for mobilizing a web application" (2002). Thesis. Rochester Institute of Technology. Accessed from

This Thesis is brought to you for free and open access by the RIT Libraries. For more information, please contact repository@rit.edu.

A Case Study on a Design Process for Mobilizing a Web Application

By

Lynn M. Bajowski

**Thesis submitted in partial fulfillment of the requirements for the
degree of Master of Science in Information Technology**

Rochester Institute of Technology

**B. Thomas Golisano College
of
Computing and Information Sciences**

November 21, 2002

Rochester Institute of Technology

**B. Thomas Golisano College
of
Computing and Information Sciences**

Master of Science in Information Technology

Thesis Approval Form

Student Name: Lynn Bajowski

Thesis Title: A Case Study on the Design Process for
Mobilizing a Web Application

Thesis Committee

Name

Signature

Date

Prof. Evelyn Rozanski
Chair

11/21/2002

Prof. Rayno Niemi
Committee Member

11/21/02

Mr. Michael Vogel
Committee Member

11/21/2002

Thesis Reproduction Permission Form

Rochester Institute of Technology

**B. Thomas Golisano College
of
Computing and Information Sciences**

Master of Science in Information Technology

**A Case Study on a Design Process for Mobilizing
a Web Application**

I, Lynn M. Bajowski, hereby grant permission to the Wallace Library of the Rochester Institute of Technology to reproduce my thesis in whole or in part. Any reproduction must not be for commercial use or profit.

Date: 11/21/2002

Signature of Author: _____

© 2002

Lynn Marie Bajowski

Abstract

Title of Thesis: A Case Study on a Design Process for Mobilizing a Web Application

Author: Lynn Marie Bajowski

Thesis Advisor: Evelyn Rozanski, Ph.D., Professor
Department of Information Technology

Mobilizing web applications is a current design problem facing software development teams. The majority of projects aimed at developing solutions for mobile devices have been focused on extending the functionality of existing Web applications. The solutions, being developed for personal digital assistants are scaled down versions of the existing Web application. This design solution has proved to be unusable. The usability failures are tied to not having a clear understanding of the user and task requirements. The Web interface seems to be getting in the way of designing an appropriate solution for personal digital assistants.

Requirements analysis involves a wide range of activities aimed at eliciting a precise description of the functional, data and usability requirements of the system under consideration. There are many methods and techniques that are available to assist development teams in being able to analyze the underlying structures of a system. The issues with many of these techniques are that they focus on the user interface. These techniques hide the structure of the system behind the user interface details, making it easier to talk about menus, icons, and screen layout than about whether the structure supports the work.

This thesis sets out to demonstrate the benefits of using the Contextual Design methodology as the framework for a front-end design process. Contextual design offers techniques that assist in moving the focus from the user interface to the underlying structure. A front-end design process will be defined, using contextual design; to extend the functionality of Rochester Institute of Technology's web based course registration system to a Palm.

Dedication

This thesis is dedicated to my family and many others who believed in me.

IHFMD

Table of Contents

Abstract	i
Dedication	ii
Table of Contents	iii
List of Figures	v
List of Tables.....	vi
1 Introduction.....	1
1.1 Background.....	1
1.2 Statement of the Problem	2
1.3 Purpose of the Study.....	3
1.4 Scope	3
1.5 Goal.....	3
1.6 Motivation	4
1.7 Organization of this Thesis.....	4
2 Literature Review.....	5
2.1 Overview	5
2.2 Mobile Users	7
2.3 Wireless Devices	10
2.4 Mobile Applications	12
2.5 Wireless Infrastructure	15
2.5.1 Wireless Application Protocol (WAP).....	16
2.5.2 Development Approaches.....	18
2.5.3 Deck of Cards	20
2.6 Microdesign.....	21
2.7 Design Process.....	26
2.8 User Centered Design.....	32
2.9 Contextual Design	34
3 Case Study	47
3.1 Design Process.....	48
3.1.1 Analysis: Understanding the Current Situation.....	48
3.1.1.1 Step 1: Define the Existing Work Structure	48
3.1.1.2 Step 2: Define the Design Problem	52
3.1.1.3 Step 3: Identify the Participants	57
3.1.1.4 Step 4: Analyze the Key Functions	59
3.1.2 Design: Planning the Solution	68
3.1.2.1 Step 5: Identify the Design Concept.....	68
3.1.2.2 Step 6: Define the New Work Structure.....	69
3.1.2.3 Step 7: Develop the Concept.....	71
3.1.2.4 Step 8: Map UED to Palm Interface.....	76
3.1.2.4.1 mySIS	77
3.1.2.4.2 myRequirements	78
3.1.2.4.3 mySchedule.....	85
3.1.2.4.4 Registration.....	90
3.1.2.5 Step 9: Solution Evaluation.....	100
3.1.2.5.1 Prototype Interview.....	101
3.1.2.5.2 Questionnaire for User Interaction Satisfaction (QUIS™)	101
3.2 Participants	114
3.2.1 Selection Criteria	115
3.2.2 Environment	115
3.3 Equipment	115
3.3.1 Hardware	115
3.3.2 Software.....	116
4 Summary.....	117
4.1 Further Research.....	119

References	120
Appendix	125
A. User Environment Model – Web	126
B. Flow Model	133
C. Participant Profile – Questionnaire	134
D. Participant Profile – Results	139
E. Participant Tasks - Web	142
F. Contextual Interview - Summary	146
G. Requirements Worksheet – MS/IT	153
H. User Environment Model – Palm	154
I. User Interface Design – Initial	155
J. Participant Tasks – Palm	160
K. QUIS Questionnaire	162
L. QUIS Questionnaire - Results	168
M. Facilitator Script – Contextual Interview	178
N. Facilitator Script – Prototype Interview	179
O. User Environment Model – Final	180

List of Figures

Figure 1: Comparison of the Internet and WAP Architecture	17
Figure 2: Differences between Web Design and Microdesign	24
Figure 3: Example of a User Environment Model.....	44
Figure 4: Comparison between Web page and Focus Area.....	51
Figure 5: Flow Model of RITs Registration Process.....	55
Figure 6: Focus Area – Register for Classes	60
Figure 7: Sequence Model.....	66
Figure 8: User Environment Design – Palm.....	70
Figure 9: Screen Layout for the Palm.....	74
Figure 10: Focus Area – mySIS	77
Figure 11: Screen Design – mySIS, home page	78
Figure 12: Focus Area – myRequirements	79
Figure 13: Screen Design – myRequirements, view All	80
Figure 14: Screen Design – myRequirements, view by category.....	81
Figure 15: Screen Design – myRequirements, view by summary.....	82
Figure 16: Focus Area – myRequirements, Add Course	82
Figure 17: Screen Design – myRequirements, Add Course	84
Figure 18: Focus Area – myRequirements, Edit Course	84
Figure 19: Screen Design – myRequirements, Edit Course	85
Figure 20: Focus Area – mySchedule.....	86
Figure 21: Screen Design – mySchedule.....	87
Figure 22: Focus Area – mySchedule, class details	87
Figure 23: Screen Design – mySchedule, view course details	88
Figure 24: Screen Design – mySchedule, view course instructor	89
Figure 25: Screen Design – mySchedule, view course location.....	90
Figure 26: Screen Design – mySchedule, view course description.....	90
Figure 27: Focus Area – Connect to RIT	91
Figure 28: Screen Design – DCE Login.....	92
Figure 29: Screen Design – SIS Login	93
Figure 30: Focus Area – Registration Options	93
Figure 31: Screen Design – Registration Options	95
Figure 32: Focus Area – Add Course	95
Figure 33: Screen Design – Registration, add course by course title	97
Figure 34: Screen Design – Registration, select course section number	98
Figure 35: Screen Design – registration confirmation.....	98
Figure 36: Focus Area – Registration, Drop Course	99
Figure 37: Screen Design – Registration, drop course by course title.....	100
Figure 38: Profile – Overall Reaction.....	104
Figure 39: Profile – Screen Factors.....	106
Figure 40: Profile – Terminology and System Information	108
Figure 41: Profile – Learning Factors.....	110
Figure 42: Profile – System Capabilities.....	112
Figure 43: Profile – General Impressions.....	113

List of Tables

- Table 1: Test Factors – Overall Reaction 103
- Table 2: Test Factors – Screen 105
- Table 3: Test Factors – Terminology and System Information 107
- Table 4: Test Factors – Learning..... 109
- Table 5: Test Factors – System Capabilities 111
- Table 6: Test Factors – General Impressions 113
- Table 7: List of Hardware..... 115
- Table 8: List of Software..... 116

1 Introduction

1.1 Background

The “Mobile Millennium” has arrived. We are currently witnessing a trend towards the increased usage of mobile computing devices. This trend supports the increased number of people who are always on the go. Mobile computing couples the need for mobility with the need to access information.

Mobile computing devices are the conduit between people and information. The adoption of mobile computing devices is on the rise. Such devices include but are not limited to notebooks, Palm Pilots, Windows CE devices, WAP-enabled cell phones, two way pagers, Web TV, etc. These devices allow a person to satisfy their insatiable need for information anytime, anywhere, twenty four hours a day, seven days a week.

Development teams are working hard to develop applications to meet the needs of the mobile user (m-User). The majority of projects aimed at developing solutions for mobile devices have been focused on extending the functionality of existing Web applications. My preliminary research points out that many projects have failed to develop usable solutions for mobile devices. Further investigation suggests that the usability failures are tied to not having a clear understanding of user and task requirements. Mobilizing web applications has become a challenging design problem.

System design is the process of developing a solution for a specified problem. Every project presents new problems often requiring new design solutions. To support each project, a design process needs to be defined. Defining a process appropriate for the problem will enable a development team to collaborate in gathering data, designing a system, and producing a usable result. The best way to ensure quality user interface design for a mobile device is to use an orderly and well-defined design process that is focused on making the data gathered from mobile users the base criteria for deciding what a system should do and how it should be structured.

Over ten years ago, Hugh Beyer and Karen Holtzblatt set off to research how to use data

for design. They devised an approach that would focus on making the data gathered from users be the base criteria for deciding what a system should do and how it should be structured. Their efforts resulted in Contextual Design.

Mobile computing is very conducive to students because they are never in the same place for long. Whether it be moving from class to class or increasing their social circle, there is a need to streamline many of the time consuming nuances a student faces on a daily basis. The deliverable for this thesis, will be to define a front-end design process, using Contextual Design; to extend the functionality of Rochester Institute of Technology's web based course registration system to a personal digital assistant. This design process will result in a low-fidelity prototype that will illustrate how students will be able to dynamically interact with information pertaining to the course registration process through a Palm. The Questionnaire for User Interaction Satisfaction (QUIS™) will be used to evaluate the success of the design.

1.2 Statement of the Problem

Mobile development for personal digital assistants is in its infancy. Development teams have little or no previous experience in developing software for these devices. The majority of projects aimed at developing solutions for Palm devices have been focused on extending the functionality of existing Web applications. The results have been that many projects have failed to develop usable solutions for the Palm. Delivering applications that are just like the "Windows" version is proving to be a mistake. Palm devices cannot mimic the advantages of a desktop such as gigabytes of hard drive space, megabytes of RAM, super VGA display, and large keyboard. Palm devices demand a different type of application. The literature review indicated that the usability failures are tied to not having a clear understanding of user and task requirements.

User satisfaction is greatly influenced by the design of the user interface and ease of use. The user interface is what users see and work with to use an application. There is a need to build a bridge between the users of Palm devices and software developers to help software

development teams connect the structure of the user interface to the structure of use. The bridge is an orderly and well-defined design process. A design process for mobilizing web applications needs to be defined.

1.3 Purpose of the Study

The purpose of this study will be to gain insight into the field of mobile computing and contextual design. Once accomplished, a case study will be used as the research process to carry out an investigation designed to examine the use of Contextual Design for addressing the design problems inherent to personal digital assistants, specifically the Palm.

1.4 Scope

A front-end design process will be defined, based on the contextual design methodology, to extend the functionality of Rochester Institute of Technology's web based course registration system to a personal digital assistant.

The scope of this study will be limited to the course registration process at Rochester Institute of Technology, as it has been designed for the Student Information System. This study will stop short of the actual development and implementation of a registration system for a Palm device. The development effort would be deemed a separate thesis project.

1.5 Goal

The goal of this study will be to demonstrate the use of contextual design as the framework for addressing the design problems inherent to personal digital assistants. The design process resulting from this study will provide the readers of this study with three answers: what Rochester Institute of Technology's mobile course registration system must do, the structure of the mobile system and the data that needs to be available, and the acceptable level of user satisfaction with the new system. This study will provide the readers of this study with greater insight as how to approach development for personal digital assistants, and how the design for these devices differs from applications designed for the Internet.

1.6 Motivation

The motivation for this thesis is the Author's personal interest in Human Computer Interaction and the challenges being faced by application developers who are now beginning to figure out how to deploy applications on mobile computing devices. As a Project Leader for an application development team, the Author has seen the large number of failures resulting from the inaccurate identification of the users needs. In addition, the Author sees great value and tremendous opportunity for the use of personal digital assistants such as a Palm, in college and university settings like Rochester Institute of Technology.

1.7 Organization of this Thesis

This thesis is organized into four parts. The first part states the purpose of the study and the intent of the Author. The second part presents the review of literature, which in turn documents the need for a new design approach for mobilizing Web applications. The third section describes the case study and the results. The final section has conclusions and implications for further study.

2 Literature Review

2.1 Overview

The “Mobile Millennium” is upon us. Through the enhancement of communication, the role of technology is changing the way we communicate.

The Internet and in particular the World Wide Web (WWW), introduced a new era of computing. Tim Berners-Lee, the founder of the World Wide Web consortium (W3C), defines the Web as, “the universe of network accessible information.” Since its public introduction in 1991, the Web has changed the way people communicate. The Web offered people with a personal computer a user-friendly way to distribute information and access information from around the world. The Web made the personal computer a collaborative communication and media tool.

In his book, *Being Digital*, Nicholas Negroponte (1995), discussed the elimination of physical location. “In the same ways that hypertext removes the limitations of the printed page, the post-information age will remove the limitations of geography” (p. 165). The introduction of a new generation of smart cellular phones and sophisticated wireless personal digital assistants diminish the importance of physical location. The ability to eliminate the dependency of physical location was considered a key technological breakthrough for the new information age.

With the blurring of geographical boundaries, thanks to the distance insensitive Internet, the majority of business and individuals rushed to become part of the high-speed networking fabric which enabled secure digital communication of voice, data, and video to or from anyone, anywhere and anytime. People quickly took up Web browsing to explore the new frontier. This activity has changed the way people think about computing.

Currently, we are witnessing a merging of the rapid growth of mobile devices and the phenomenon of the Internet. Wireless Internet usage is on the rise. According to the International Data Corporation (IDC) (2001), the number of wireless subscribers in the United States will increase at a whopping compound annual growth rate of 73%, from approximately 5 million in

2000 to more than 84 million in 2005. The world is becoming one of multiple, portable, connected devices. The types of devices that will connect to the Internet, and the ways that people will use them, will be as varied and colorful as the people themselves.

When people think of web browsing, they would most likely think of a rich user interface containing colorful images and large amounts of information that is viewed through a web browser installed on a desktop computer. Beyond the desktop computer, there has been a proliferation of types of devices using the Web to access information. These devices range from web tablets, appliances and televisions, to mobile devices including phones and personal digital assistants.

Mobile computing is dramatically changing our day-to-day lives, especially with the popularity of small devices such as personal digital assistants (PDAs). The first PDA, the Apple Newton, was introduced in 1993. Although handheld devices have been available for a number of years, it wasn't until 3Com started selling thousands of handheld organizers or Palm Pilots, that Microsoft and other software vendors sat up and took notice of this viable new development market.

New devices and applications are about to ignite a similar usability revolution in wireless data as was experienced in the 1990s by the Web. New wireless devices are being introduced at a more rapid pace. These devices now offer more storage and features than what a complete desktop system offered just a few years ago. The rapid pace of advancements has moved the personal computing experience from our lap to our palm.

The wireless data experience will become more compelling for a larger audience as improvements to content, access, and software applications are developed, devices are enhanced, and low cost access to greater bandwidth is enabled. The Web contains many useful, highly functional applications. When considering which applications to develop in a mobile scenario, the choices seem to coincide with the same applications that are or will be web enabled.

Palm applications need to be simple, providing the user with a whole new set of conveniences, which are not necessarily the same as those that are provided by an Internet

application. Palm devices cannot mimic the advantages of a desktop such as gigabytes of hard drive space, megabytes of RAM, super VGA display, and large keyboard. An application that provides a few highly accessible and well-designed features that makes the users life easier is what the development team needs to learn how to identify.

The user interface is what users see and work with to use an application. Just as with any other device, content, design and navigation must be developed in a way that meets the needs of typical users. Interfaces can help or hinder, be effective or ineffective. Designing an effective interface doesn't happen by chance. Good design happens only when the software development team understands people as well as technology. The best way to ensure quality user interface design is to use an orderly and well-defined design process.

Palm applications will only be successful if they are usable. To be usable, a user interface must let the people who use the application, working in their own physical, social, and cultural environments, accomplish their goals and tasks effectively and efficiently. Unless it is known who is going to use an application, for what purpose, and in what circumstances, an application can not be effectively designed or tested to see whether or not it works well.

Contextual design is an approach to define a system that collects multiple user-centered techniques into an integrated design process. This approach focuses on making the data gathered from users be the base criteria for deciding what a system should do and how it should be structured. It is the assumption of this study that the use of user-centered techniques can improve the design and usability of a Palm application. To test this assumption, a case study will be used. This study seeks to examine mobile computing and the use of contextual design as an approach for mobilizing a web application.

2.2 Mobile Users

Over the last few decades, remote access to corporate facilities has usually meant sales people on the road doing a once a day call back to the office to submit requests for quotes and orders. Today, people in many professions and job functions have reasons to access online

corporate resources from remote sites: the home, other business locations, client locations, job sites, or branch offices. A new generation of access options has emerged in which the user or remote user accesses the corporate facility over the Internet.

While working away from the office is nothing new, according to the IDC, “the U.S. work force today includes more than 35 million mobile workers. That number is projected to grow to 47 million by 2003, driven by an annual 10-15% increase in telecommuting and an explosive growth rate in the use of cellular phones and other wireless devices” (Weiss, 2001, para. 1). Business professionals are becoming increasingly mobile. These professionals require anytime, anywhere access to critical user and product information, regardless of their location. In a world of highly competitive markets, time-sensitive transactions, and intense competition, businesses must empower their employees with mobile technology. People want information on the move. They want timely, relevant services that will make their working life easier.

Teenagers are also discussed as early adopter of wireless services, with entertainment applications driving their usage. A teenager’s primary interest will be associated with streaming music videos, MP3 files, and playing on-line games. Applications using directional/mapping services may also be an area of interest, since a teenager would love to be able to locate their friends, when they are unable to reach them by phone.

Brian Ruttenbur and Ginger Spickler, industry analysts for Morgan Keegan in New York authored an industry report entitled “eLearning: The Engine of the Knowledge Economy.” Ruttenbur and Spickler are also seeing the shift in education and how schools want to embrace newer technologies. They go on to extend this embracing of technology to also include the possibilities of wireless technology. They believe that the integration of wireless personal computing technology into schools will go a long way in getting students more involved in the educational process and that it will ultimately improve their work (Ruttenbur, Spickler & Lurie, 2000, p. 86). Their support of wireless technology rests around the question of logistics. “Kids move from classroom to classroom all day and need rugged tools that can go where they go. Desktop computers certainly don’t fit the bill for portability, and laptops have to be plugged into

the network causing disruption as kids need to move from classroom to classroom” (Ruttenbur et al., 2000, p. 86). Wireless solutions are not on the horizon for most schools, but it is an interesting case study and one in which this study supports.

The INT Media Group, Inc. (2001), identified the following characteristics as being important to the success of applications being developed for mobile user whose usage supports their desire for information access and/or communication:

- “Users of wireless devices will be directed and goal oriented. The user is interested in performing a specific task rather than using the device for entertainment” (p. 4).
- “Interaction with the device is typically short (less than 10 minutes)” (p. 4).
- “Mobile Users are likely to concentrate on the task at hand while using their wireless device. Interruptions are more likely to be task relevant, such as receiving a phone call while trying to look up an address book entry” (p. 4).
- “Tasks are typically structured and directed, the mobile user will be motivated to complete a specific task. For instance, the user may need to send an e-mail to her friend to ask about tonight’s plans. That is the main purpose of the interaction with the device” (p. 4).
- “Ultimately, the mobile user wants the mobile experience to be quick, efficient, and easy” (p. 4).
- “Ease of learning and long-term ease of use are two of the more important design factors, since the mobile user must be able to get the task completed quickly and efficiently” (p. 4).
- “Task completion time may be another critical factor. While most mobile users are not concerned about a few extra seconds in performing a task, they are not interested in spending much time completing a task that appears to be inefficient. Design tasks so that they can be accomplished as efficiently as possible” (p. 4).

While both consumer and business users currently make up roughly equal pieces of the

wireless Internet user base, business usage is expected to be higher in the near future. “Business users will lead the way in wireless adoption as they are usually the early adopters and are willing to pay for services and applications they see valuable” (IDC, 2001, para. 2), said Charul Vyas, senior research analyst with IDC's Wireless and Mobile Communications program. The needs of mobile employees have created the demand for highly functional devices with higher speed wireless Internet capabilities.

2.3 Wireless Devices

Wireless devices reside on one end of an information delivery stream that flows between databases and servers in conventional wired environments to users who create and consume content. It has been the Author's experience that development teams are looking at many of the same problems that exist in today's wired world, how to represent data and build applications that work across a variety of platforms and systems. Wireless devices provide an opportunity to bring data to mobile users.

In his book, *Wireless Internet Applications and Architecture*, Mark Beaulieu (2002), identified the following groupings for wireless devices, which are currently being used to access the Internet:

- “*Web Phones* — The most common device is the Internet ready cellular phone, also known as a Web phone. These devices allow its user to exchange short messages, access the Web with a microbrowser, and run applications. In addition, Web phones are always on” (p.5).
- “*Wireless Handhelds* — Another common device, the wireless handheld, such as a Palm, can also message and use a microbrowser. More sophisticated models can perform very complex operations and all have the advantage of working offline” (p.5).
- “*Two-Way Pagers* — These devices receive and send messages and more sophisticated devices allow for microbrowsing” (p.5).

- *“Information Appliances* — This type of electronic device is outfitted with wireless technology that can participate in the Internet. Such devices include, cameras, watches, set top boxes, and home game machines, just to name a few” (p.5).

As higher functioning wireless devices are made in higher volumes and offered to users for lower prices, they will become more desired and consumed by larger audiences. According to the Strategis Group (CyberAtlas staff, 2002), “more than 483 million wireless devices will be sold to end-users in 2003, and one-third of the world's population will own a wireless device by 2008” (para. 2).

Recent PDA device introductions incorporate a wireless modem card, increased processing power, and consume less power. These improvements are necessary to access more media rich content and applications. In addition, newer devices are being developed with higher resolution color displays. As resolution and screen sizes improve and color replaces today’s black and white displays, applications and content will incorporate more graphics and multimedia features, driving the demand for higher bandwidth technology.

Constraints associated with wireless devices are unique and should be considered the starting point for any development effort. Developing applications for personal digital assistants has a number of implicit design issues:

- *Screen Size and Resolution* — Personal digital assistants have a very small, low-resolution screen. Screen size and resolution are important considerations in defining the appropriate visual media assets (e.g. text, images, video, etc.) to use. Screen size and resolution are also important in the design of the physical layout of the presentation. This issue requires the design of a concise and simple user interface as specified in the Palm design manual
- *Input Capabilities* — Input capabilities of personal digital assistants are somewhat more limited than a desktop computer. The input devices include a stylus or

miniature keyboard. These limitations impact the ease of use of PDAs. The ease of use of a device's input facilities is of importance since the interaction between a web application and its user will need to be simplified for use on a personal digital assistant.

- *Limited Bandwidth* — At present, wireless Internet connections are very slow. The average wireless connection speed is similar to that of a 9600-baud modem (9600 kilobit-per-second / max download time). The speed with which data can be exchanged with the end user is inherently associated with the type of device and the network it is attached to. The speed of the data transfer will vary from minute to minute and will depend on many factors, including how busy the network is.
- *Cost* — The cost of transmission of data between a mobile device and the server that provides the information is still somewhat expensive. To control costs, it is important to design applications that require minimal amount of time to connect to get the job done.
- *Need for Speed* — As per the Palm design recommendations; people who use PDA's need access to information virtually instantly and do not have the patience to wait for results, unlike desktop applications that frequently pause while they perform a complex task. According to Palm, complexity and flexibility should be sacrificed to maximize speed and efficiency.

Because of the unique characteristics of personal digital assistants, usability becomes increasingly more important. The constraints on displaying information by small screens with low resolution make it necessary for development teams to rethink the strategies of the interface design.

2.4 Mobile Applications

Applications that are available for the wireless platform include: messaging, e-mail, and

applications supporting the productivity of businesses. Compelling, rich media applications typical of today's Internet experience are not yet widely available for the wireless experience. However, high speed wireless data rates and improved usability will quickly make these richer more desired experiences common on wireless devices in the coming years. It has been the Author's experience that development teams are looking at many of the same problems that exist in today's wired world, how to represent data and build applications that work across a variety of platforms and systems.

Mobile technology is not new, but mobile handheld web browsing has been described as the next killer application for the Web. As the literature indicates, many experts believe that in several years time, there will be more people accessing the Internet via mobile devices than via conventional desktop computers. The Web contains many useful, highly functional applications. It is not unreasonable to expect that a Web application that has been developed for the desktop computer can be delivered in an acceptable way to other kinds of devices, such as personal digital assistants.

Microbrowsing

Microbrowsing the Internet on a wireless device is not equivalent to browsing the Internet from desktop browsers, such as Microsoft's Internet Explorer. The microbrowser is a "mini" version of a regular Web browser customized for wireless devices. Like the traditional browser, it serves as the entry point for accessing the Web.

Today's browser model for accessing World Wide Web information evolved within the context of desktop computers with extensive user interfaces (displays, keyboards, pointing devices), considerable computing resources (CPU, storage, operating systems), and high bandwidth network connectivity. This model involves downloading and displaying HTML documents that include content (text, images, and user interface components) as well as links to other HTML and non-HTML documents (such as audio, video, Adobe PDF, and Microsoft Office files). When a user attempts to follow a link to a non-HTML document, the browser automatically invokes a client-side plug-in application. Such plug-in applications display the

content and in some cases allow it to be manipulated and output using resources provided by the user's computer or other networked devices.

The success of the browser model is due, in large part, to the characteristics of networked desktop computers. Large displays allow rich content to be presented in conjunction with embedded links without sacrificing a user's ability to navigate the hyperlink structure. Full-sized keyboards and flexible pointing devices allow users to provide input to Web pages and plug-in applications without undue strain. Abundant CPU, storage, and operating system resources allow complex plug-ins to be executed locally in order to display, manipulate, and output Web content in various ways. Finally, high-bandwidth network connectivity allows media-rich content as well as sizeable plug-in applications to be quickly and easily downloaded to users' devices without compromising interactivity.

Development teams have to strike a balance between developing an application that is simple enough to use, but functional enough to be useful. A benefit of wireless devices is their dedication to a narrow range of tasks. Being able to identify the range of tasks that support an appropriate and compelling solution is somewhat of a challenge. In some ways, designing applications for wireless devices is like turning back the clock on computing. We are back in a time of small screens, slow processors and slow network connections. These problems have all been solved for desktop computers, but the same solutions cannot be easily applied to wireless devices. New solutions need to be identified, which will allow us to get information into and out of wireless devices more easily and in a wide range of different situations.

Corporations already have a lot of compelling information, much of which is now accessible on the Inter/Intranet. Currently, many corporations are defining their Mobile Strategy. Corporations are looking at how they can incorporate wireless technology into their business so that they can take advantage of real time data, anytime, and anywhere. Evans Data Corp reported, "nearly half (46.1 percent) of development managers at large corporations plan to develop applications for wireless devices in the coming year" ("Enterprises Continue to," 2001, para. 1). These companies realize how integrating Web and mobile technologies introduces

immediate efficiencies and cost savings across the entire corporation. Since corporations already have a big investment in their Web sites and its content, the question being asked is: Is it possible to take the existing Web content and re-purpose it for wireless devices without having to create a whole separate infrastructure?

The area of mobile application development, which is seeing a flurry of activity are those applications that have customized functionality and are tailored to the needs of a specific industry. When considering which applications to develop in a mobile scenario, the choices seem to coincide with the same applications that are or will be web enabled. Web based access to data has been in place for some time to better serve users (e-commerce) and to increase employee productivity. For wireless data to be successful, efforts must be made to develop new applications. According to Intermarket, “the biggest wireless opportunities are likely to be found in adding value to existing business processes rather than in m-commerce or selling products and services via PDAs and WAP handsets” (CyberAtlas staff, 2002, para. 7).

2.5 Wireless Infrastructure

It is important to have an understanding of the technology available to deploy Web content to wireless devices.

Today’s wireless infrastructure is a combination of 2G and 2.5G technologies. The 2G portions are circuit switched and provide a maximum throughput of about 9.6Kbps, while 2.5G is packet switched, offering a maximum throughput of just more than 100Kbps. On the horizon third generation (3G), which is promising speeds up to 2Mbps.

Interaction over 9.6Kbps may be painful, especially if there are multiple steps that must be performed before receiving the results of a query. When designing new mobile applications, speed and throughput must be considered.

“In delivering Web content wirelessly, developers in 1997 and 1998 faced two major obstacles. One, cell phones had a small fraction of the internal memory and processing power of a PC, and two, wireless bandwidth, at 9.6–14.4 kbps, was substantially more limiting than a

typical PC's 56 kbps modem. As a result, a new set of protocols were developed for the wireless environment, led by Phone.com, which resulted in the Wireless Application Protocol (WAP)" (Rehaut & Dwyer, 2001, p. 150).

Most wireless Internet users in Europe and the United States access wireless data via WAP. WAP is only one standard, which can be used to access wireless data. Another standard, which is equally popular in a different part of the world, is NTT DoCoMo's i-Mode service. This service is primarily used in Japan on its packet-based network and uses an HTML subset known as compact HTML (cHTML). Upgrades are being designed so that both i-Mode and WAP will both eventually use XHTML for the markup. As wireless technology in the United States evolves from circuit switched to packet switched, there may be a push to move from WAP to the more ubiquitous transport protocols used on the Internet. This would allow delivery of data in HTML and other W3C standards, such as XML and XHTML.

2.5.1 Wireless Application Protocol (WAP)

WAP supports information display through its Wireless Markup Language (WML) and scripting language, WML Script.

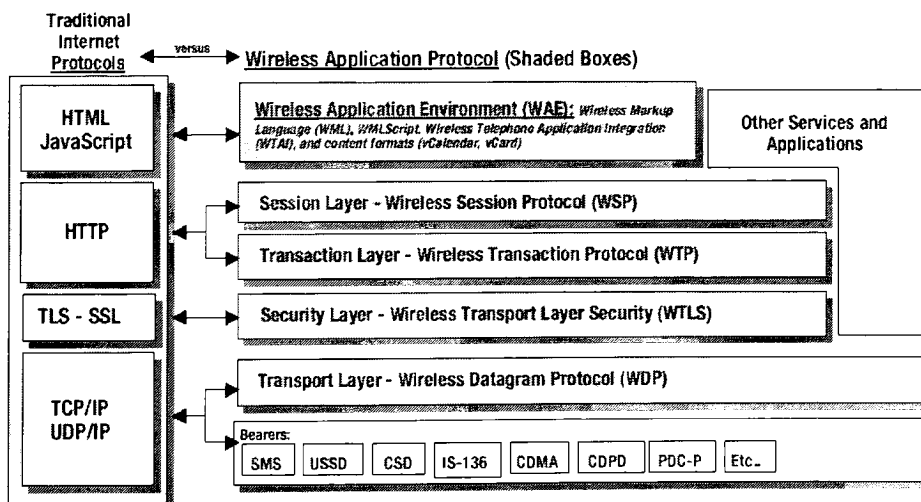
Wireless application protocol has several benefits. "First, WAP brings Internet content to WAP enabled devices by sidestepping the Internet standard HTML. Secondly, WAP can run on any kind of device, e.g. cell phones, PDAs, and laptops. Third, WAP will work with any of the global networks including; Global System for Mobile Communications (GSM), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), or any of the newer enhanced second (2.5G) or third (3G) generation networks" (Coyle, 2001, p. 115).

Even though WAP is the global standard for bringing Internet content and services to mobile phones and other wireless devices, there has been widespread dissatisfaction with WAP's performance and ease of use. Both end-users and programmers have become frustrated with WAP. One frustration developers are experiencing is with WAP's laborious requirements for reconfiguring HTML Web pages so that they can be used by WAP enabled devices.

It is desirable to be able to provide a single Web site to which both mobile and non-mobile users can connect. Today, most of the content on the Web is stored as Hypertext Markup Language (HTML). None of the current wireless devices have sufficient screen real estate to handle full HTML content such as rich graphics, and large screen specific features such as frames. Ultimately, the content delivered to the browser must be customized to suit not only the capabilities of the device, but also the intentions of the user. These limitations include, the ability to read small fonts, tolerance for extended texts on small screens, patience for downloads over limited wireless bandwidth, and the expense of wireless data links.

WAP's suite of protocols is very similar to the various layers upon which the Internet is built and operates. Figure 1 compares the Internet and WAP architectures. Internet standards such as HTML and HTTP, are inefficient over mobile networks, requiring large amounts of data to be sent. Standard HTML Web content generally cannot be displayed in an effective way on the small size screens of pocket sized mobile phones and PDAs. Navigation around and between screens is more complex. HTTP and TCP are not optimized for intermittent coverage, long latencies and limited bandwidth associated with wireless networks.

Figure 1: Comparison of the Internet and WAP Architecture



Sources: WAP Forum

Source: WAP Forum

Although they line up nicely in a table, the protocols and markup languages don't have the same rules and properties, which presents the first challenge: converting from one protocol to another and one markup language to another.

2.5.2 Development Approaches

Designing for mobile access to the Internet is challenging. There is no universally adopted standard browser user interface, or even a standard markup language, for mobile access. The challenge involves minimizing the amount of coding, while maximizing the number of devices that can access the Internet. These strategies have varying implications for user experience, potential features, navigation, and response time.

Multiple Sources

One approach looks to develop parallel sets of content specific for each device category, e.g. WAP phones, PDAs, pagers, etc. When a request for information is received, the appropriate variant of the information is selected based on the delivery context, such as the capabilities of the requesting device, user preferences and other constraints. The issue that arises is that every time content changes, each representation of that content must also be modified. This is a wasteful approach and is potentially error prone. It is a maintenance burden that complicates the publishing process.

Style Sheets

This approach creates only one set of source information for both the web and mobile device. The source set of information may be in a non-presentation form such as ASCII text, XML or other encoding. When a request for information is received, the delivered variant is generated from the combination of the content and the appropriate template. Alternatively, the content is returned along with the appropriate style sheets, and the device user agent is responsible for presentation based on the received style sheet.

Transformations

Typically known as “Transcoding” or “Screen-Scraping,” this approach is designed to take

Web content (HTML) and eliminate or transform elements that do not conform to a mobile device display (e.g. images). This approach is appropriate if only simple access to limited content from an application or Web page is desired. Only one set of content is created in a markup language such as XML or XHTML. This content is transformed onto other markups for other delivery contexts. The transformation may be automatic, dynamic or static and can be carried out either at the origin server or an intermediate proxy.

An additional obstacle is that the navigational structure of a Web site is very different than that of an application being built for a WAP enabled device. On the fly conversion is suitable for some purposes but is limited in its ability to reorganize a sites structure. This type of solution is usually dependent upon a manufacturer specific product or technology. Over time the solution runs the risk of no longer being supported or developed and becomes costly to maintain. This is an inherently fragile approach that may prove to be more trouble than it's worth.

Re-Usable Objects

The most favorable approach is the one in which the business logic layer is re-used. The business logic layer resides in the middleware. For example, "a Web application with its presentation layer built in HTML, java server pages (JSPs) or active server pages (ASPs) shares common business logic built in enterprise JavaBeans (EJBs) or component object model (COM+) components. It is feasible to build distinct HTML and WML presentation implementations on top of the business layer" (Zetie, 2000, para. 6). Each application will have different organization and navigation, according to the needs of the user. For mobile application development efforts, it is key to be able to share existing business logic but be able to organize the presentation based on the device limitations and the goals of the mobile user.

Realistically, existing Web content will neither be completely re-used nor completely re-written when used by wireless devices. Content will need to be adjusted accordingly given that it can be developed for a variety of channels like the Intranet, Internet, or mobility.

2.5.3 Deck of Cards

Currently, navigation in web content follows the “desktop” paradigm of the personal computer. The desktop paradigm uses a “page” metaphor to structure Web content. A user can navigate to the relevant information on a page by either scrolling or using a hyper-link. On a personal digital assistant, there is no way of structuring content in other ways than an infinite scroll. Research done in this area has concluded that navigation is actually a larger part of the user experience than the presentation.

In devices with very small screens, alternative paradigms are emerging for navigation of content. In small-screen devices, the “deck of cards” paradigm of WML is emerging. The W3C is also working on presentation standards for small devices.

It is not the intent of this thesis to develop a new design paradigm for a personal digital assistant, but to focus on the use of a design process for gathering the user requirements in support of the user interface.

An important part of WAP is the Wireless Markup Language (WML), used to define content for WAP devices.

Like HTML, WML is a markup language providing layout, data entry, and navigation. However, WML differs from HTML in many areas, as it must address the limitations of wireless devices. WML provides an explicit navigation model that helps wireless devices ensure that navigation elements are visible to the user despite the limited display area.

WML uses a deck and card model for organizing information into manageable chunks. In WML, there's no such thing as a “page.” Rather, the information is organized into cards, roughly comparable to Web pages. A card is intended to represent a single physical display screen. A complete collection of cards is called a deck. Each deck consists of one or more cards.

Each deck is a self-contained unit, allowing a user to work offline between deck requests. Wireless users receive a WML deck consisting of one or more cards. A WML micro browser is used to access a deck. The micro browser reads the whole deck, and navigation between the cards in this deck is done without the need to load any more data. This is important to know,

because once a deck has been loaded, all cards within it stays statically in the WML micro browser memory until the browser is instructed to reload the whole deck.

Jakob Nielsen, a principal of the Nielsen Norman Group, agrees that WAP will eventually evolve into a powerful tool, which will be widely used throughout the wireless industry. Currently, there's a question of how much time and effort people are willing to spend to get information from a mobile device since the technology is still awkward and slow. Several WAP usability studies have been conducted in the past few years and the results all support the viewpoint that small displays, cumbersome input, and limited bandwidth create a challenging wireless design environment, but in order to be successful in this evolving environment, usability must be addressed. Regardless of speed and capacity, only a wireless device can offer a wireless experience and this means that there will always be demand for content and services that purposefully address the wireless space. The wireless Internet is not about what the technology can do, rather what the technology can enable the end user to accomplish. It is the opinion of the Author that Nielsen and other prominent usability experts view that the dissatisfaction with WAP is more closely tied to core design issues rather than the limitations of the technology.

2.6 Microdesign

Just as with any other device, content, design and navigation must be developed in a way that meets the needs of typical users. Mobile applications will only be successful if they are usable. The following usability issues need to be addressed when building mobile applications: content and functionality, site structure and navigation, page design, dialogue and feedback, and device compatibility.

JoAnn Hackos and Janice Redish (1998) begin their book, *User and Task Analysis for Interface Design*, talking about the user interface. Their viewpoint is that the user interface is “what users see and work with to use an application. Interfaces can help or hinder, be effective or ineffective. Designing an effective interface doesn't happen by chance. Good design happens only when the software development team understands people as well as technology” (p. 1).

“Mobile use is at first entirely strange to conventional software developers and interface designers. Even software developers working on wireless projects are shocked when they put down their emulators and actually move about and use a wireless device. Even at this point, software developers do not really understand the application they have created unless they are in sync with the real users and what they are trying to get done. Mobile users are unique. They do not program, they do not think software is an art, and a good number do not even use personal computers. Because they are walking about, they are busy and will not give their full attention to any gadget. They expect to complete tasks within minutes. When a mobile user catches a train to pick up his child, with dinner in hand, talking to a colleague, and casually using a wireless application—this is the real world” (Beaulieu, 2002, p. 53).

Content alone does not guarantee that the user will be satisfied with what has been developed for their use. Content is ultimately what the user comes to see, and how effectively the information can be accessed, presented, and be read is the critical measure for success. The structure of the content will drive the design and logic of the interface. User satisfaction is greatly influenced by the design of the user interface and ease of use. These factors will affect issues such as: productivity, learnability and adoptability. There is a need to build a bridge between users and software developers to help software development teams connect the structure of the user interface to the structure of use.

The best way to ensure quality user interface design is to use an orderly and well-defined design process that is specifically geared to producing quality results. This applies to the design of the application that the user interface supports as well to the design of the user interface itself. The best user interface in the world will not be well received if the application itself is poorly designed and difficult to use.

By now, it's pretty obvious that a page designed for a computer screen may not look so good, or may not even be usable on the small screens of a Palm device, or the screen of a tiny mobile phone. Not only do the commands, navigation, and functionality differ from those on the Web, they also differ from device to device in wireless space. Design and user-experience

architecture require a mobile-specific approach, which some have called “microdesign.”

The research seems to indicate that WAP sites fail for one central reason: corporations are force-fitting existing Web content onto a tiny screen without considering the unique needs of mobile users. Furthermore, because of the mobile Web's unique attributes, Web experience doesn't yield WAP success, and the lessons learned from years of Web site design fail to apply to mobile devices. Instead, companies must unlearn the Web's rules and master a new competency that Forrester calls Microdesign.

Designing for the wireless Web presents important new challenges for development teams. Michael Mills, chief interface technologist of AlterEgo Networks, Inc. addressed these challenges in the white paper, “Microdesign: Challenges and Opportunities” (2000). As he pointed out in the paper, some of the more obvious differences between traditional Web design and designing an Internet experience for mobile devices, are as follows:

- *“Context of use* — Microdesigners have to create experiences relevant for people on the move who aren't comfortably seated at a desktop machine. Mobile phones are designed to be light enough to be carried in one hand and fit in one's pocket. Moreover, mobile phone users will often be interacting with their devices in noisy, poorly lit environments” (p.2).
- *“User's time is precious* — Compared to the desktop user, a cell phone user will have a very small window of time to get the information he or she needs, i.e. seconds as opposed to several minutes or hours” (p.2).
- *“Network latencies* — Although download times are still an issue for the desktop, they are even more severe for mobile users (9.6 Kbps vs. 28.8Kbps for desktop dial- up modem).” (p.2).
- *“Screen size and color depth* — On the desktop Web, a designer can create pages for large displays – typically 800 x 600 pixels with millions of colors per pixel. The microdesigner is faced with a severely limited design palette: phone displays

are about 1- inch square (around 4 lines of text and 12 to 15 characters wide) with 1-bit color” (p.2).

- “*Input mechanisms* — Today’s cell phones are designed for voice conversations, not data input. Data entry is currently the most painful part of using cell phones to interact with the Web. The microdesigner cannot depend on the user having a full keyboard for entering alphanumeric data. (Eventually, voice recognition should alleviate much of the input burden. But for now text entry is a reality.)” (p.2).

Figure 2 compares the differences between traditional Web design and microdesign.

Figure 2: Differences between Web Design and Microdesign

	Web design	Microdesign
User interface	Big, robust	Small, simple
Time available for the user	Hours or minutes	Minutes or seconds
Site role	Destination	Means to an end
Navigation elements	Distinct, persistent	Interwoven with content
Target pages viewed per user	Many	Few
Potential navigation path	Unlimited	Few or one
Site availability	When user seeks it	Whenever relevant
Content scope	Continually expanded	Proactively limited
Multidevice synchronization	Optional	Required
Personalization	Additional feature	Key to site’s value

Source: Forrester Research, Inc.

Source: Forrester Research, 2000

This list of usability constraints can severely diminish the wireless Internet experience for the mobile user. According to a report by Forrester Research, microdesign rests on three principles: effortless navigation, concise content, and automated integration with other channels. “Users must be able to tap a site’s value immediately without learning a navigation scheme. Content must be optimized for small screens and only users who demand more depth should see it. Mobile offerings must synchronize with other channels, like the Web, invisibly and

immediately” (“Report Reveals,” 2000, para. 10). It is these three basic principles that many of the guidelines for developing WAP applications are based on.

The literature seems to indicate that microdesign is an often-overlooked element of the current wireless world. This element could mean the difference between success and failure for this emerging market. Examining how people interrelate to the information once it is delivered can be the difference between a user staying or a user being frustrated and leaving. The literature also suggests that Web experience does not yield WAP success, and the lessons learned from years of Web site design fail to apply to mobile devices.

According to the W3C, to change the navigational paradigm of a document is not simply a matter of changing the formatting of the content. In the case of a small screen device, the information will need to be filtered, so that the user will not have to wade through enormous amounts of irrelevant information. Browsing becomes extremely tiresome in a mobile environment. Given that most users do not read the text but scan it, the main features of a Web application need to be highlighted. Ultimately, the kind of problems people are having using wireless devices to access the Web content will only be resolved by the use of appropriate design.

Ultimately, design is problem solving, and the best way to discover which problems need solving is to look for them in context. The Internet as it exists today is the product of an evolution from static HTML pages to rich multimedia experiences. The new wireless medium brings with it new design requirements which differ from the design principles for the Web. When software developers design computer software and online services, they often regard what they are designing as if it were the center of “their” universe. They often fail to consider the broad context in which the technology will be used, and what the users’ total experience will be in using the technology in that context. Web and microdesign requirements may be different but they share one similar principle, and that is being “user-centered.”

2.7 Design Process

A software developer views the design process a bit differently than a HCI specialist. Software engineering has several models for software development. The Waterfall Model is a simplistic representation of the software design process. The design process for this model is linear and consists of the following stages: requirements analysis and definition, system and software design, implementation and unit testing, and integration and system testing. In practice, the stages are not linear but involve a sequence of iterations. As defined in *Human-Computer Interaction*, an HCI design model is “based on the premise that design should be: user-centered, integrate knowledge and expertise from different disciplines, and be highly iterative” (Preece et al., 1994, p.46). The HCI design model is a foundation that should be the basis for each of the software design stages.

Requirements Analysis and Design

The critical phase in classic system design is requirements analysis and definition. Analysis is essentially the understanding and refinement of the requirement and the documenting of such in a clear and logical fashion from which a design can be developed. A design for software is essentially the adoption of the analysis and the adaptation of it to the technology available for implementation. It is possible to have a single analysis of a problem domain but a separate design for say a C++ based implementation and a Java based implementation. Design is generally influenced by the technology to be used and is adapted to that technology, thus it is difficult to re-use a design across varying technologies. The analysis, however, can be re-used to produce a suite of designs. In the design phase, the requirements are used to create a detailed architecture and specification for building the application. The output of this phase can be thought of as a detailed blueprint and road map for the application.

It makes sense, therefore, to separate analysis from design. So user interface analysis is about understanding and refining the detail of the problem domain and documenting it in a design independent fashion. The analysis is technology independent. It can later be used to produce a design that is technology specific.

Tom Farrell views requirements gathering to be “about aiming at the right target.” Mr. Farrell goes on to say, “it doesn’t matter how accurate you are, if you aim at the wrong target, you miss. To be usable, a user interface must let the people who use the application, working in their own physical, social, and cultural environments, accomplish their goals and tasks effectively and efficiently. Unless you know who is going to use an application, for what purpose, and in what circumstances, an application can not be effectively designed or tested to see whether or not it works well. User and task analysis is designed to identify this information and use it to set design and testing goals and establish measurable success criteria” (Farrell, 2001, para. 3).

Classic system design begins by having the analyst talk with the users to extract what it is they need. User involvement is critical, and it cannot be assumed that the user can tell the analyst what they want from the system. This is particularly important point when designing wireless applications, since most users are not familiar with mobile devices. Effective user involvement is an important step in improving the design process. The effectiveness and involvement of the user is driven by the creativity and insight of the analyst. The analyst works with the user to articulate the most appropriate design, much like an interpreter works with a deaf person to communicate to the non-deaf world.

There are informal ways of expressing and recording design ideas as well as structured ones. The HCI literature offers a slew of methodologies designed to analyze users needs and task performance in order to translate these into user interface design. The literature reviewed seems to indicate most methodologies assume implicitly or explicitly that the purpose and functions of the system in question are already known and that the tasks it is intended to support already have been determined. Hence there is a strong focus on user and task analysis techniques. Because task analysis techniques specifically aim to re-describe user tasks in great detail as they are currently performed and as preparation for detailed product design, these techniques are of little help when seeking to understand the relevance of certain system functions to several different user populations.

As defined in the book, *Human-Computer Interaction* (1994), “Requirements gathering is an analytic process in which representations of the system are produced which not only describe what is required but also helps the designer to analyze situations. The result is either a representation of the problems with the current system or a representation of the requirements for a new system. The requirements process should provide the analyst with three answers: what the system must do, the structure of the system and the data that must be available, and the acceptable level of user performance and satisfaction with the system” (p.384).

The functional requirement process is concerned with understanding what the system does and what the user does. “Decisions on which activities are to be carried out by a human vs. which will be carried out by a computer is known as the process of task allocation. In addition to being concerned with what the system is capable of doing, it is equally important to identify any constraints the system has” (Preece et al., 1994, p. 385).

Defining what the system must do is only one-third of the requirements puzzle. Another third should focus on identifying the meaning and structure of the data that will support the tasks and functions of the system. It is vital that all data elements are understood, precisely defined, and available from the system. Data elements are the basic building blocks of any system. Data requirements seek to represent the entities and relationships that are required in an application and the constraints that apply to the data. The data analysis process is focused on establishing exactly what data is required by the system, how it is structured and how it is logically stored. (Preece et al., 1994, p.395)

When thinking about data, as it would pertain to a wireless application, development teams must think carefully about the amount of data the software is expected to handle. It would be a mistake to think that an application on a PDA with the same amount of data that is handled on the desktop would perform the same. A mobile user has little time and even less patience to be scrolling through thousands of records in search of the one piece of data they are looking for. It will be the shape of the content that will drive the actual interface design.

As it pertains to the Palm device, the following issues need to be understood and factored in to the data requirements process:

- *Choose Content Carefully* — When deciding what information to store on the Palm, choose only the data that is most essential. Information that a user will access regularly or will urgently require in certain situations.
- *Targeted Data* — Different users have different needs, it is important to keep the audience in mind. When possible, customize the content specifically for the targeted user and target only the information important to that user.
- *Limited Palm Resources* — May need to provide data filters that allow the user to specify only the data they want downloaded.
- *Application Partitioning* — To be able to provide users the benefit of instant access, lower cost of service, longer battery life, and efficient performance, Palm Computing conceived the design concept of application partitioning. This concept looks to separate data into two groupings, static and dynamic. The dynamic data should reside on the Internet server and be available for download and display when requested by the user. The static data should be built into the application and reside on the Palm device. Separating the static and dynamic data elements makes it possible to limit the volume of data that needs to move over the network. This is a critical concept, which needs to be factored into the design process when developing a wireless application for a Palm. Palm Computing named the design concept “Web clipping,” and is critical to the success of the usability of the application.

Usability

As the name suggests, usability has to do with bridging the gap between people and machines. Stefanos-Zcharias Zachariadis defines the usability of a system as: “a measure of its effectiveness and efficiency, and a measure of the satisfaction with which users can achieve

specified goals through the system” (Zachariadis, 2001, para. 1). A user interface refers to the parts of a hardware and/or software system that allow a person to communicate with it. In order for a tool, e.g. a computer, website, wireless device, etc. to be effective, it must allow intended users to accomplish their tasks in the best way possible.

All information seems to point out that from the user’s perspective, usability is important because it can make the difference between performing a task accurately and completely or not, and enjoying the process or being frustrated. From the developer’s perspective, usability is important because it can mean the difference between the success or failure of a system. From the corporate point of view, software with poor usability can reduce the productivity of the workforce to a level of performance worse than without the application. In all cases, usability can greatly determine the success or failure of a development effort.

According to Jakob Nielsen, all systems have five characteristics of usability, and all five characteristics need to be considered in any interface design. The users of the interface design will ultimately determine whether or not a wireless application is successful, the following usability characteristics, as defined by Mr. Nielsen (2001), need to be factored into the usability requirements process:

- *“Ease of Learning* — How fast can a user who has never seen the user interface before learn it sufficiently well to accomplish basic tasks?” (para. 6).
- *“Efficiency of Use* — Once an experienced user has learned to use the system, how fast can he or she accomplish tasks?” (para. 6).
- *“Memorability* — If a user has used the system at some earlier date, can he or she remember enough to use it more effectively next time or does the user have to start over again learning everything every time?” (para. 6).
- *“Error Frequency and Severity* — How often do users make errors while using the system, how serious are these errors, and how easy is it to recover from a user error?” (para. 6).

- “*Subjective Satisfaction* — How much does the user like using the system?”
(para. 6).

Requirements gathering involves a wide range of activities aimed at eliciting a precise description of the functional, data and usability requirements of the system under consideration. Since mobile development for Palm devices is in its infancy, chances are that development teams have little or no previous experience in developing software for these devices. In defining the requirements desired, it is proving to be a mistake delivering mobile applications that are just like the “Windows” version. Palm devices cannot mimic the advantages of a desktop such as gigabytes of hard drive space, megabytes of RAM, super VGA display, and large keyboard. Palm devices demand a different type of application.

The lesson learned up to this point, is that a mobile application should not attempt to replicate the functionality of a desktop program. Mobile applications need to be simple, providing the user a whole new set of conveniences, which are not necessarily the same as those that are provided by an Internet application. An application that provides a few highly accessible and well-designed set of features that makes the users life easier is what the analyst needs to identify. Identifying these features relies upon the requirements gathering methods used by the analyst. Requirement gathering methods that work for the desktop and the Internet are not working for mobility.

The characteristics of mobile devices and mobile users differ from what is known about the desktop and the Internet. These differences are requiring analysts to seek alternate methods and techniques to be able to support wireless development efforts. Usability methods provide tools that an Analyst needs in order to bring some repeatability to the process of analyzing a system requirement and identifying the key design ideas, which will formulate the shape, behavior, and information displayed by a finished product. The analyst needs to be aware of the variety of techniques available to assist in this process, e.g. from paper based checklist to diagrammatic techniques to prototyping, meetings and walkthroughs. The selection of a method

should be made after a thorough understanding of the unique balance between the mobile user and mobile device characteristics are understood.

2.8 User Centered Design

The most influential step in improving the usability and acceptability of a mobile application is to take its intended users into account in the early stages of the development effort. Focusing early on the user transforms the design process from “trial and error” to an informed activity resulting in fewer iterations. “Underlying HCI research and design is the belief that the people using a system should come first. Their needs, capabilities and preferences for performing various activities should inform the ways in which systems are designed and implemented. People should not have to change radically to fit in with the system, the system should be designed to match their requirements” (Preece et al., 1994, p.15).

Determining how and why people will use a new mobile device that has never been used before is difficult. Even more challenging is determining where and how user feedback and usage information can be placed in the development cycle for optimal results. User centered design is a development process that combines ten years of research by the human computer interaction and human factors communities, and results in the development of applications that meet end user requirements.

User centered design is especially suited for developing PDA applications because it manages complexity by starting with the big problems and working towards the small details later in the process. It ensures that requirements are well researched, documented and agreed upon by all participants. It also ensures that real users are evaluating designs and functionality when there is still time to make changes to satisfy their needs.

In typical development cycles, the requirements analysis phase is not evaluated from a user perspective. Requirements are often set before it is understood how users work and what they will do with the product. Often, programming starts too early, rapidly making changes in design more difficult, if not impossible.

User centered design is built on the philosophy that user requirements and goals drive application design. If usable mobile applications are to be created, the entire development process needs to be user centered. When a user centered design process is used to develop a mobile application, it restructures all of development around the central question of how the application is to be used and what it is being designed to accomplish.

The requirements needed to make mobile communication accepted by everyone are still being identified. The ability to understand the “real” needs of a mobile user must be understood by all participants involved in developing applications for wireless devices.

Research and thorough understanding of today’s mobile needs indicate that contextual design is an increasingly popular method for discovering this information and would be well suited for obtaining the requirements to support the development of an application for a Palm device.

System design is the process of developing a solution for a specified problem. Every project presents new problems often requiring new design solutions. To support each project, a design process needs to be defined. Defining a process appropriate for the problem will enable a development team to collaborate in gathering data, designing a system, and producing the result. This thought process not only applies to contextual design, but to any other user-centered design approach. What differentiates contextual design from other approaches is that it offers a complete set of techniques, to guide design from gathering the initial data, to defining the system function.

Ultimately, system design is the invention of the system's response to a user problem. Without adequate user data this invention is ungrounded. The development team needs to define a design process, which will assist them in gathering the necessary data. Developing a good system requires that the data and its use be incorporated into a coherent design process.

A design process alternates between working out a piece of design, then stepping back and considering the whole design as a structure. Any sequential design step requires a following step to look at the whole and check for appropriate structure, consistency, and completeness.

Once the structure is good, the next step is to work out the next level of detail sequentially. The alternation between doing and reflecting keeps the design moving forward while remaining coherent. The individual system features tend to be the starting point in the design process. The contextual design approach tries to move the focus away from the individual system features to the identification of work issues. It is the belief of Beyer and Holtzblatt that this shift in thinking assists in creating new solutions.

2.9 Contextual Design

Over ten years ago, Hugh Beyer and Karen Holtzblatt became frustrated with being told more often than not that the systems they built did not provide its users with an appropriate solution. They began to examine what was failing with classic systems design. They came to the conclusion that users were drawn into the software design process to check the design at the tail end, but not to drive it.

Software engineers do not want to build a system that does not meet the needs of its users. Beyer and Holtzblatt concluded that the direction for trying to figure out exactly what the users need is tied to user data. User data gives direction about how work is structured, what matters to people, and real characterizations of an environment. Beyer and Holtzblatt state that “data is the source of invention because it defines the need,” and if development teams can obtain the right data, learn how to roll the data up to see the larger user population, and have knowledge of how to pull design implications from the data, then it will be the data that guides the team to successful system design.

Beyer and Holtzblatt set off to research how to use data for design. They devised an approach that would focus on making the data gathered from users be the base criteria for deciding what a system should do and how it should be structured. Their efforts resulted in Contextual Design. It is their intent to help development teams see design implications in user data. Contextual design is an approach to define a system that collects multiple user-centered techniques into an integrated design process.

When a development team begins work, it has to decide how to approach the task of deciding what to build. Design methods define a coherent series of actions that hopefully lead a team to a well-designed system. But every problem is different, and every team and organizational system is different; any design method must accommodate specific needs. Because contextual design deals with the front end of design, from finding out “who” your users are to testing a specific solution for them, it offers a useful framework for tailoring a design process.

Contextual design is grounded in principles of what it takes to drive design thinking, what makes for good user data, and what’s going on in teams and organizations to ensure that the design process works. The principles on which the process is based fall into three categories: using user data, running the team, and driving design thinking.

The sentiment that Beyer and Holtzblatt experienced years ago is similar to what is occurring today, with developing and implementing mobile technology. In the book, *Contextual Design*, Beyer and Holtzblatt discuss the concrete actions that enable a contextual design project to get started. These actions include: setting the focus for a project, planning who to talk to, and establishing the data gathering process.

Setting the Focus

To set the focus for a project, the development team needs to begin by defining the problem that they intend to solve, from the perspective of the work the team plans to support.

Typically, a project receives its mission in terms of the solution it will deliver, for example, an application to register for courses online, or a mobile version of the online course registration system. Following the contextual design approach, the project “solution” needs to be transformed into a statement about the work.

Initially, the project focus tends to be restricted to the work of the tool that is being built. To see the entire work context and identify opportunities and potential problems, it is the belief of Beyer and Holtzblatt that the development team needs to expand the focus beyond what the tool is to be used for, e.g. registering for courses.

To expand this focus, Beyer and Holtzblatt suggest asking the following questions. These types of questions help a development team think about how the system fits into the user's overall work.

Aspects of Work

- What is the work the development team expects to support?
- How does this work fit into the users' whole work life?
- What are the key work tasks?

These type of questions help identify the tasks to be seen.

People to Talk To

- Who is involved in making the work happen?
- Who are the informal helpers?
- Who provides the information needed to do the job, and who uses the results?

These type of questions help identify the kind of people to interview.

Interview Constraints

- Where does the work happen physically?
- What is the cultural and social context in which the work happens?

These sample questions can help identify any unique situations and/or issues that the team should be aware of.

Analogous Work

To help expand the development teams perspective on the work, it may be helpful to study analogous work. Beyer and Holtzblatt indicate that this may stimulate insight into how work is structured. To accomplish this, the team should look for unrelated kinds of work that have the same structure as the work the team wants to support. This study looks at how students would locate a class using the Schedule of Classes booklet. This helped the Author understand the basic structure of finding a class, independent of technology. It also provided insight into the aspects of this data, which made it unique for each student. As Beyer and Holtzblatt suggest, studying analogous work can provide insight into the work being supported, suggesting hidden

aspects that might be important.

Once the project's focus has been established and the key people to speak with have been identified, the data gathering process can be defined.

Beyer and Holtzblatt have identified a process for gathering user data. This process has a defined set of steps to guide the design phase beginning with gathering initial data to defining the system function and structure. The following steps make up Beyer and Holtzblatt design process: contextual inquiry, interpretation sessions, work models, consolidation, vision, storyboards, user environment design, and paper prototyping. Like any other design process, the contextual design framework is flexible. System design is problem solving. Design problems can present themselves in a number of different ways. Each kind of problem needs a different design approach, appropriate to the scale and time frame. Development teams need to create a design process, which meets the unique needs of the design. Using contextual design as the framework, it may be necessary to: alter or substitute steps that achieve a similar intent, add new techniques to put more emphasis on a design step, or remove steps which are irrelevant to the specific design problem.

Step 1: Contextual Inquiry

“The first problem for development teams is to understand the users: their needs, their desires, and their approach to the work. Often the work has become so habitual to the people who do it that they often have difficulty articulating exactly what they do and why they do it. Contextual inquiry is an explicit step for understanding who the users really are and how they work day to day. The design team conducts one-on-one field interviews with users in their workplace to discover what matters in the work. A contextual interviewer observes users as they work and asks about the users' actions step by step to understand their motivations and strategy. Through discussion, the interviewer and user develop a shared interpretation of the work (“Interactions,” 1999, p. 34).

Step 2: Interpretation Sessions

Team interpretation sessions bring together a cross-functional team to hear the whole

story of an interview and glean the insights and learning relevant to their design problem. An interpretation session lets everyone on the team bring his or her unique perspective to the data, sharing design, marketing, and business implications. Through these discussions, the team captures issues, draws work models, and develops a shared view of the user whose data is being interpreted and their needs.

Step 2: Work Modeling

Work models are a convenient and compact way to represent a user's work. Being pictorial, they are easy to scan; they don't have to be read, like user scenarios. They assist communicating what has been learned about the users work. Work models help development teams transition from knowing the work of individual users to understanding the fundamental structure of work for a whole user population.

People's work is complex and full of detail. Work is also intangible. This makes it difficult to capture and discuss the work practice. Development teams seldom have the critical skill of seeing the structure of work done by others, looking past the surface detail to see the intents, strategies, and motivations that control how work is done.

Work models are a technique for showing the work of individuals and organizations in diagrams. Five different models provide five perspectives on how work is done: (1) the flow model shows communication and coordination, (2) the cultural model shows culture and policy, (3) the sequence model shows the detailed steps performed to accomplish a task, (4) the physical model shows the physical environment as it supports the work, and (5) the artifact model shows how artifacts are used and structured in doing the work.

Step 3: Consolidation

Systems are seldom designed for a single user, but are designed for a whole user population, such as a department or organization. The design depends on seeing the common aspects of the work different people do. The goal of this step is to create a single statement of the work practice of the entire user population.

“Consolidation collects data from individual user interviews so the development team can

see common patterns and structure without losing individual variation. The affinity diagram is a technique that maps issues and insights across all users into a wall-sized, hierarchical diagram to reveal the scope of the problem. The consolidated work models bring together each different type of work model separately to reveal common strategies and intents while retaining and organizing individual differences. Together, the affinity diagram and consolidated work models produce a single picture of the user population a design will address. They give the development team a focus for the design conversation, showing how the work functions as a whole rather than breaking it up in lists” (“Interactions,” 1999, p. 36). Consolidation identifies what matters in the work and is used as a guide for structuring of a coherent response, including system focus and features, business actions, and delivery mechanisms.

Step 4: Vision

This step is designed to bring the development team together to discuss the consolidated data and how technology can improve the work people need to complete to get their jobs done. “The redesigned work practice is portrayed in a vision, a story of how users will do their work in the new world the development team invents” (“Interactions,” 1999, p. 39). A vision includes the system, its delivery, and support structures to make the new work practice successful. Storyboards can be used as a technique to add details to the vision, showing how people will work with the new system.

Step 5: User Environment Design (UED)

This step of the contextual design process is focused on analyzing the underlying structure of a system and identifying how each part of the system supports the user’s work.

There are several techniques that can assist development teams in being able to analyze the underlying structures of a system. “Prototypes, mockups, or sketches are techniques that can be used to represent the system structure. The issues with these techniques are that they focus the development team on the user interface. These techniques hide the structure of the system behind the user interface details, making it easier to talk about menus, icons, and screen layout than about whether the structure and organization supports the work. To consider how the existing

system hangs together as a whole, a model that depicts the structure and function of the system, as experienced by the user must be created” (Holtzblatt & Beyer, 1993, p. 99).

To separate the discussion about system structure from the discussion about user interfaces, Holtzblatt and Beyer introduced a new technique for representing the system called User Environment Design (UED). The UED can be used to: make sure the system structure is right for the user, plan how to introduce new features in a series of releases, and manage the work of the project across the team.

The UED is essentially a model. To make this model more concrete, Holtzblatt and Beyer use the metaphor of designing a house to convey their concept. “In designing a house, rooms are dedicated to different purposes. The kitchen, for example, is for cooking. The tools needed for cooking are located in the kitchen. Food is also located in the kitchen, because food is what is worked on when in the kitchen. Items, which are unrelated, such as a bed, are not located in the kitchen. Even a related but distinct purpose such as eating is given its own place, a dining room” (Holtzblatt & Beyer, 1993, p. 99). The UED is similar to a floor plan. It shows each part of the system, how it supports the user’s work, exactly what function is available in that part, and how the user gets to and from other parts of the system, without tying this structure to any particular user interface.

It is the belief of Holtzblatt and Beyer that a place (room) exists to perform an activity and that this same type of pattern exists in every area of life. The items to be worked on that are directly related to the activity are collected and brought to the place, which houses the activity. Anything that is deemed to be unrelated to that activity is cleared away. “Related but distinct activities are kept nearby, but are not allowed to interfere with one another” (Holtzblatt & Beyer, 1993, p. 99).

This is the same for software systems. Development teams strive to create a place for each coherent activity. The goal is to provide the functions needed to do the work. Clearing away any function, which is not necessary to complete the work, results in a clearly defined user interface that does not confuse the user. The User Environment Model defines “focus areas” or

places in the system for focusing on each activity. Each focus area provides the functions and work objects necessary to do one activity.

Creating a UED

The UED should be built with paper. Paper is still the best medium for being able to quickly change things around. The size and physical nature of the design should be such that it can be easily manipulated. The goal of the model is to structure the functions of the system in a way that support the users tasks without imposing a strict task order. The structure is implementation independent, even if in reality the choice of platform and “look and feel” is often obvious. There is no right or wrong way to tackle the placement of a focus area but the scenarios supporting the new wireless application act as a natural guide as to the order in which focus areas are laid out.

In this case, the individual Web pages of the Student Information System would be the starting point for identifying the focus areas. Each page may suggest a new focus area, function, or link in the emerging UED. Screen prints are pictorial and assist with being able to recall the context and the implications of each page for the model better than a scenario or other textual description. Depending on the level of detail of a Web page, the focus areas will be more or less detailed, sometimes comprising one or more functions, and sometimes a number of more detailed activities.

The focus area is representative of a place where the user focuses on completing their work. The focus area collects functions and work objects into a coherent place in the system to support a particular type of work. A box is used to represent each focus area. Words and objects are used to capture the system structure supporting the focus area. The term formalism is used to identify the primary parts of the User Environment Model and what they represent in a real system. An example of a User Environment Model and its formalism is illustrated in Figure 3. The primary parts of the User Environment Model as defined by Holtzblatt and Beyer (1998) are as follows:

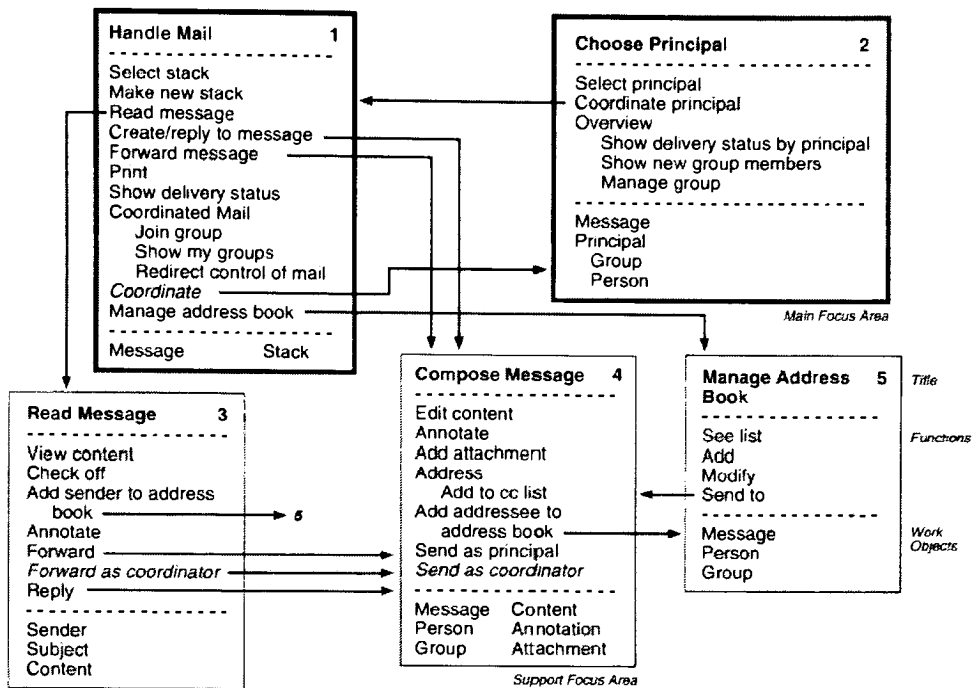
- *Purpose* — A short description of the actual work the focus area supports. The purpose should be written in a single sentence. If this is not the case, then it may be that there are many different functions trying to accomplish different things within a single focus area, which may indicate that the system may be poorly structured.
- *Functions* — are described by a short phrase, including a description of their behavior and justification. Functions are made available through menus, toolbars, keyboard command, and by direct manipulation. Which mechanism the development team chooses to implement for a function matters. A poor user interface or inconvenient access to a function gets in the users way, but it doesn't change the purpose of the place or the work done there. There are three types of functions that can exist within a system:
 1. • — This notation is used to identify functions that are invoked by the user to do work
 2. ° — This notation is used to identify functions that are automatically invoked by the system as necessary, e.g. a process which has been automated. The user knows these functions exist, but does not invoke them explicitly.
 3. (name) — This notation is used to identify function cluster that appear in multiple focus areas. This is shorthand for listing all the functions in the cluster. The function cluster name appears between parentheses and is separately defined once to apply to all focus areas.
- *Links* — Each box or focus area represents a coherent place to do work. The links between places show how the system supports the flow of activities but doesn't indicate particular order of work. Links are like other functions in that the user has to take an explicit action to follow the link; they're different in that the effect they have is to move the user to a new focus area
 1. > — A single arrow between focus areas represents the link. The function

name may not be the same as the destination focus area name, in which case the name or number of the destination focus area should be given in parentheses

2. >> — This notation is used to identify functions that support double links between focus areas. A double line is used to represent the double link between focus areas. A double link would be used when a user needs to do the work of one focus area in the context of another. An example of this would be the use of a spell checker. A double link may indicate a challenge when designing the user interface because the user will need to switch between focus areas without losing context in either.
- *Work Objects* — The interface objects the user sees and manipulates in the focus area
 - *Constraints* — Implementation constraints on the focus area, e.g. speed, reliability, connections, etc.
 - *Issues* — Open design issues associated with the focus area, user interface ideas, implementation concerns, and quality requirements.”

(Holtzblatt & Beyer, 1998, p.322)

Figure 3: Example of a User Environment Model



Source: Communications of the ACM, October 1993, Vol.36, No.10

“Building a User Environment Model defines the requirements for the implementation, provides initial objects for the system data model, and defines the structure of the user interface. Making the system structure explicit in a User Environment Model gives the development team a tool in which scenarios can be walked through it and usability problems can be identified and addressed before the actual user interface design process begins” (Holtzblatt & Beyer, 1993, p. 99). The sketches of a storyboard provide the development team with a way to think in the language that is most natural to them. The User Environment formalism is a direct representation of the issues for structuring the users experience of the system. User Environment formalism is not as natural a form for thinking as the sketches of a storyboard. Holtzblatt and Beyer believe that the more time spent between the User Environment Model and the user interface, the more the development team will begin to see the design implications from the User Environment diagram directly, and the more likely it will be regarded as a well regarded design technique.

This study focuses on extending an existing Web-based database application to a new technology (Palm). It makes most sense to begin the design process with a Reverse User Environment model of the existing Web interface to view and understand its structure. The only difference between a User Environment Design and Reverse User Environment Design is how it is used. The UED is focused on a new system being development while a Reverse User Environment Design focuses on an existing system version so it can be extended. As stated by Karen Holtzblatt and Hugh Beyer (1998), “the Reverse User Environment Design is a good way to step back from a system and get insight into it. The value of this insight is that the model may reveal the values and assumptions about the work practice built into the existing system” (p. 325). The Reverse User Environment Design can then be compared to the work model of real users to decide whether the assumptions built into the current system will work for the new system. This technique will be used to see what the students experience as they move through the Student Information System. The resulting model may reveal a set of issues that would need to be addressed by the new implementation and it may reveal structural issues through the development of a prototype.

Step 6: Paper Prototyping

A paper prototype tests the structure captured in a UED by talking to users through the medium of a user interface. The initial intent of the prototype is to test structure and the user interface of the prototype should be a fair representation of the underlying structure. The priority of the prototype is that it conveys the translation of the UED through a user interface that conforms to the specific guidelines for the selected technology.

Prototypes act as a language for communicating between users and technologists. “Instead of introducing a new language, a prototype builds on the users own experience using computers. A prototype enables the user to interact with the proposed system as they would with any system and to respond in a language that is immediately relevant to them, e.g. “I think I should be able to go to this section from here by clicking a button...” Comments such as this may actually impact the UED. The analyst understands the relation of the comment to the

structure and uses such comments to challenge the overall design” (Holtzblatt & Beyer, 1998, p. 372).

Prototypes are a prop used in a contextual interview that enables the user to play out the experience of living with the new system. By acting out their real work in the prototype, users can make their unarticulated knowledge explicit. Fleshing out the prototype with the users own data and work situations gives them the touchstones they need to put them in the experience of doing the work within a new context. The interaction between the user and the technologist provides the framework to explore different technical possibilities. The technologist knows the technology and provides options, which the user considers and matches to their experience at that moment opening discussion as to why one alternative works and another doesn't.

“A new system is designed in response to the current work structure. Working through a prototype of the new system is a technique that reveals issues and opportunities that would otherwise remain invisible. Together, user and technologist can explore how the system will impact their work and how their work could be potentially changed, for the better, in the future (Holtzblatt & Beyer, 1998, p. 375).

3 Case Study

A case study was chosen as the research process to carry out the investigation. This section presents the research. The first section presents the design process, the second section introduces the participants, and the third section describes the equipment used.

Formulation of Problem Statement –The purpose of this thesis was to gain insight in the field of mobile interface design. This study focused on a specific problem area challenging software development teams. The area demanding investigation is tied to developing mobile solutions. The majority of projects aimed at developing solutions for mobile devices have been focused on extending the functionality of existing Web applications. The results have been that many projects have failed to develop usable solutions for mobile devices. Further investigation indicated that the usability failures are tied to not having a clear understanding of user and task requirements. The process for defining user and task requirements has been based on what works for developing desktop solutions. These processes are designed to support robust functionality. Unlike the Web, a personal digital assistant is not designed to handle robust functionality. These devices are better suited for a well-defined sub-set of tasks. The front-end design process for identifying user tasks and requirements, for a personal digital assistant, requires further investigation.

Selection of the Case to Study – The Contextual Design methodology will be applied to the Course Registration application at Rochester Institute of Technology (RIT) for several reasons. First, RIT has many existing web applications. The Student Information System (SIS) is one such system that provides students with the functionality to register for courses on-line. Based on the literature review, this system fits the profile of the type of system that would make a good starting point for exploring the use of mobile technology. Second, the primary users of this system are students. One aspect of being a student is that they are always on the go (mobile). Students are more open to the adoption of new technologies, and are the largest segment of growth for personal digital assistants. Mobile solutions are targeted for this type of user. Third, a

diverse group of participants were available for this thesis. Fourth, at the time of the investigation, no mobile applications had been designed for RIT.

Research Design – This thesis examines the use of Contextual Design for addressing the design problems inherent to mobile technology. The user-centered approach identified by Beyer and Holtzblatt will be applied to develop a front-end design process and resulting Palm interface for RIT’s Course Registration application.

3.1 Design Process

The planning process for personal digital assistants is similar to other computer systems/applications in that it follows the traditional life cycle methodology. The basic components of the traditional life cycle methodology include: Analysis, Design, Implementation and Evaluation.

This thesis focuses on three of these components: Analysis, Design, and Evaluation. Implementation was not in scope for this thesis.

3.1.1 Analysis: Understanding the Current Situation

This section seeks to identify the scope of the web-based tasks and user requirements that would be best suited for a Palm.

This case examines developing a design process to extend RIT’s web based registration process to a personal digital assistant. The starting point for this design process is to gain a better understanding of how the web based registration process has been implemented.

The existing system contains a lot of useful data. This data will be used to identify how the existing web based registration system is used, what registration functions the web based system supports, and who are the key participants in the registration process.

.3.1.1.1 Step 1: Define the Existing Work Structure

RIT has already designed an application for the Intranet to enable the process of registration. Implicit in the system is an appropriate allocation of function between the user and the technology. This allocation supports a natural flow of work. The presentation of the web

interface has already taken into consideration the multiple tasks and roles the system must support.

The starting point for this design process is to determine which of the existing functions would be appropriate for the Palm. It is not the goal of this step to identify the precise tasks and actions of the user to carry out these functions.

The User Environment Design (UED) was selected as the technique to show each part of the system, how it supports the user's work, exactly what function is available in that part of the system, and how it connects with other parts of the system, without tying this structure to any particular user interface.

The UED is communicated as a series of diagrams. These diagrams provide an orientation to the parts of the system, showing how the different parts have been implemented to support the users' roles and tasks. This diagram is used to capture all the functions that had been implemented and the roles the system support.

The first step in building the User Environment Design was to take screen shots of every page of the Student Information System. Registration is one aspect of the Student Information System (SIS). To conduct a thorough analysis of the Registration process design for the Web, the Author deemed it necessary to look at the entire Student Information System.

Beyer and Holtzblatt use the term Focus Area to refer to the user interface appearance "place" that supports work. A dialog box is used to represent a focus area. Each focus area should support one activity within the overall task. Each dialog box contains the following information about the activity:

- *Purpose* — what is the intent of each web page

This should be stated as a succinct statement. If this cannot be done, then it is an indicator that there are many different functions doing different thing, indicative of a poorly structured system.

- *Function* — what function(s) are available on each page

A function is indicative of action being taken by the user. If there were any focus areas that had no functions, this indicates a structural concern in which the web design has an extra layer that has no real purpose (adds a navigation layer).

- *Links* — does a function span across multiple web pages (focus areas)

A link supports the need of a user to switch between different activities “they” support. The name of the link may be different than the destination focus area. This could be an issue that adds confusion for the user.

- *Constraints* — are there any constraints associated with the focus area.

Figure 4 shows the web page used to register for classes and next to it is the diagrammatic representation of the activity supported within this focus area.

Figure 4: Comparison between Web page and Focus Area

4

Register for Classes

Purpose:
View, select, and delete courses for the available term

Functions:

- o View Class Schedule
- Drop Class
- Add Course by Course #
- Select Discipline
- Refresh open course list
- Select Open Course
- Add Course from Open Course List

Links:

- > Main Menu
- > Register
- > Academic Information
- > Financial Information
- > Address Information
- > Housing Information
- > Miscellaneous
- > Financial Aid Information
- > services@rit.edu

- > Directory
- > Search
- > Calendar
- > RIT News
- > Web Help
- > SIS

Constraints:

- Internet access
- Requires a DCE Account (DCE username and password)
- Requires SIS Account (PIN number)
- Access is limited to a set period of time every term

Forty-two focus areas supporting the Student Information System were identified. Refer to (Appendix A) for the User Environment Model – Web.

The User Environment Design indicates that the registration process is a large and a somewhat more complicated process that originally anticipated. The SIS is made up of many functions that form a structure that Beyer and Holtzblatt have termed as “leggy,” which means that the user needs to navigate through multiple layers of pages to complete an activity. The various functions also suggest that there are multiple roles supporting the registration process.

Issues Raised by the Existing Structure:

It was determined that the following issues would impact the design of the mobile version

of the registration system:

- It would not be wise to attempt implementing all of the functions on a Palm
- The mobile version of the registration process may only want to support one role, e.g. the student

Questions Raised by the Existing Structure:

1. What is the key way in which a Palm makes the registration process different for a student?
2. Which of the functions associated with Web registration need to be supported on a Palm?
3. How difficult would it be to implement the functions on a mobile device?

.3.1.1.2 Step 2: Define the Design Problem

As a result of the User Environment Design, the goal of the second step was to learn more about the activity of registration, how it is structured, and how it hangs together to support multiple roles.

A technique was identified which would shift focus from the technology and what the tool will be used for, e.g. registering for courses, and focus on the entire work context.

Using her knowledge of the registration process, the Author identified several key questions. These questions were formulated to gather data about the key aspects and user participation associated with the registration process. The RIT Schedule of Courses was used to formulate answers to the questions.

Assumptions

The answers to these questions could change after observing the registration process.

Aspects of Work

The following questions were used to reveal the key aspects of registration.

Q1: What is Registration?

- Registration is a process that students use to add and/or drop a course

Q2: How can a student register for classes?

- There are five registration methods available at RIT: telephone, Web registration (a.k.a. student information system (SIS)), mail, fax, and in-person
- The most efficient and most popular methods are by telephone and Web

Q3: When does registration occur?

- Registration at RIT occurs four times a year, once in March, once in April, once in September, and once in December

Q4: What information is required to register?

- Knowledge of courses required

Q5: Where does registration occur?

- The place in which registration occurs is the decision of each individual student and is dependent upon the chosen registration method. Examples of possible registration locations are the Registrars Office at RIT, the dorms at RIT, a students home, a students place of work, etc.
- Determining where registration can occur is out of the scope for this Thesis. This could be the focus for a separate research effort

Q6: What are the results of the Registration Process?

- Schedule Confirmation (written / mailed)
- Tuition / Billing Information (mailed)
- Grade Report
- Registration Materials
- Class Roster
- Enrollment Verification
- Open / Closed Classes

User Participation

The following questions were used to reveal user participation in the registration process.

Q7: What roles support the Registration Process?

- Student
- Bursar
- Academic Advisor
- Registrar
- Student Health Services
- Student Affairs
- Apartment Housing
- International Student Services
- Academic Department

Q8: What are the characteristics of a college student?

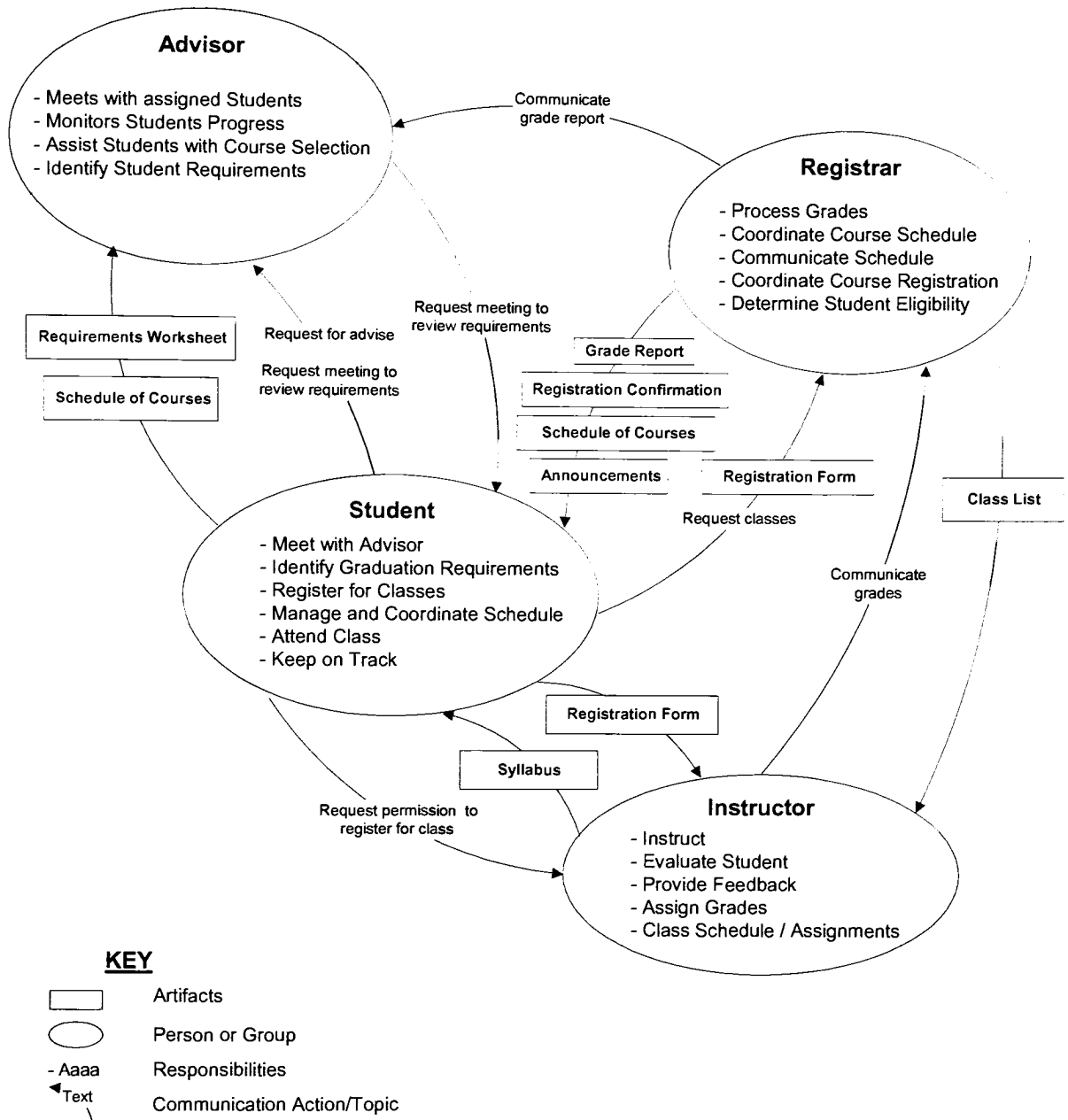
- Over the age of 18
- Male or Female
- Young or Old
- Has knowledge of computers

Q9: What are the other roles of a college student?

- Employee
- Mother / Father / Caretaker
- Friend

This step generated a lot of qualitative data about registration at RIT and the people it supports. Registration is somewhat an intangible process, which makes it difficult to capture and communicate. A technique was needed that would effectively capture and communicate the knowledge acquired about Registration. Contextual Design offers, “work models” as a language for seeing work. A “Flow Model” was used to communicate the findings from this step. Figure 5 is a diagram of the RIT’s registration process. Refer to (Appendix B) for the Flow Model.

Figure 5: Flow Model of RITs Registration Process



This diagram communicates the following information about the registration process at RIT.

- **Individuals** — This is the role a person plays in the process. An oval is used to identify the individual roles. The following roles support the registration process at RIT:
 - Advisor, Registrar, Student, Instructor

- **Responsibilities** — This is a list of the tasks associated with a role. A list within an oval is used to identify the responsibilities. A Student has the following responsibilities:
 - Meet with advisor; create schedule; register for classes; manage and coordinate schedule; attend class; keep on track
- **Flow**— This is the communication required between roles to finish a task. An arrow is used to connect the roles.
- **Artifacts** — This is a tangible or intangible item that is thought of and/or manipulated within the process, e.g. a document. Artifacts are shown as small boxes on a flow. Some of the objects that a Student comes in contact with include:
 - Requirements worksheet; schedule of courses; grade report; registration confirmation; registration form
- **Communication Action** — This is the communication action taken between roles, e.g. request for help. Communication is written on a flow without a box. Figure 5, illustrates the communication and coordination supporting Registration at RIT.

The flow model provides a snapshot of the registration process. This model supports the findings from the User Environment Model, which suggested that registration is a multi-faceted process. The flow model does a good job of communicating which functions are supported on the Web. The Student Information System has been built to support the communication between all of the roles identified in the model. The Flow Model shows that many of the artifacts have been implemented as part of the Web solution.

Focusing on the role of the Student, the Author noticed that the area of the registration process not handled by the Web is the one between the Advisor and the Student; the task of identifying graduation requirements.

Prior to taking any classes, a student and their advisor identify a curriculum /graduation requirements. A curriculum is a combination of required courses and elective courses, which the student needs to take in order to graduate. This “roadmap” is captured as an artifact. This artifact

is the requirements worksheet. This task is actually the starting point for the registration process.

A mobile solution would be well suited to this task since; the graduation requirements make course selection unique for each student.

Question Answered:

What is the key way in which a Palm makes the registration process different for a student?

- Focus on implementing the Requirements Worksheet; this will personalize the Schedule of Courses for each student, be used to select classes, used to track the student's relationship between themselves and RIT.

.3.1.1.3 Step 3: Identify the Participants

The goal of this step is to gain a better understanding about the participants' characteristics, their use of computers and mobile devices.

A questionnaire consisting of twenty questions was designed to gain a better understanding about the participant, their use of computers and mobile devices. Refer to (Appendix C) for the Participant Profile - Questionnaire. Six participants completed the Questionnaire.

The data obtained from the questionnaire was scored. Refer to (Appendix D) for the Participant Profile – Results. The raw data captured on the questionnaire was transferred into simple rows and columns by which tabulations and percentages could be computed. The results indicate how the participants answered each item on the questionnaire by percentages for each possible response category.

The results identified a number of user characteristics, which may influence the use of the system. Information about these characteristics was gathered for each participant to help interpret the individual user results. Examples of such characteristics include:

- Amount of experience with various technologies (computers / internet / mobile devices)
- Length of time using various technologies
- Attitude about mobile devices and their applications

Highlights from these results are:

Background Information

- 67% of the participants were between the ages of 25 – 30
- 83 % of the participants are college graduates
- 100 % of the participants have registered for classes using either the telephone or web site
- 100 % of the participants prefer to register for classes by using the web

Computer and Internet Usage

- 100 % of the participants use a computer at both home and at work
- 100 % of the participants use a 19 “ monitor or larger
- 100 % of the participants use both a keyboard and a mouse 4 or more days a week
- 67 % of the participants have never used a stylus

Mobile Device Usage

- 33 % of the participants own a Notebook Computer
- 83 % of the participants own a Cellular Phone
- 33 % of the participants own a Pager
- 17 % of the participants own a PDA

Mobile Device Functionality

- 50% of the participants who own a Cellular Phone also have internet access on their phones
- 60 % of the participants who own a mobile device use it primarily for voice mail, followed by Address book, Calendar
- Only 20 % of the participants use their mobile device for E-Mail or Web Browsing

Participant Profile

The results show that the participants have attended school at various ages. The majority of the participants are not familiar with a Palm, or its input device (stylus). The majority of participants own cell phones. They primarily use their phones to check voice mail and look up phone numbers. Most of their phones have access to the Internet. At this point in time few participants access the Internet using a mobile device. Many of the participants work. The older participants are more likely to access the Internet from work than they are from home.

.3.1.1.4 Step 4: Analyze the Key Functions

As previously stated, the registration process implemented on the Web has many focus areas. The initial mobile development effort should have a single focus, namely “Register for Classes” which is the natural first focus area for the Palm.

This step analyzes the functions of the focus area, Register for Classes. Figure 6, shows the focus area associated with registering for classes, which will be the focal point of this step.

Figure 6: Focus Area – Register for Classes

4

Register for Classes

Purpose:
View, select, and delete courses for the available term

Functions:

- o View Class Schedule
- Drop Class
- Add Course by Course #
- Select Discipline
- Refresh open course list
- Select Open Course
- Add Course from Open Course List
- Logoff S*I*S

Links:

- > Main Menu

- > Register for Classes
- > Academic Information
- > Financial Information
- > Address Information
- > Housing Information
- > Miscellaneous
- > Financial Aid Information
- > services@rit.edu

- > Directory
- > Search
- > Calendar
- > RIT News
- > Web Help
- > SIS

Constraints:

- Internet access
- Requires a DCE Account (DCE username and password)
- Requires SIS Account (PIN number)
- Access is limited to a set period of time every term

Contextual Inquiry was used for examining how each participant used the web to complete the tasks associated with registering for classes.

Since the majority of the participants are RIT alumni and do not need to register for classes, the Author looked for a way to keep the participants focused only on the functions associated with registering for classes. The functions for this focus area are:

- View Class Schedule
- Drop Class
- Add Course by Course number
- Select Open Course
- Add Course from Open Course List
- Logoff S*I*S

Scenarios and a series of tasks supporting these functions were created. These techniques were used to help keep the participants focused on the part of the SIS, which needed to be investigated. Refer to (Appendix E) for the Participant Tasks – Web.

The observations took place at the participants' place of work. A tape recorder was used to capture each session. Notes were taken for each session. The amount of time spent on each session ranged from three-quarters of an hour to two hours.

Each participant was provided with a login id and password to access the Student Information System. A list of the tasks was provided, which included any data needed to complete the tasks.

The rules for the interview were:

- The participant was asked to complete each task
- The Author would be observing the participant completing the tasks
- Notes would be taken during the observations
- While trying to work out any task which may be unclear, the participant was encouraged to talk out loud about any thoughts they are having

Each session ended with the participant being asked one or more questions. The questions originated from the observations. The questions were different for each participant.

Immediately following each site visit, the notes were typed into Microsoft Word, and the tape was reviewed to see if anything was missed. The observations resulted in a large amount of data.

Affinity diagramming was used to sort and group the issues, comments and notations. The information was grouped by the categories that define usability. Refer to (Appendix F) for the Contextual Interview - Summary.

Based on the observations, the highlights are as follows:

Presentation

- The majority of the participants were confused when viewing the Class Schedule on the registration screen if they selected a course that is held on different days /

different locations

- When the task asked the participant to register by the Course Title, several participants elected to navigate to the “Open/Closed Course” page to find the course
- The majority of the participants would have preferred to see the list of courses in alphabetical order
- None of the participants noticed that the Course Title differs between the on-line Course List and the Schedule of Courses
- All participants found the list of courses on the registration screen difficult to read

Navigation

- The majority of the participants navigated through the web interface using the forward and back buttons.
- All participants disliked the effort it took to locate the page that contained the course title / number they were looking for
- Four participants commented that the registration system would benefit from a search tool

System Messaging / Alerts

- The majority of the participants were concerned after registering for a course that had restrictions, their concern was with the effort they exerted to receive a system message indicating that their attempt to register was unsuccessful

System Response

- Five participants commented on the amount of time it took the system to present the course list
- Two participants were disconnected from the registration system before completing their tasks, each participant found this to be an inconvenience

User Confidence

- Three of the participants asked where the “Submit” button was after selecting the

course they wanted to add, not realizing that their action invoked a “soft” submit

- Two participants questioned “how current” was the open course list. Prior experience resulted in inaccurate data
- After completing all tasks, two participant proceeded to print the registration to be used as proof that they registered

User Behavior

- The majority of the participants preferred selecting a course by title than by course number
- Before proceeding with the next task, the majority of the participants navigated back to the Student Information System home page
- The majority of the participants register for class upon knowing that the registration period is open, to ensure the get into the classes desired

Investigators Comments

- For all of the participants, the registration process boils down to “Time and Convenience”
- All of the participants exerted only the effort needed to complete the “task at hand”
- All but one participant had blind faith that the registration system would result in an accurate class schedule. This in fact is not the case as one participant discovered
- The courses which have been selected by the student and their advisor is the key piece of data which makes the registration process unique for each person

Design Issues

The analysis indicates that the following issues would impact the design of the mobile implementation of the registration system:

- The presentation of multiple functions on a single Palm screen would invoke scrolling which is undesired by mobile users

- Adding a Course from the Open Course List requires two steps. These steps are designed to support every student at RIT. A mobile user desires only the information that pertains to him/her self.
- To add a course, the current structure allows the user to either add the course, by course number or select a course from the open course list. Selecting by course number requires the mobile user to know the section number. This piece of data is necessary for a mobile user and is missing from the current structure.
- The ability to print the class schedule once all the desired classes have been selected acts as a confirmation for the student that they have successfully registered. Confirmation of registration is a piece of functionality that is desired by all users; regardless of the technology. This piece of functionality has been deemed out of scope for this thesis, but should be addressed in a future release.

How Participants Used the Web

In addition to the notes captured during the observations the sequence of steps that were taken by each participant to register for classes were identified.

A. Identify which courses are needed

For this study, the Author identified the classes that the participants needed. This would not be the case under normal circumstances. This activity is implicit. As previously stated, in theory, the advisor and student work together to ensure that the student has identified the appropriate courses to fulfill the graduation requirements. The mechanism used to facilitate this communication is a worksheet used to capture and track the courses. Refer to (Appendix G) for the Requirements Worksheet – MS/IT. It is the student’s responsibility to track their progress against this worksheet. On occasion, the student can obtain an official updated worksheet for their program from the Program Coordinator. It does not matter which method a student uses to register, the student must ensure they are following their roadmap.

B. Identify which courses are being offered

Several of the participants indicated that they would identify which classes are being

offered prior to the registration period. These participants either refer to the Schedule of Courses booklet, or information they receive from their departments. It is interesting to note that the method for communicating this information is the US Postal Service.

C. Identify which courses are open

To identify which courses are open, the majority of the participants did not use the functionality within the key focus area. These participants navigated to the focus area, Open / Closed Courses. This focus area organizes its data by college / discipline. Within each college / discipline, all of the courses being offered are listed alphabetically by course number. To find whether or not a course is being offered, the participant needed to navigate through the open/closed courses, until they find the page that contains the correct course number. The participants could not easily locate a course based on the course title. This navigation structure would not be appropriate for a Palm.

D. Select Course

To select a course, the participants needed to identify the course's section number. One course could have several section numbers. The section number is associated with the timeframe of when the course will be offered.

The section number selected by the participants was based on one or more of the following factors: day of the week, time of day, and instructor. The criteria used by the participants to select a course varied by participant.

The focus area, Open / Closed Courses, presented the criteria used to select a course in a more user-friendly format.

E. Add Course

Given the choice between adding a course by course number or by course title, the majority of the participants preferred to add a course, by course number. The majority of the participants would make the extra effort of navigating to the Open / Closed Courses to secure the section number then navigate back to Register for Courses to add a course by course number.

F. Class Schedule

The majority of the participants relied on the system to notify them of any conflicts. They did not mock-up a schedule on paper to eliminate the hassle of adding two classes with identical timeframes.

G. Confirmation

Participants lacked the confidence that the web successfully added them to the class roster. All of the participants felt that until they received their class schedule in the mail, then they had not successfully registered.

Task Structure and Work Strategy

The participants used several different approaches for accomplishing a similar task. The sequence of steps that were taken by each participant were captured and analyzed to look for a technique that would communicate the task structure and work strategies of the participants.

The Sequence Model was used to identify the common structure in the detailed actions people take: the common activities, intent, and strategies for accomplishing a task. The sequence model resulting from the observations is listed in Figure 7.

Figure 7: Sequence Model

Activity	Intent	Abstract Step
Attend school	<ul style="list-style-type: none"> Decide which courses I need to take 	<ul style="list-style-type: none"> Meet with Advisor
Enroll in classes	<ul style="list-style-type: none"> Decide to take classes 	Trigger: registration period <ul style="list-style-type: none"> I am reminded to register
Identify courses not taken	<ul style="list-style-type: none"> Determine which courses I haven't taken 	<ul style="list-style-type: none"> Try to figure out what I need to take next
Go to registration location	<ul style="list-style-type: none"> Make sure I get the classes I want 	<ul style="list-style-type: none"> Go to the place where I can "quickly" register
Select course(s)	<ul style="list-style-type: none"> Create my class schedule 	<ul style="list-style-type: none"> Decide whether the course I want/need are being offered Execute commands on system to locate course Decide which course section meets my scheduling needs Execute commands on system to add course
Confirm Registration	<ul style="list-style-type: none"> Decide if action to add course was successful 	<ul style="list-style-type: none"> Make sure I got into the class I selected

The consolidated sequence model reveals the structure of a task, showing the strategies common across all participants. This model brings together many instances of many individuals accomplishing the same task. This model was used to identify what is important to the participants who register for classes. This model identifies what needs to be done (Activity), the order and strategy for doing it (Intent), and the motivation driving specific actions (Abstract Step).

3.1.2 Design: Planning the Solution

The Palm implementation to course registration at RIT will be designed in response to the structure implemented on the Web for Course Registration. This section discusses how the Palm implementation will impact the process of Registration and how the future of registering for classes would change through this implementation.

.3.1.2.1 Step 5: Identify the Design Concept

The Author elected to focus on improving the registration process, specifically addressing the communication between the student and their advisor.

The Author used acquired knowledge to come up with the initial design concepts for the Palm implementation. The Author envisions the Palm implementation having three functions. These functions include: track graduation requirements, register for classes, and provide a class schedule.

The primary feature of the application would be to implement a design to track a student's graduation requirements, and replace the worksheet that is currently used. This worksheet lists all of the courses a student needs to meet their department's curriculum.

The second feature to be implemented for the Palm is the ability to register for classes. The Palm will include the functions to add a course and to drop a course. The way in which these functions have been implemented on the web is not suited for the Palm. The primary reason is that a considerable amount of navigation is required to add a course using the Web. The Web is designed to accommodate every student. As a result, every course being offered by RIT is presented. To narrow the selection for the student using the Web, the classes are grouped by college then by department / discipline. Within a discipline, a student may still need to navigate through several pages before finding the course the student is looking for.

The registration function for the Palm would be approached in an innovative way. The list of courses / worksheet would drive the registration process. The Palm would track which courses a student has not taken. The student would select from this list the course the student

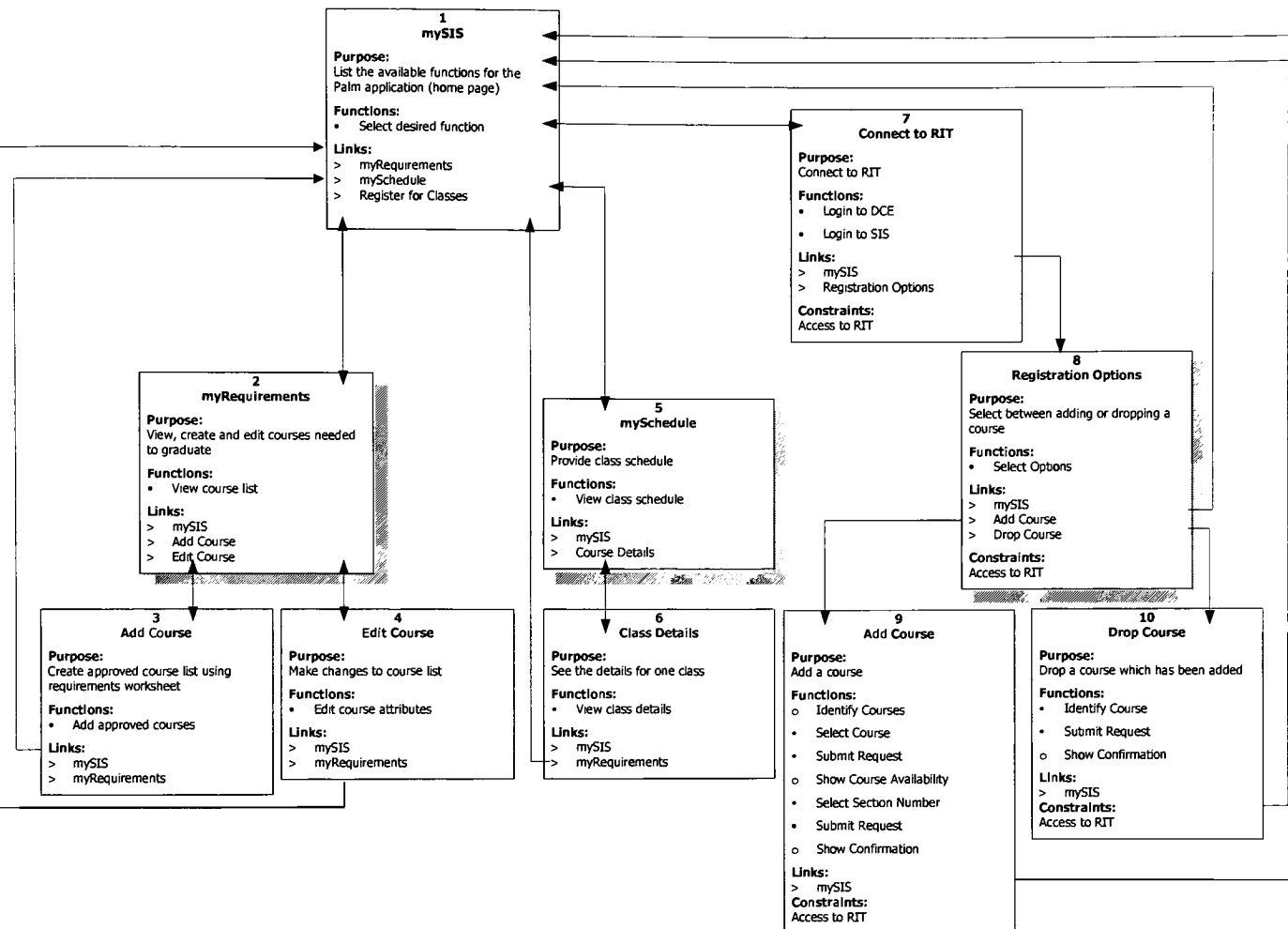
would like to add. A connection to RIT would be established. The course number associated with that course would be submitted to RIT. RIT would submit the details about the sections for that course. The student would select a section number and submit the request (course number plus section number) back to RIT. RIT would send confirmation back to the student.

The final feature to be implemented on the Palm would be the Class Schedule. The student would be able to reference his/her schedule. This schedule would include: the course attributes, class location, class instructor, and class description.

.3.1.2.2 Step 6: Define the New Work Structure

The User Environment Model was modified to reflect the new work structure of the current situation. Figure 8, shows the User Environment Design for the Palm implementation. This figure can also be viewed as an appendix, refer to (Appendix H) for the User Environment Model Palm. This model will be used to validate design concept with the participants.

Figure 8: User Environment Design – Palm



Each box represents a focus area. The primary focus areas in this design are shaded:

myRequirements, mySchedule, and Registration Options. These focus areas permit the student to focus on one activity. The purpose statement describes the work the focus area supports.

Functions, which enable the student to do the work, are listed in the focus area. The arrows between focus areas are links and show how the user can move through the Palm.

The Palm implementation will support the following activities:

- Enroll in classes
- Identify courses not taken
- Gather registration information

- Select course(s)
- Confirm Registration

These are the identical activities identified in *Step 4: Analyze the Key Functions*. What will differentiate the Palm from the Web will be the motivation driving specific actions (Abstract Steps).

Evaluate Modified User Environment Model

The modified User Environment Model was reviewed with two of the participants. The goal of this review was to ensure that the concept of how to organize the system to support the registration process is correct. The review consisted of each participant being shown all parts of the Palm application and how each part interrelates with detailed descriptions of what the participant would experience. The following questions were used to check the designs structure:

- Does each focus area support a single activity within the overall registration process?
- Does the title and purpose statement accurately describe the activity?
- Do the functions support the purpose of the focus area?
- Do the links make sense?
- Does the design account for the issues the participants indicated they care about?

This review did not result in any objections. Both participants were excited how the registration process would change with the Palm.

.3.1.2.3 Step 7: Develop the Concept

To gain insight about how to develop a Palm interface, some Palm applications were reviewed to understand how to work within the screens real estate. Based on these reviews the screen layout for the course registration system was defined.

Design Constraints

As previously stated in the literature review, the Palm has several implicit design issues, which must be factored into the interface design.

Small Display – Screens of Palm devices are considerably smaller than even the smallest laptop display, so designs need to be simple, easy to understand, and fast. Mobile users want information delivered quickly and in an easily accessible format.

Limited Functionality – A stylus cannot compete with a keyboard for ease of use. Differences in Input device must be factored into the screen design. It becomes necessary to try and limit the amount of information that needs to be entered by hand.

Data Transfer Rates – At present, wireless Internet connections are very slow. The average wireless connection speed is similar to that of a 9600-baud modem (9600 kilobit-per-second / max download time). This converts to 960 characters per second. Until wireless providers are able to provide connection speeds comparable to home PC's, speed will continue to be an important constraint.

Design Guidelines

The interface detail level is concerned with graphics, fonts, colors and other such refinements that polish the interface and provide subtle clues to the user about the conceptual model of the interface. The guidelines published by 3Com used for this study include the following:

Layout

- All screens should have a consistent look and feel to enable users to easily navigate between screens and across applications.
- Whenever possible, design elements should be similar to those used in other Palm OS applications so that users don't have to relearn the interface.
- Keep screens well organized and easy to read.
- Avoid excess verbiage and keep functionality simple. Say and show only what users need.
- Keep screens clean and easy to read—and quick to transmit and load.
- The content area for a screen is 153x144 pixels. Using the normal Palm font (TD 9), only eleven lines can be displayed at a time, including the header or banner.

- Try and design screens to display on one screen. When laying out screens, always go to the edge of the screen—do not waste space on borders.

Fonts

- Large fonts take up additional screen real estate— use them sparingly.
- Use boldface for labels and normal type for data items.
- Don't use boldface extensively—it's best for contrast, but hard to read as a text type.
- Avoid using underline—since hyperlinks are normally underlined, use of this in-line markup will cause confusion.

Control Elements

- Use pop-up menus to enter data such a state, city, airline, cuisine, price ranges, and other known categories.
- While there are no technical limits on the number of options you can include on a menu, you should keep the user experience in mind. Users do not like scrolling a lot to find an option. And the more items on the menu, the slower the application runs. Around 50 items is probably the upper practical limit.
- Use submit buttons to send information collected in the query form.
- When naming submit buttons, make sure the label doesn't grow too large.
- Use terms that clearly indicate the action that will be taken; e.g., “Find Package,” “Get Directions,” “Locate Office.”

Labels

- The meaning of labels should be immediately clear to users.

Graphics

- Use graphics when they effectively communicate a message or make things simpler for the user.
- Avoid using unnecessary graphics, especially over the air. Users will not want to pay for their transmission, and graphics slow down response time.

- Graphics should be clear, bold, and easy to understand. Because of limitations of the handheld computer's screen, graphics should be as simple as possible.

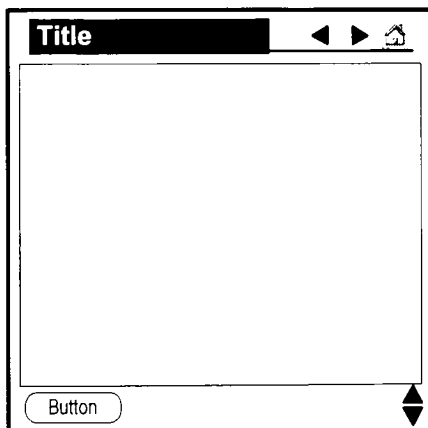
Wireless Connection

- Users pay for every byte transferred over the air. Plan the application in such a way as to keep connect time to a minimum.
- Leave it up to users to initiate all wireless connections. Make sure that users understand when an action causes a wireless transaction. Clearly label commands and dialog boxes to indicate which ones will send and receive data over the air.

Screen Layout

Figure 9, shows the basic interface layout. Each screen has a consistent look and feel and contains the following elements:

Figure 9: Screen Layout for the Palm



- A title appears at the top of each screen to tell the user where they are in the application. The Palm devices display the title as a tab that does not take up the full screen width. The title of the screen coincides with the title of the focus area.
- Navigational links are presented at the top of the screen. The left arrow allows the user to return to the previous screen. The right arrow allows the user to navigate to the next screen. The Home icon allows the user to return to the beginning, home screen of the application. The web icon for home was used, which has

become universally recognized.

- The middle section of the screen is used to present the content associated with the function of a focus area.
- The control elements for the screen have been placed at the bottom of the screen. This location allows the data being manipulated to stay in view. The Palm's stylus or the users fingers can use the control elements selected.
- The amount of scrolling has been kept to a minimum. The existing data has been broken into smaller subsets to minimize the amount of information that would appear on any given screen. If the data could not be logically broken down into smaller subsets, two arrows are invoked which will allow the user to scroll through the information.

Mock Up Concept

A paper prototype was used to test the structure captured in the User Environment Design and the participants' interaction with it. Visio was used to create a few screens, to scale, of the initial design concept. Refer to (Appendix I) for the User Interface Design - Initial. A cardboard version of the Palm was created. The paper images and cardboard Palm were used to simulate the operation of the design.

Evaluate Concept

The initial design concept was reviewed with two participants. Each review was conducted at the participant's place of work. Each review was done separately. The participants manipulated the picture's input devices, e.g. pressed the images of buttons, using a stylus, and the Author changed the screen contents accordingly.

The results from the review of the initial design are as follows:

- Participants lost focus "where they were"
too many levels
- Labels for buttons were not clear
e.g. use of OK vs. Submit

- Concern about adequate confirmation from RIT
e.g. receiving confirmation for adding / dropping a course, being connected
- Participants desire seeing both the course title and course number together
e.g. as seen on mySchedule
- Create separate cards for the action of adding or editing
- Overall design was too complex, need to simplify and create more consistency

.3.1.2.4 Step 8: Map UED to Palm Interface

This step is focused on making the translation from User Environment Design to user interface. The goal of this step is to communicate the basic intent of the users specification. This step will provide a concrete picture of how the final screen iteration, for this study, looks and how it works.

The modified User Environment Design was used as the user interface specification. This diagram provides the following information: how to organize the interface, what functions should be available, and where to put the functions. The low-level design detail, such as exact content was taken from the Web implementation.

Like any specification, the User Environment Design does not determine how to design the user interface, which includes: the interface paradigm, the interaction style and the appearance. The hardware platform, operating system, and user interface technology determine user interface style; the User Environment Design defines the structure and function to implement. The Author applied knowledge of the technology to get the Palm's Interface out of the participants' way so they could focus on registering for classes, not the tool.

Mapping the UED to the Palm required three steps: separate each of the focus areas from the modified UED, translate the UED component to the Palm equivalent, and render the functional requirements into the screen design.

.3.1.2.4.1 mySIS

RIT's mobile course registration application has been named mySIS. The starting screen / home page for this application is the focus area, mySIS.

Step 1: Separate Each Focus Area

The first step in mapping the UED to the Palm is to separate each of the focus areas from the modified UED. Figure 10, shows the focus area titled mySIS, which is the starting point for the application.

Figure 10: Focus Area – mySIS

1 mySIS
Purpose: List the available functions for the Palm application (home page)
Functions: <ul style="list-style-type: none"> • Select desired function
Links: <ul style="list-style-type: none"> > myRequirements > mySchedule > Register for Classes

Step 2: Translate Focus Area Components

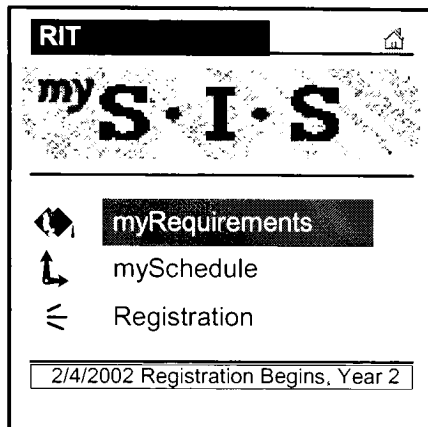
The next step is to list each of the features of the mySIS focus area. Each feature is then translated to the Palm equivalent.

<u>User Environment Component</u>	<u>Palm Equivalent</u>
mySIS (focus area)	The "mySIS" screen is the home page for the Palm Application. It lists 3 hyperlinks to the key function areas.
myRequirements (link)	Selecting the myRequirements hyperlink will bring the student to myRequirements (focus area).
mySchedule (link)	Selecting the mySchedule hyperlink will bring the student to mySchedule (focus area).
Register for Courses (link)	Selecting the Register for Courses hyperlink will bring the student to the Registration (focus area).

Step 3: Screen Design

The final step is to render the requirements into the screen (card) design. The home page has been designed like a menu allowing the student the choice of three functions: myRequirements, mySchedule, and Registration. Figure 11, shows the result of this step.

Figure 11: Screen Design – mySIS, home page



.3.1.2.4.2 myRequirements

This is the primary feature of the application to be used to track the students' graduation requirements.

Step 1: Separate Each Focus Area

Figure 12, shows the focus area titled myRequirements, which is the starting point for this feature. There are several focus areas that support this feature, they include: view course list, add course, and edit course.

Figure 12: Focus Area – myRequirements

2 myRequirements
Purpose: View, create and edit courses needed to graduate
Functions: <ul style="list-style-type: none"> • View course list
Links: <ul style="list-style-type: none"> > mySIS > Add Course > Edit Course

Step 2: Translate Focus Area Components

The next step is to list each of the features of the myRequirements focus area. Each feature is then translated to the Palm equivalent.

<u>User Environment Component</u>	<u>Palm Equivalent</u>
View “all” courses needed to graduate by category and status (automatic function)	The myRequirements screen is devoted to displaying a list of all of the courses needed to graduate.
Choose to cancel function (link)	Selecting the Cancel button will bring student back to mySIS (home page).
Choose to add course (link)	Selecting the Add Course button will bring student to Add Course screen.
Choose to edit Course (link)	Selecting the Edit Course button will bring student to Edit Course screen.
Choose to go to beginning of application (link)	Selecting the Home icon will bring student back to mySIS screen (home page).

Step 3: Screen Design

The final step is to render the requirements into the screen (card) design. Three screens have been created to communicate the functionality of this feature. These screens include: view myRequirements by all courses, view myRequirements by a single category, and view myRequirements by summary. Figure 13, shows the view of myRequirements by all courses. The functional requirements for this screen are as follows:

- A tab metaphor was used to be able to break the course information into smaller subsets. The tabs allow the user to easily navigate through the data.

- Each tab represents each group of courses a student needs to fulfill, e.g. students completing a M.S. in Information Technology, need to fulfill courses in the following areas: Prerequisites, Core, First Concentration and Second Concentration.
- The default tab allows the student to see all of the courses needed to graduate including the courses category and status.
- Selecting the small triangle next to Status invokes a drop down list. The student can filter the data by course status. The values for status are:
 Taken – have taken the course and received a grade
 Enrolled – currently taking the course
 Need – still need to take the course
- A student can elect to add a course, edit a course or cancel what they are doing and return to mySIS (home page).

Figure 13: Screen Design – myRequirements, view All

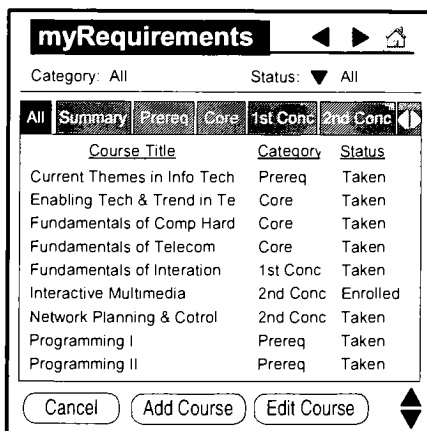


Figure 14, shows the view of myRequirements by a single category. The functional requirements for this screen are as follows:

- Each of the Category tabs has a similar design. The design is similar to the grade report.

- The data needed: course title, course number, section number, credit hours, term, and grade.
- Selecting the small triangle next to Status invokes a drop down list. The student can filter the data by course status. The values for status are:
 Taken – have taken the course and received a grade
 Enrolled – currently taking the course
 Need – still need to take the course
- A student can elect to add a course, edit a course or cancel what they are doing and return to mySIS (home page).

Figure 14: Screen Design – myRequirements, view by category

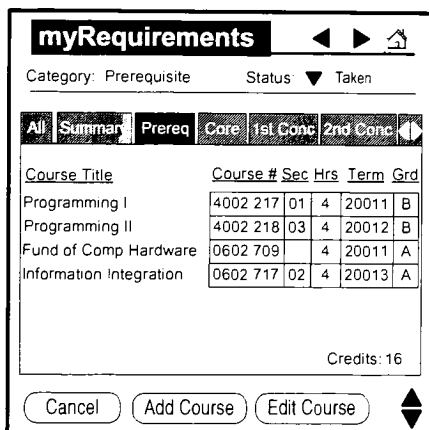


Figure 15, shows the view of myRequirements by summary. The functional requirements for this screen are as follows:

- The Summary tab provides the student with a quick summary of their credit hours. For each category, the student can quickly see how many credit hours have been taken, are need, are currently being taken and the total number required.
- A student can elect to add a course, edit a course or cancel what they are doing and return to mySIS (home page).

Figure 15: Screen Design – myRequirements, view by summary

Category	Req'd	Taken	Need	Enrolled
Prerequisite	16	16	0	0
Core Courses	12	12	0	0
1st Concentration	12	4	8	8
2nd Concentration	12	4	8	8
Electives	8	8	0	0
Capstone	4	0	4	0
Total Credit Hours	64	44	20	16

Add Course

This feature of the application supports myRequirements and is used to add the students' graduation requirements.

Step 1: Separate Each Focus Area

Figure 16, shows the focus area titled Add Course, which supports the feature, myRequirements.

Figure 16: Focus Area – myRequirements, Add Course

3 Add Course
Purpose: Create approved course list using requirements worksheet
Functions: <ul style="list-style-type: none"> • Add approved courses
Links: <ul style="list-style-type: none"> > mySIS > myRequirements

Step 2: Translate Focus Area Components

The next step is to list each of the features of the Add Course focus area. Each feature is then translated to the Palm equivalent.

<u>User Environment Component</u>	<u>Palm Equivalent</u>
Create courses needed to graduate by category and status (function)	The Add Course screen is a form used to create the list of courses needed to graduate.
Choose to cancel function (link)	Selecting the Cancel button will bring student back to myRequirements screen.
Choose to go to beginning of application (link)	Selecting the Home icon will bring student back to mySIS screen (home page).

Step 3: Screen Design

The final step is to render the requirements into the screen (card) design. Figure 17, shows the result of this step. The functional requirements for this screen are as follows:

- A form metaphor was used to add a course.
- A drop down list allows the student to select the category that the course should be associated with. The values for the drop down list will be based on the college and department worksheet and will be built into the application.
- The Course Title has been limited to 28 characters. To add the title, the student could use Graffiti® or the built in keyboard.
- The Course Number has been limited to 7 characters. A numeric keyboard has been created for ease and convenience.
- The student selects the course hours to be attempted.
- The course status, defaults to need.
- To accept the information, the student selects the OK button.
- A student can elect to cancel what they are doing and return to mySIS (home page).

Figure 17: Screen Design – myRequirements, Add Course

myRequirements ◀ ▶ ↻

Add Course

Category ▼ - Select One -

Course Title: _____ (28 char)

Course # XXXX - XXX (7 numb)

7 8 9

4 5 6

1 2 3

0 Bksp Clr

Hrs Attempted: 0 1 2 3 4

Status: Need Enrolled Taken

Grade:

A	B	C	D	E	F
I	W	Z	R	S	X

OK Cancel

Edit Course

This feature of the application supports myRequirements and is used to edit the students' graduation requirements.

Step 1: Separate Each Focus Area

Figure 18, shows the focus area titled Edit Course, which supports the feature, myRequirements.

Figure 18: Focus Area – myRequirements, Edit Course

<p>4</p> <p>Edit Course</p> <p>Purpose: Make changes to course list</p> <p>Functions:</p> <ul style="list-style-type: none"> Edit course attributes <p>Links:</p> <ul style="list-style-type: none"> > mySIS > myRequirements

Step 2: Translate Focus Area Components

The next step is to list each of the features of the Edit Course focus area. Each feature is then translated to the Palm equivalent.

User Environment Component**Palm Equivalent**

Modify courses needed to graduate (function)

The Edit Course screen is a form used to modify the list of courses needed to graduate.

Choose to cancel function (link)

Selecting the Cancel button will bring student back to myRequirements screen.

Choose to go to beginning of application (link)

Selecting the Home icon will bring student back to mySIS screen (home page).

Step 3: Screen Design

The final step is to render the requirements into the screen (card) design. Figure 19, shows the result of this step. The functional requirements for this screen are as follows:

- A form was used to allow students to modify their course list. This is the same form that was used to add a course.
- A drop down list is used to allow the student to quickly select the course they wish to modify.
- The data associated with the course selection will be populated. The student can proceed to modify the data associated with the course title.
- To accept the information, the student selects the OK button.
- A student can elect to cancel what they are doing and return to mySIS (home page)

Figure 19: Screen Design – myRequirements, Edit Course

.3.1.2.4.3 mySchedule

This feature enables a student to reference his/her class schedule.

Step 1: Separate Each Focus Area

Figure 20, shows the focus area titled mySchedule, which is the starting point for this feature. There are several focus areas that support this feature, they include: view course list, add course, and edit course.

Figure 20: Focus Area – mySchedule

5 mySchedule
Purpose: Provide class schedule
Functions: <ul style="list-style-type: none"> • View class schedule
Links: <ul style="list-style-type: none"> > mySIS > Course Details

Step 2: Translate Focus Area Components

The next step is to list each of the features of the mySchedule focus area. Each feature is then translated to the Palm equivalent.

<u>User Environment Component</u>	<u>Palm Equivalent</u>
View Class Schedule (automatic function)	The mySchedule screen is devoted to displaying the class schedule for the current or upcoming quarter.
Choose to view course details (function)	Selecting the Course Title will bring the student to Class Details screen.
Choose to go to beginning of application (link)	Selecting the Home icon will bring student back to mySIS screen (home page).

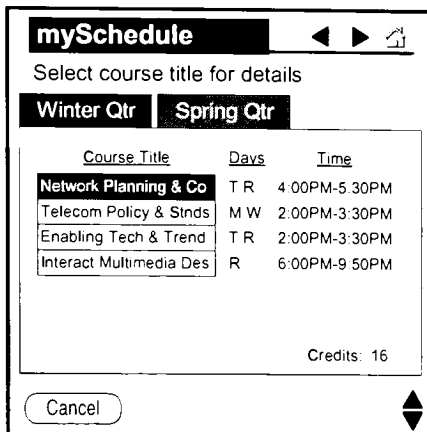
Step 3: Screen Design

The final step is to render the requirements into the screen (card) design. Figure 21, shows the result of this step. The functional requirements for this screen are as follows:

- A tab metaphor was used to present the class schedule for two quarters.
- Each tab represents a quarter, e.g. Winter Qtr (current) and Spring Qtr (upcoming).
The tab default is the current quarter.
- The data includes: course title, course days and time.

- A student can elect to cancel what they are doing and return to mySIS (home page).

Figure 21: Screen Design – mySchedule



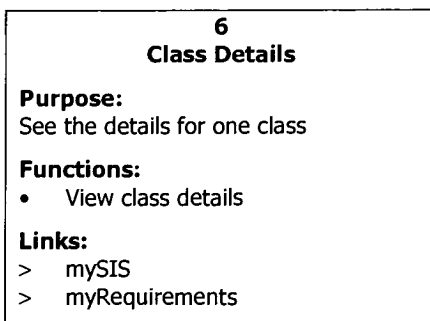
Class Details

This feature of the application supports mySchedule and is used to view the course details.

Step 1: Separate Each Focus Area

Figure 22, shows the focus area titled Class Details, which supports the feature, mySchedule.

Figure 22: Focus Area – mySchedule, class details



Step 2: Translate Focus Area Components

The next step is to list each of the features of the Class Details focus area. Each feature is

then translated to the Palm equivalent.

<u>User Environment Component</u>	<u>Palm Equivalent</u>
View Class Details (automatic function)	The Course Details screen is devoted to displaying the important details about a class.
Choose to go to beginning of application (link)	Selecting the Home icon will bring student back to mySIS screen (home page).

Step 3: Screen Design

The final step is to render the requirements into the screen (card) design. Four screens have been created to communicate the functionality of this feature. These screens include: view course details, view course instructor, view course location, and view course description. Figure 23, shows the view of mySchedule, view course details. The functional requirements for this screen are as follows:

- A tab metaphor was used to subdivide the important information about a course. The information has been divided into four tabs: course, instructor, location, and description.
- The Course tab displays the following data about the course: title, section number, hours, days and time.
- A student can elect to cancel what they are doing and return to the mySchedule screen.

Figure 23: Screen Design – mySchedule, view course details

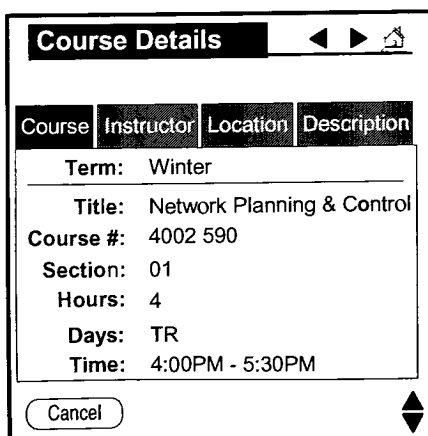


Figure 24, shows the view of mySchedule, view course instructor. The functional

requirements for this screen are as follows:

- The Instructor tab displays information about the course instructor.
- A student can elect to cancel what they are doing and return to the mySchedule screen.

Figure 24: Screen Design – mySchedule, view course instructor

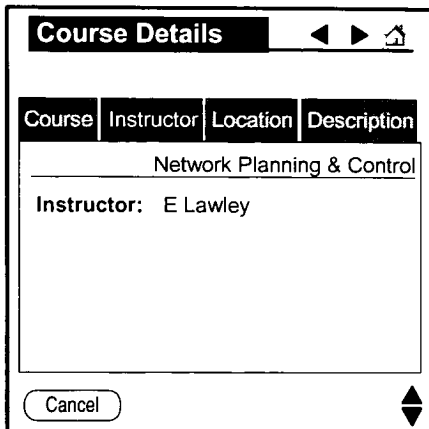


Figure 25, shows the view of mySchedule, view course location. The functional requirements for this screen are as follows:

- The Location tab displays information about the course location, including: day, building number, and room number.
- A student can elect to cancel what they are doing and return to the mySchedule screen.

Figure 25: Screen Design – mySchedule, view course location

The screenshot shows a mobile application window titled 'Course Details'. At the top, there are navigation arrows and a home icon. Below the title is a tabbed interface with four tabs: 'Course', 'Instructor', 'Location', and 'Description'. The 'Location' tab is selected. The content area displays the course title 'Network Planning & Control' and a table with three columns: 'Day', 'Bldg #', and 'Rm #'. The table lists days from Monday to Sunday, with specific building and room numbers for Tuesday and Wednesday. A 'Cancel' button is located at the bottom left, and a vertical scroll indicator is at the bottom right.

Day	Bldg #	Rm #
M	---	---
T	70	2160
W	---	---
R	70	2320
F	---	---
S	---	---

Figure 26, shows the view of mySchedule, view course description. The functional requirements for this screen are as follows:

- The Description tab displays the course description.
- A student can elect to cancel what they are doing and return to the mySchedule screen.

Figure 26: Screen Design – mySchedule, view course description

The screenshot shows the same 'Course Details' window, but with the 'Description' tab selected. The content area displays the course title 'Network Planning & Control' and a paragraph of text describing the course content. A 'Cancel' button is located at the bottom left, and a vertical scroll indicator is at the bottom right.

Network Planning & Control

The development of interactive multimedia requires principles garnered from a variety of disciplines. Through readings, critiques, exercises and discussions, students will explore what makes an interactive multimedia application (or component of an application) successful and what types of applications are best suited to interactive multimedia. This course provides an introduction to the design of interactive

.3.1.2.4.4 Registration

This feature enables the student to register for courses.

Step 1: Separate Each Focus Area

Figure 27, shows the focus area titled Connect to RIT, which allows the student to login to RIT to register for courses. There are several focus areas that support this feature, they include: connect to RIT, login to DCE, and login to SIS.

Figure 27: Focus Area – Connect to RIT

7 Connect to RIT
Purpose: Connect to RIT
Functions: <ul style="list-style-type: none"> • Login to DCE • Login to SIS
Links: <ul style="list-style-type: none"> > mySIS > Registration Options
Constraints: Access to RIT

Step 2: Translate Focus Area Components

The next step is to list each of the features of the Connect to RIT focus area. Each feature is then translated to the Palm equivalent.

<u>User Environment Component</u>	<u>Palm Equivalent</u>
Connect to RIT (function)	The DCE Login screen presents the student with the option to initiate a wireless connection with RIT.
Choose to Login (wireless transmission)	Selecting the Login button will initiate the wireless connection with RIT.
Choose to cancel function (link)	Selecting the Cancel button will bring student back to Registration Options screen.
Choose to go to beginning of application (link)	Selecting the Home icon will bring student back to mySIS screen (home page).

Step 3: Screen Design

The final step is to render the requirements into the screen (card) design. Two screens have been created to communicate the functionality of this feature. These screens include: DCE login and SIS login. Figure 28, shows the view of the screen to login to DCE. The functional requirements for this screen are as follows:

- A form is used to login to DCE.
- A User ID and Password are required to login to RIT.
- To enter the User ID, the student could use Graffiti® or the built in keyboard.
- To enter the Password, the student could use Graffiti® or the built in keyboard.
- To commit to the connection, the student selects the Login button.
- A student can elect to cancel what they are doing and return to mySIS screen (home page).

Figure 28: Screen Design – DCE Login

Registration Login

DCE Login

To complete the registration process you will need to connect to RIT. Please enter your DCE user identification number and password. When finished, click Login. If you do not have a DCE account, please contact Information and Technology Services (ITS). 716 475-4357 or 716 475-2810 (TTY)

User ID: _____

Password: _____

Cancel Login →

Figure 29, shows the view of the screen to login to SIS. The functional requirements for this screen are as follows:

- A form to is used to login to the Student Information System (SIS).
- A User ID and Password are required to login to SIS.
- To enter the User ID, the student could use Graffiti® or the built in keyboard.
- To enter the Password, the student could use Graffiti® or the built in keyboard.
- To commit to the connection, the student selects the Login button.
- A student can elect to cancel what they are doing and return to mySIS (home page).

Figure 29: Screen Design – SIS Login

Connecting...

SIS Login

For additional security, you will need to login to the Student Information System (SIS). Please enter your personal identification number (PIN) and password. When finished, click Login. If you do not have an SIS password, please contact the Registrar's office. 585 475-2821

User ID: _____

Password: _____

Cancel Login →

Registration Options

This feature enables the student to make their registration selection.

Step 1: Separate Each Focus Area

Figure 30, shows the focus area titled Registration Options, which allows the student to either add or drop a course. There are two focus areas that support this feature, they include: add course and drop course.

Figure 30: Focus Area – Registration Options

8

Registration Options

Purpose:
Select between adding or dropping a course

Functions:

- Select Options

Links:

- > mySIS
- > Add Course
- > Drop Course

Constraints:
Access to RIT

Step 2: Translate Focus Area Components

The next step is to list each of the features of the Registration Options focus area. Each feature is then translated to the Palm equivalent.

<u>User Environment Component</u>	<u>Palm Equivalent</u>
Make registration choices (function)	The Registration Options screen allows the student to select how they would like to proceed with the registration process by either adding or dropping a course by course number or course title.
Choose to go to beginning of application (link)	Selecting the Home icon will bring student back to mySIS screen (home page).

Step 3: Screen Design

The final step is to render the requirements into the screen (card) design. Figure 31, shows the view of the screen that allows the student to make the selection, how they would like to proceed. The functional requirements for this screen are as follows:

- The student can elect to add a course by course number or by course title by selecting the Add Course button and the course number or course title button.
- The student can elect to drop a course by course number or by course title by selecting the Add Course button and the course number or course title button.
- To accept the selection and proceed with the registration process, the student selects the OK button.
- A student can elect to cancel what they are doing and return to mySIS (home page).

Figure 31: Screen Design – Registration Options

Registration Option

Please make the following selections:

Registration Options:

Add Course Drop Course

Add Course by:

Course # **Course Title**

OK Cancel

Add Course

This feature enables the student to add / register for a course.

Step 1: Separate Each Focus Area

Figure 32, shows the focus area titled Add Course, which allows the student to add a course.

Figure 32: Focus Area – Add Course

9
Add Course

Purpose:
Add a course

Functions:

- Identify Courses
- Select Course
- Submit Request
- Show Course Availability
- Select Section Number
- Submit Request
- Show Confirmation

Links:
> mySIS

Constraints:
Access to RIT

Step 2: Translate Focus Area Components

The next step is to list each of the features of the Add Course focus area. Each feature is then translated to the Palm equivalent.

<u>User Environment Component</u>	<u>Palm Equivalent</u>
Identify courses (automatic function)	A list of courses the student needs to take will be created from myRequirements, using the courses that have a status value equal to “need.”
Select course to add (function)	Similar to the Web application, the student can select to add one course at a time.
Choose to submit request (wireless transmission)	Selecting the Send Request button will transmit the registration request to RIT. Only the course number will be transmitted.
View course sections (automatic function)	The Select Section number screen is devoted to displaying which course sections are available.
Select course section (function)	The student selects the section number of the course, which best meets, their needs.
Choose to submit request (wireless transmission)	Selecting the Send Request button will transmit the registration request to RIT. Only the course number will be transmitted.
View course confirmation (wireless transmission)	The Confirmation screen is devoted to displaying the course schedule, verification that the registration process was a success.
Choose to go to beginning of application (link)	Selecting the Home icon will bring student back to mySIS screen (home page).

Step 3: Screen Design

The final step is to render the requirements into the screen (card) design. Two screens have been created to communicate the functionality of this feature. These screens include: add course by course title, select course section number, and registration confirmation. Figure 33, shows the view of the screen to add a course by course title. The functional requirements for this screen are as follows:

- The courses that have a status of “need” are used to generate the list of classes the student will use to register for classes.
- To verify whether or not a course is available, the student will choose one course and select the checkbox next to the course title.
- To accept the selection and proceed with the registration process, the student selects the Send Request button. This button uses the wireless transmission icon to let the student know that they will be invoking a wireless transmission. The course number

will be transmitted to RIT.

- Selecting the Cancel button will bring student back to mySIS (home page).

Figure 33: Screen Design – Registration, add course by course title

Select One	Course Title	Category
<input type="checkbox"/>	Fund of Interact Multimedia	2nd Conc
<input type="checkbox"/>	Telecom Mgmt	1st Conc
<input type="checkbox"/>	Telecom Policy & Stnds	1st Conc
<input type="checkbox"/>	Thesis	Capstone

Figure 34, shows the view of the screen to select the course section number. The functional requirements for this screen are as follows:

- If the course is open and has available seats, the information about the section number will be transmitted back to the Palm. The data to be transmitted includes: section number, hours, day, from, to, and instructor.
- The student selects the checkbox next to the desired section number.
- To accept the selection and proceed with the registration process, the student selects the Send Request button. This button uses the wireless transmission icon to let the student know that they will be invoking a wireless transmission.
- Selecting the Cancel button will terminate the wireless connection and bring the student back to mySIS (home page).

Figure 34: Screen Design – Registration, select course section number

Add Course

Select Section #

At this time, this course has more than one section available. Please select one section # When finished select Send Request.

Course Title: Telecom Policy & Stnds
Course #: 0602 855

Sec #	Hrs	Day	From	To	Instructor	
<input type="checkbox"/>	01	4	M	4:00PM	5:30PM	E Rozanski
<input type="checkbox"/>	02	4	R	4:30PM	5:30PM	E Lawson
<input type="checkbox"/>	03	4	TR	2:00PM	3:30PM	M Axelrod

Cancel Send Request

Figure 35, shows the view of the registration confirmation screen. The functional requirements for this screen are as follows:

- If the transmission is a success, the student will receive this confirmation message and be shown the mySchedule screen.
- To stay connected and add additional courses the, the student would select the Add Course button. This will bring the student to the Select Course Title screen.
- To stay connected and drop a course, the student would select the Drop Course button. This will brings the student to the Drop Course screen.
- Selecting the Logoff button will terminate the wireless connection and bring the student back to mySIS (home page).

Figure 35: Screen Design – registration confirmation

Confirmation

You have successfully added a course.

Winter Qtr

Course Title	Course #	Sec	Hrs	Day	Time
Fund of Interact Multi	0604 741	01	4	M	4:00-5:30
Telecomm Mgmt	0602 840	03	4	TR	2:00-3:30
Telecom Policy & Stn	0602 855	02	4	R	4:00-5:30

Credits: 12

Logoff Add Course Drop Course

Drop Course

This feature enables the student to drop a course.

Step 1: Separate Each Focus Area

Figure 36, shows the focus area titled Drop Course, which allows the student to drop a course.

Figure 36: Focus Area – Registration, Drop Course

10 Drop Course
Purpose: Drop a course which has been added
Functions: <ul style="list-style-type: none"> • Identify Course • Submit Request ○ Show Confirmation
Links: > mySIS
Constraints: Access to RIT

Step 2: Translate Focus Area Components

The next step is to list each of the features of the Drop Course focus area. Each feature is then translated to the Palm equivalent.

<u>User Environment Component</u>	<u>Palm Equivalent</u>
Identify courses (automatic function)	A list of courses the student is currently registered for will be created from myRequirements, using the courses that have a status value equal to "enrolled."
Choose to submit request (wireless transmission)	Selecting the Send Request button will transmit the registration request to RIT. This button uses the wireless transmission icon to let the student know that they will be invoking a wireless transmission. Only the course number will be transmitted.
View course confirmation (wireless transmission)	The Confirmation screen is devoted to displaying the course schedule; verification that the registration process was a success.
Choose to go to beginning of application (link)	Selecting the Home icon will bring the student back to mySIS screen (home page).

Step 3: Screen Design

The final step is to render the requirements into the screen (card) design. Figure 37, shows the view of the screen to drop a course by course title. The functional requirements for this screen are as follows:

- The courses that have a status of “enrolled” are used to generate the list of courses the student could select to drop.
- To drop a course the student would choose one course and select the checkbox next to the course title.
- To accept the selection and proceed with the registration process, the student selects the Send Request button. This button uses the wireless transmission icon to let the student know that they will be invoking a wireless transmission.
- Selecting the Cancel button will terminate the wireless connection and bring the student back to mySIS (home page).

Figure 37: Screen Design – Registration, drop course by course title

Course Title	Course #	Sec Hrs	Day	Time
<input type="checkbox"/> Fund of Interact M	0604 741	01	4	M 4:00-5:30
<input type="checkbox"/> Telecomm Mgmt	0602 840	03	4	TR 2:00-3:30
<input type="checkbox"/> Telecom Policy &	0602 855	02	4	R 4:00-5:30

Credits: 12

Cancel Send Request

.3.1.2.5 Step 9: Solution Evaluation

The final design concept was not actually any single design idea but a combination of ideas from iterative evaluations. To evaluate whether or not the participant’s conceptual model of the Palm interface is correct, two techniques were selected: a prototype interview and the

Questionnaire for User Interaction Satisfaction (QUIST™). The results from this evaluation could be used as a benchmark upon which continued user interface development, of mySIS, could be based.

.3.1.2.5.1 Prototype Interview

A screen simulation of the final iteration of the design concept was created using Microsoft PowerPoint. The screen simulation provided each participant with a clear picture of how the different course registration functions could be implemented, and how the participant would conduct specific tasks using the Palm.

A prototype interview was conducted with each participant. The goal of this interview was to test the usability and participant acceptance of the Palm interface to the Palm version of RIT's Web registration system. Each participant was observed completing realistic task scenarios using the screen demo. Refer to (Appendix J) for the Participant Tasks Palm.

The feedback received from these interviews indicated that the design did not do a good job supporting the confirmation messages. The Author reviewed the UED and discovered that the participants' feedback was accurate. The UED, refer to (Appendix O) User Environment Model –Final, was modified based on this interview. Due to the time constraints on this study, these changes will not be evaluated.

The prototype interview concluded with each participant completing the Questionnaire for User Interaction Satisfaction (QUIST™).

.3.1.2.5.2 Questionnaire for User Interaction Satisfaction (QUIST™)

The Questionnaire for User Interaction Satisfaction (QUIST™) was used to gauge the participants' subjective reactions to the screen simulation of the Palm interface so improvements could be made in future versions.

The Questionnaire for User Interaction Satisfaction (QUIST™) is a tool developed by a multi-disciplinary team of researchers in the Human-Computer Interaction Lab (HCIL) at the University of Maryland at College Park. The QUIST™ was designed to assess users' subjective

satisfaction with specific aspects of the human-computer interface, providing a score from 1 (e.g. poor) to 9 (e.g. excellent) on a variety of user factors.

The use of this questionnaire is not limited to only working versions of a product. Most software is created on the basis of improvements or upgrades to a previous version, or in response to a market opportunity created by gaps in competitive products. Usability evaluation can therefore feed into the earliest stages of system specification, as well as enabling the setting of usability targets to be achieved by the new system. Many companies now use some kind of rapid prototyping strategy, especially with GUI environments, and the QUIST[™] questionnaire lends itself ideally to this kind of development work as it is short (it takes 5 minutes to complete, at maximum) and does not require a large user sample.

The current version of QUIST[™] is 7.0. This version uses 132 questions to gather data on 12 facets: system experience, past experience, overall user reactions, screen, terminology and system information, learning, system capabilities, technical manuals and on-line help, on-line tutorials, multimedia, teleconferencing, software installation. Each question is used to measure the users' overall satisfaction with that facet of the system, as well as the factors that make up that facet, on a 9-point scale.

The questionnaire has been designed to be changed, e.g. include only the facets that pertain to the system being evaluated. The questionnaire for this study was tailored, refer to (Appendix K) for the QUIST[™] Questionnaire, to measure the participants overall satisfaction and their satisfaction of four facets: screen factors, terminology & system information, potential learning factors, and general impressions.

After the QUIST[™] data was collected; Microsoft Excel was used to score the responses. Refer to (Appendix L) for the QUIST Questionnaire - Results. The following calculations were used to analyze the questionnaire data: min and max, mean, and standard deviation.

If the data is normally distributed, then 68% of the data points should fall within ± 1 standard deviation of the data's mean. To determine whether or not the data was normally distributed, Microsoft Excel was used to create a stock chart for each of the facets. This chart

was used to plot the minimum, maximum, and mean values of each data set. The means are graphed on a scale from 1 to 9 and are plotted on the y-axis. The factors associated with that facet are plotted on the x-axis.

To identify the areas of the design that were particularly good or particularly bad following process was completed for each facet. The Author started with the question having the lowest mean. The Author referenced the UED and her knowledge of the study to identify flaws in the design that may have led to this low mean. The Author moved to the next lowest question and repeated the process. The Author did this she was satisfied that she had identified any significant issues. This process was repeated for the questions with the highest mean. The Author repeated this process until she was satisfied that she identified all of the strong points of the design.

Overall Reaction

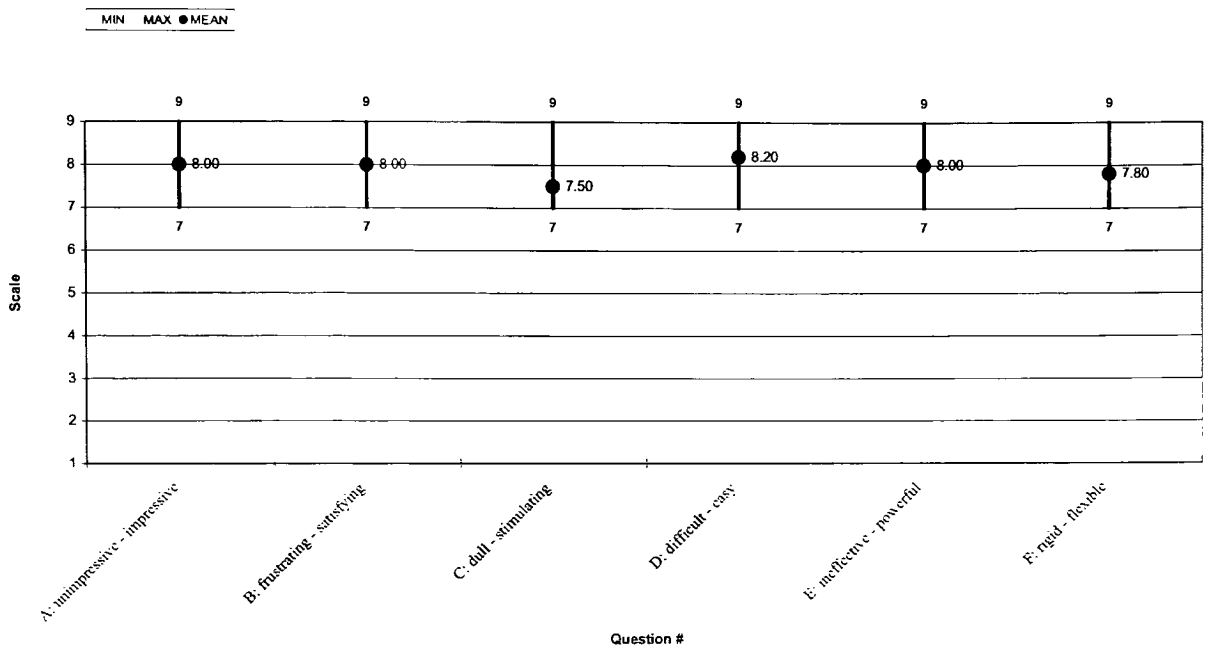
There were six factors used to measure the participants overall reaction to the screen simulation of the Palm interface, refer to Table 1. These factors were: 1) how impressed they were with the system, 2) satisfaction with the system, 3) how stimulated they were with the system, 4) ease of use, 5) perceived "power" of the system, and 6) flexibility of the system.

Table 1: Test Factors – Overall Reaction

Question #	Test Factor	Scale	
		1	9
A	How impressed they were with the system	unimpressive	impressive
B	Satisfaction with the system	frustrating	satisfying
C	How stimulated they were with the system	dull	stimulating
D	Ease of use	difficult	easy
E	Perceived "power" of the system	ineffective	powerful
F	Flexibility of the system	rigid	flexible

Figure 38, graphs the average distribution of each factor associated with the participants overall reaction to the Palm version of RIT's registration system.

Figure 38: Profile – Overall Reaction



Of the factors associated with the overall reaction to the system, none of them were rated either significantly lower than the mean participant response level. From the overall reactions to the system, the conclusions were as follows:

Strengths

- The overall reaction to what the participants experienced was positive

Weaknesses

- Overall, the participants were not stimulated by the system. This is valid since the participant only experienced a prototype. The Author would anticipate this result to improve when the system has been implemented.

Screen

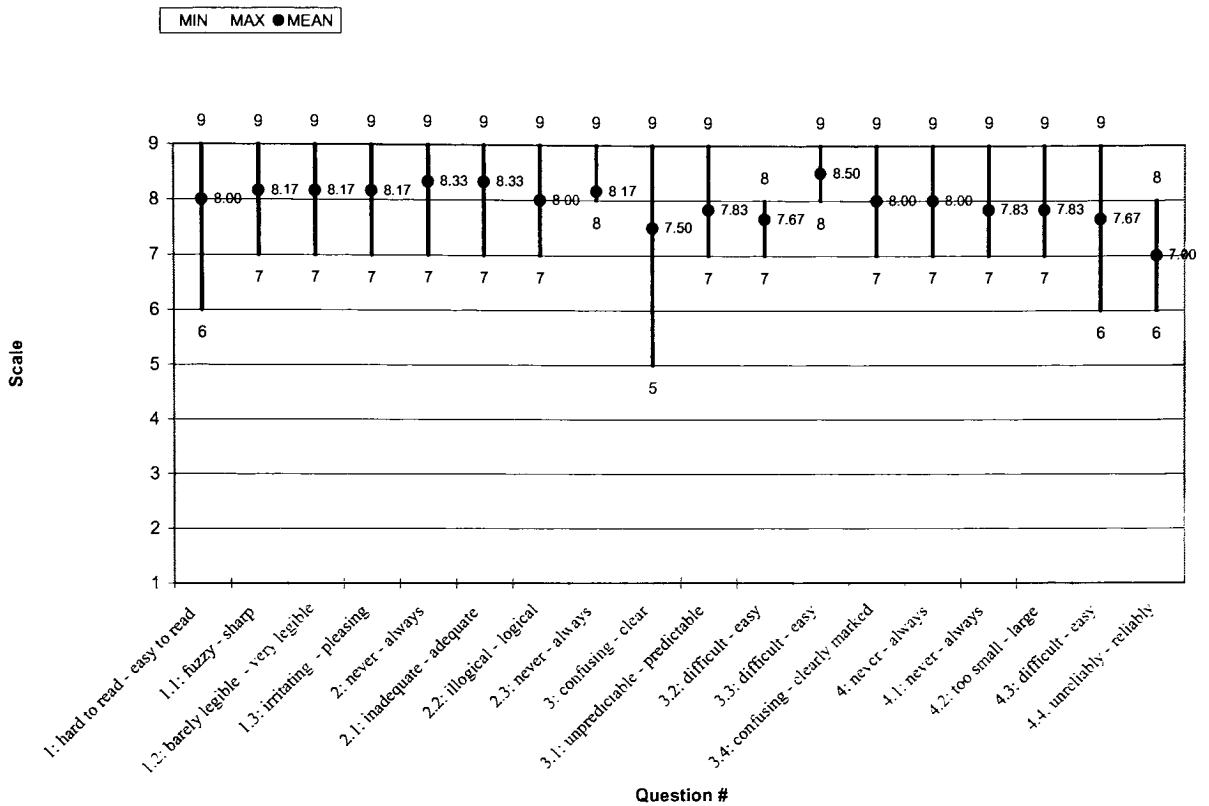
There were eighteen factors used to measure the participants' reaction to Palm interface. A few of these factors were: 1) how easy was it to read the characters on the screen, 2) were the characters sharp, 3) how legible were the fonts, 4) how pleasing was the background, 5) how logical was the information on each screen, and 6) how consistent was the information. The remaining factors can be seen in Table 2 or refer to (Appendix L) QUIS Questionnaire - Results.

Table 2: Test Factors – Screen

Question #	Test Factor	Scale	
		1	9
1.0	Characters on the computer screen	hard to read	easy to read
1.1	Image of characters	fuzzy	sharp
1.2	Character shapes (fonts)	barely legible	very legible
1.3	Contrast with the background	irritating	pleasing
2.0	Screen layouts make task easier	never	always
2.1	Amount of information displayed on screen	inadequate	adequate
2.2	Arrangement of information on screen	illogical	logical
2.3	Consistent arrangement of information	never	always
3.0	Sequence of screens	confusing	clear
3.1	Next screen in a sequence	unpredictable	predictable
3.2	Going back to the previous screen	difficult	easy
3.3	Going back to the main screen	difficult	easy
3.4	Knowing where you are in the task (what you have done, and what you need to do)	confusing	clearly marked
4.0	Screen items are easy to select	never	always
4.1	Items are easy to find	never	always
4.2	Size of item selection area (size is enough)	too small	large
4.3	Knowing whether an item is selected	difficult	easy
4.4	System responds to selection when Stylus is pulled away from screen	unreliably	reliably

Figure 39, graphs the average distribution of each factor associated with the participants' reaction to the Palm interface.

Figure 39: Profile – Screen Factors



Of the factors supporting the systems screen, one of them was rated significantly lower than the mean response. This factor was: “clear,” indicating that the characters on the screen are subject to additional scrutiny. None of the other factors, easy to read, sharp, very legible, pleasing, logical, and predictable, were significantly less than the mean participant response level. From the participants’ reaction to the screen, the Author concluded that:

Strengths

- The sequence of the screens were clearly marked and easy to navigate
- The items on the screen were easy to find, and easy to select

Weaknesses

- The characters on the screen were moderately acceptable, somewhat legible, and somewhat pleasing. This is an inherent issue with the Palm.

Written Comments by Participants

- “I really liked the setup – very navigable and minimal guesswork”
- “Clear and Concise”
- “Easy to read and logically titled”
- “Use of spectacles is required”
- “Very easy to follow, not confusing in the least bit”
- “Easy to accomplish tasks.”

Terminology and System Information

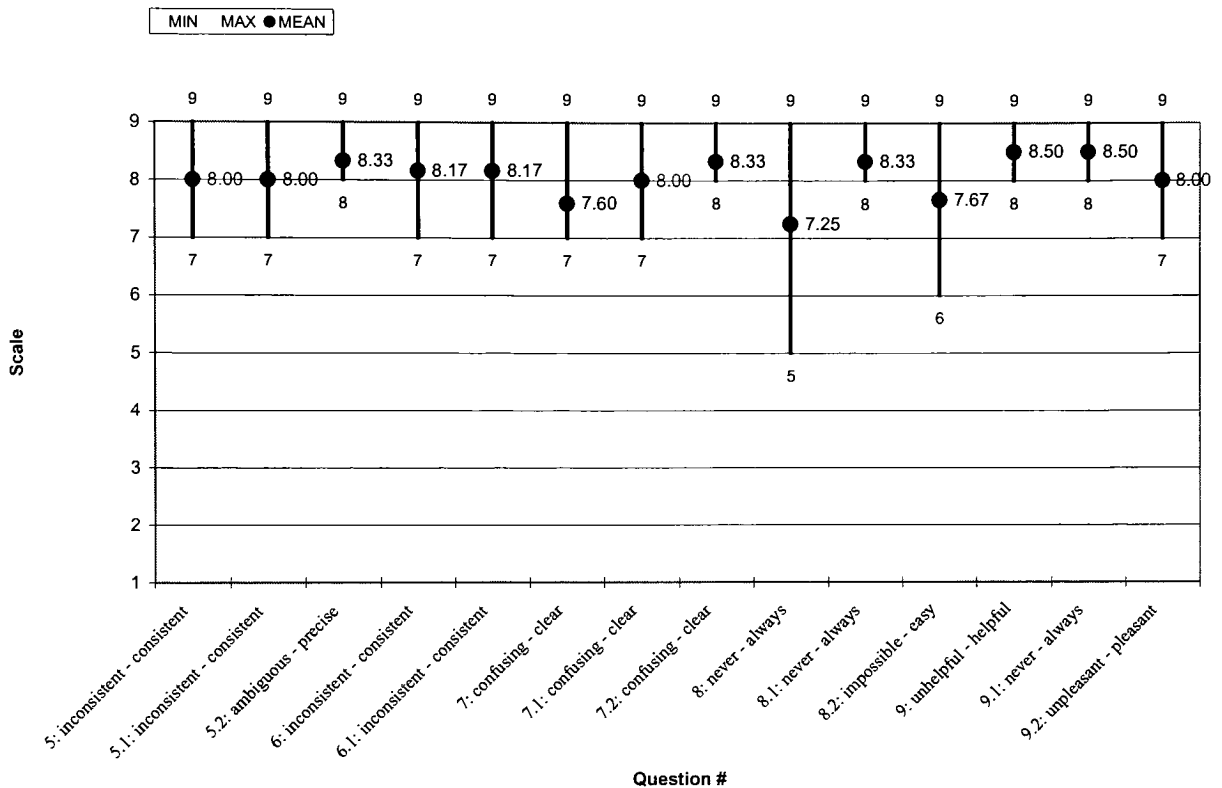
There were fourteen factors used to measure the participants’ reaction to the terminology and information used in the system. A few of these factors were: 1) how consistent were the terms throughout the system, 2) where the title of every screen consistent, 3) were the labels ambiguous, 4) was the placement of messages consistent, 5) how predictable was the systems response to the interaction, and 6) how helpful were the error messages. The remaining factors can be seen in Table 3 or refer to (Appendix L) QUIS Questionnaire - Results.

Table 3: Test Factors – Terminology and System Information

Question #	Test Factor	Scale	
		1	9
5.0	Use of terms throughout system	inconsistent	consistent
5.1	Screen headings	inconsistent	consistent
5.2	Terms on the screen (item labels)	ambiguous	precise
6.0	Messages (feedback) which appears on screen	inconsistent	consistent
6.1	Location of messages on the screen	inconsistent	consistent
7.0	Instructions to the user	confusing	clear
7.1	Instructions for commands or choices	confusing	clear
7.2	Instructions for correcting errors	confusing	clear
8.0	System keeps you informed about what it is doing	never	always
8.1	Performing an operation leads to a predictable result	never	always
8.2	User can control amount of feedback	impossible	easy
9.0	Error messages	unhelpful	helpful
9.1	Error messages clarify the problem	never	always
9.2	Phrasing of error messages	unpleasant	pleasant

Figure 40, graphs the average distribution of each factor associated with the participants' understanding of the systems terminology and messages.

Figure 40: Profile – Terminology and System Information



Of the factors supporting the terminology and system information, two of them were rated significantly lower than the mean response. These factors were: “always,” and “easy,” indicating that the terminology, specifically the error messages used is subject to additional scrutiny. None of the other factors, consistent, clear, and helpful, were significantly less than the mean user response level. From the participants' reaction to the terminology and system information, the Author concluded that:

Strengths

- The use of terminology appearing on the screens is consistent

Weaknesses

- Instructions provided to the user for commands or choices can be improved

Written Comments by Participants

- Nothing noteworthy

Learning

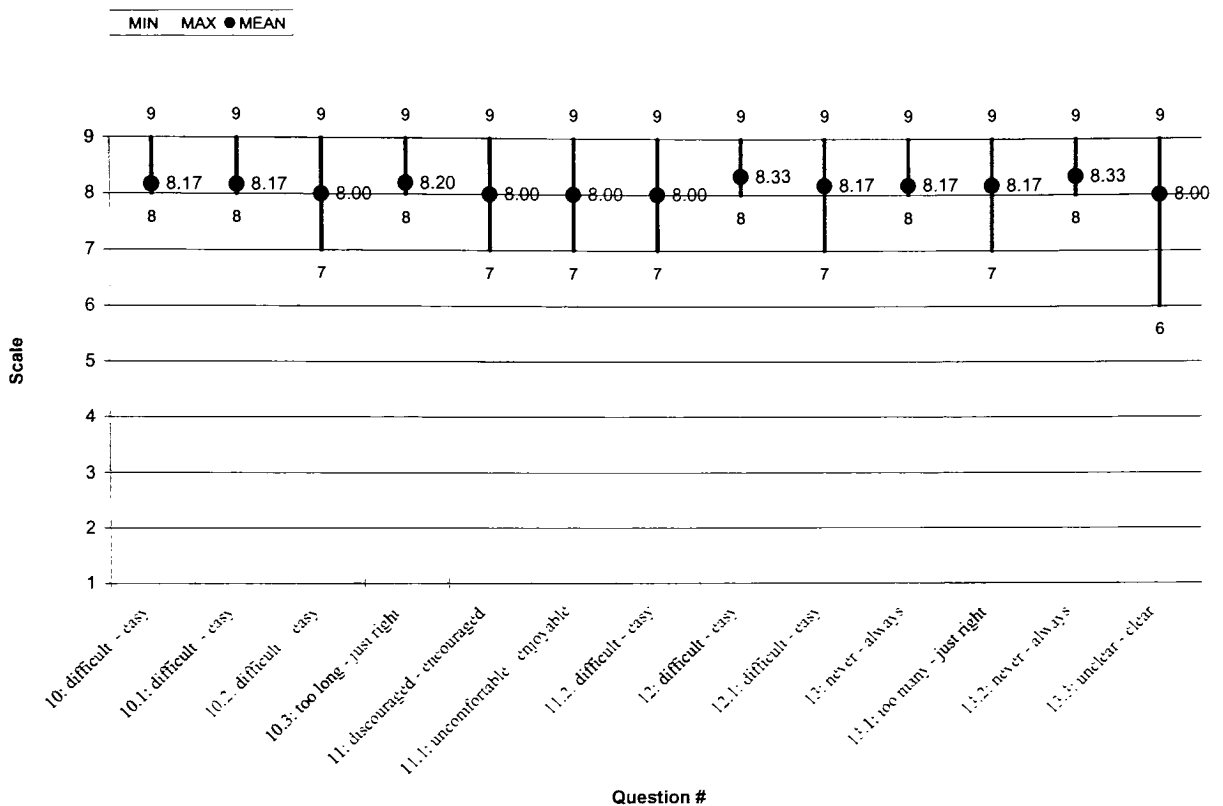
There were thirteen factors used to measure the participants' ability to learn to use the system. A few of these factors were: 1) how easy was it to learn to operate the system, 2) how easy was it to get started using the system, 3) how easy was it to learn the system features, 4) were the features enjoyable to use, 5) how easy was it to remember the system commands, and 6) were there the right amount of steps per task. The remaining factors can be seen in Table 4 or refer to (Appendix L) QUIIS Questionnaire - Results.

Table 4: Test Factors – Learning

Question #	Test Factor	Scale	
		1	9
10.0	Learning to operate the system	difficult	easy
10.1	Getting started	difficult	easy
10.2	Learning advanced features	difficult	easy
10.3	Time to learn to use the system	too long	just right
11.0	Exploration of features by trial and error	discouraged	encouraged
11.1	Exploration of features	uncomfortable	enjoyable
11.2	Discovering new features	difficult	easy
12.0	Remembering names and use of commands	difficult	easy
12.1	Remembering specific rules about entering commands	difficult	easy
13.0	Tasks can be performed in a straight-forward manner	never	always
13.1	Number of steps per task	too many	just right
13.2	Steps to complete a task follow a logical sequence	never	always
13.3	Feedback on the completion of task	unclear	clear

Figure 41, graphs the average distribution of each factor associated with the participants' ability to learn to use the system.

Figure 41: Profile – Learning Factors



Of the factors supporting learning, one of them was rated significantly lower than the mean response. The factor was: “clear,” indicating that the confirmation messages need additional scrutiny. None of the other factors, easy, enjoyable, and just right, were significantly less than the mean user response level. From the participants’ reaction to their ability to learn the system, the Author concluded that:

Strengths

- The time it took to learn to operate the system was just right.
- Remembering names and use of commands was easy
- The sequence presented to complete a task was clear
- The amount of steps taken to complete a task was just right.

Weaknesses

- Feedback / confirmation on the completion of a task can be improved. This has been a common theme throughout this study.

Written Comments by Participants

- Nothing noteworthy. The Author would anticipate these results changing once the system is developed and used.

System Capabilities

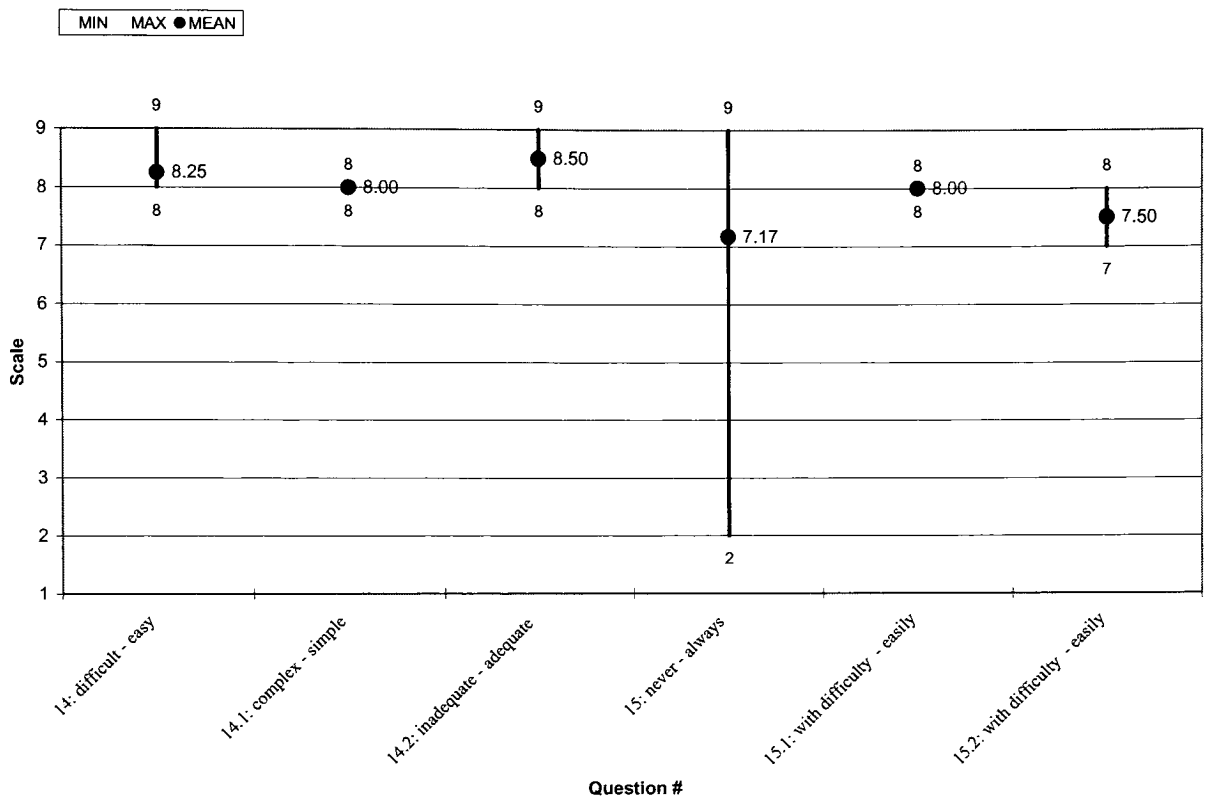
There were six factors used to measure the participants' reaction to the systems capabilities. These factors were: 1) how easy was it to correct a mistake, 2) how easy was it correct a typo, 3) was the system able to undo the previous action, 4) did using the system depend upon prior experience, 5) was it possible to use the system knowing only a couple of commands, and 6) how easy was it to use system shortcuts. These factors can be seen in Table 5 or refer to Refer to (Appendix L) QUIS Questionnaire - Results.

Table 5: Test Factors – System Capabilities

Question #	Test Factor	Scale	
		1	9
14.0	Correcting your mistakes	difficult	easy
14.1	Correcting typos	complex	simple
14.2	Ability to undo what you just did	inadequate	adequate
15.0	Ease of operation depends on your level of experience	never	always
15.1	You can accomplish tasks knowing only a few comands	with difficulty	easily
15.2	You can use features/shortcuts	with difficulty	easily

Figure 42, graphs the average distribution of each factor associated with the participants' impression of the systems capabilities.

Figure 42: Profile – System Capabilities



Of the factors associated with the systems capabilities, none of them were rated either significantly lower than the mean participant response level. From the overall reactions to the system, the Author concluded that until the system has been implemented, it would be unlikely that any meaningful data could be measured.

General Impression

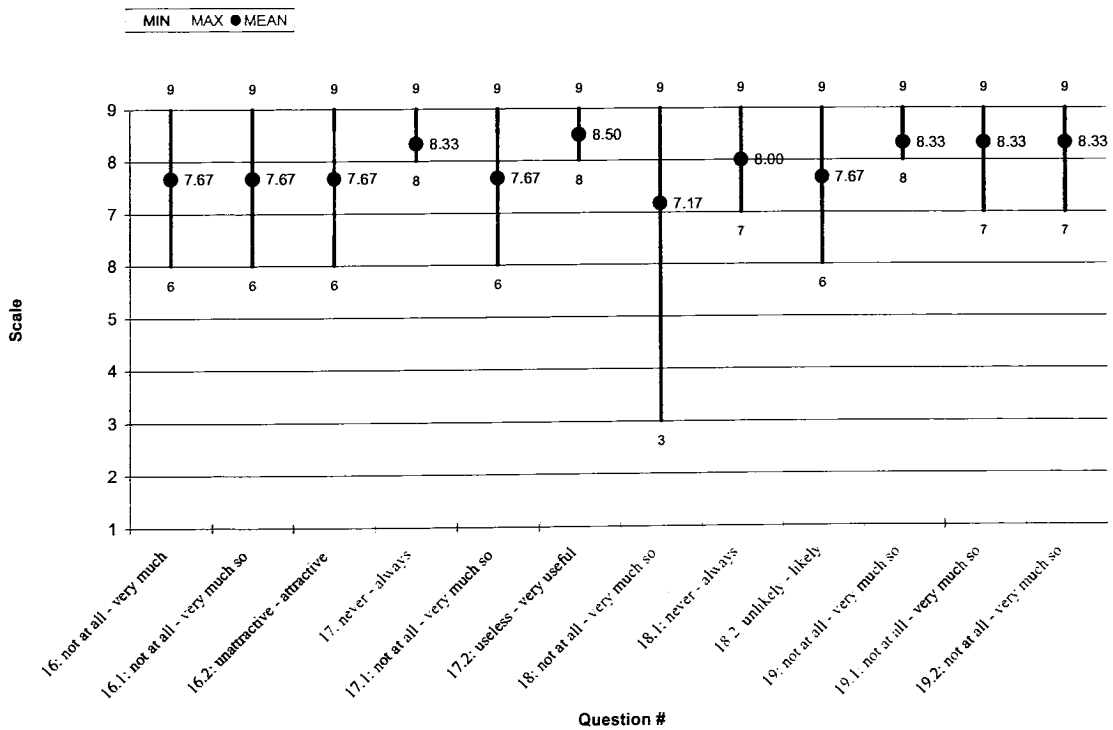
There were twelve factors used to measure the participants' general impression towards the system. A few of these factors were: 1) how aesthetically pleasing are the screens, 2) how attractive is the layout of the screens, 3) how attractive are the colors, 4) how impressive was the system, 5) how useful is the system, and 6) how would this system support my registration needs. The remaining factors can be seen in Table 6 or refer to (Appendix L) QUIS Questionnaire - Results.

Table 6: Test Factors – General Impressions

Question #	Test Factor	Scale	
		1	9
16.0	Screens are aesthetically pleasing	not at all	very much
16.1	Screen designs and layout are attractive	not at all	very much so
16.2	Use of colors	unattractive	attractive
17.0	System is impressive	never	always
17.1	System can do a great deal	not at all	very much so
17.2	Such a system at school would be	useless	very useful
18.0	System is fun to use	not at all	very much so
18.1	System maintains ones interest	never	always
18.2	System would remain interesting	unlikely	likely
19.0	System is useful	not at all	very much so
19.1	System would support my registration needs	not at all	very much so
19.2	System content is specific to my needs (personalized)	not at all	very much so

Figure 43, graphs the average distribution of each factor associated with the participants' general impression of the proposed design.

Figure 43: Profile – General Impressions



Of the factors supporting the participants' general impressions, two of them were rated significantly lower than the mean response. These factors were: "attractive," and "very much so" indicating that the appearance of the screens is subject to additional scrutiny. None of the other factors: always, very useful, and likely, were significantly less than the mean participant response level. From the participants' general impressions, the Author concluded that:

Strengths

- Such a system would be very useful at school
- Such a system supports the registration needs of the participants
- The system was successful in personalizing the content

Weaknesses

- Screens are somewhat aesthetically pleasing. This is an expected result since the Palm limits the use of colors and images, which users would expect as a result of their experience with the Internet.
- Participants were unsure whether or not this system would remain interesting. This supports how successful this prototype was supporting the theme that the users already desire something better.

Written Comments by Participants

- "The new registration approach, as presented is a great improvement over the initial maze of information"
- "Great potential for very useful and effective product. The student, the college and the maker of this product all have potential for streamlining their respected roles in the use of this product"
- "Awesome"

3.2 Participants

Students were identified as the primary user for the mobile implementation. Beyer and Holtzblatt indicate that six to ten interviews is a sufficient sample size for such a narrow focus.

Six participants, three male and three female, participated in the study. This group consisted of four RIT alumni and two non-RIT students. The two non-RIT students were chosen to represent the freshman population.

3.2.1 Selection Criteria

The selection criteria deemed necessary by the Author was:

- Uses a computer on a regular basis
- Uses the Internet on a regular basis
- Have registered for classes
- Is familiar with mobile devices
- Need not have any familiarity with a Palm

3.2.2 Environment

Participant participation occurred at the participants' place of employment. The office setting consisted of a standard office cube, which contained a desk, three chairs, a phone, printer, and personal computer. Participation involved the use of a personal computer.

3.3 Equipment

The following section discusses the equipment used in this study.

3.3.1 Hardware

The following hardware was used to produce the materials supporting this thesis:

Table 7: List of Hardware

Hardware	Purpose
Personal Computer	Used by the Participants during the Contextual Interview to execute the defined task. The personal computer was running Windows NT and had a 21-inch color monitor set with a resolution of 1280x1024.
External 56K Modem	Used during the Contextual Interview to create a slower internet connection
Palm Pilot	Used to evaluate existing application designs and to better illustrate the limitations of this technology
Tape Recorder	Used to capture the Contextual Interview sessions

3.3.2 Software

The following software was used to produce the materials supporting this thesis:

Table 8: List of Software

Software	Purpose
Microsoft Internet Explorer Browser	Used by the participants during the Contextual Interview to execute the defined task
Microsoft Word	Used to create the supporting materials used in this study
Microsoft PowerPoint	Used to create the prototype
Visio	Used to create the User Environment Model and Interface Designs

4 Summary

This thesis illuminated the complexities of migrating a Web application to a Palm device. The literature review indicated the need for a new approach to the requirements gathering process supporting the design of a mobile interface. Of particular interest was finding an approach that would separate the functionality of a Web application from its interface. The Contextual Design methodology by Beyer and Holtzblatt appeared to be a fitting approach.

Drawing on the literature review and personal design experiences, the Author applied her knowledge to define a front-end design process to extend the functionality of Rochester Institute of Technology's (RIT) web based course registration system to a personal digital assistant. The design process identified by the Author resulted in the following:

Analysis — Beyer and Holtzblatt's User Environment Design (UED) was an instrumental technique for analyzing the structure of RIT's Student Information System (SIS). This model showed how the SIS structure supports the students, exactly what functions are supported by this system, and how the functions connect with other parts of the system. The Author concluded from this step that the registration process implemented on the web has many focus areas and that the SIS structure was too complex for a Palm.

Beyer and Holtzblatt's Flow Model was used to narrow the scope of this study to a single focus area of the SIS. This model supported the findings from the UED, which suggested that registration is a multi-faceted process. The Flow Model did a good job of communicating which functions are supported on the Web. This model highlighted an area of the registration process not handled by the Web. The aspect that the Author found of particular interest was the task of identifying graduation requirements. Tracking these requirements is the starting point for the registration process and makes course selection unique for each student. The Author concluded that a mobile solution would be well suited to this task.

A questionnaire consisting of twenty questions was designed by the Author to gain a better understanding about the participant, their use of computers and mobile devices. A profile

of the participants resulted from this questionnaire.

Beyer and Holtzblatt's Consolidated Sequence Model effectively captured and consolidated the sequence of steps that were taken by each participant. This model identified what was important to the participants who register for classes. It was also successful in identifying what needs to be done, the order and strategy for doing it, and the motivation driving the specific actions.

Design — A paper prototype was used to review the initial design concept with two participants. Based on their feedback minor modifications were made to the UED and the screen design to improve navigation, which made recognition easier for users who have little to no experience with a Palm device.

The modified UED was used as the user interface specification. This diagram identified how to organize the interface, what functions should be available, and where to put the functions. Refining the requirements of RIT's web-based course registration system supported the limited screen space of the Palm. A simulation of the user interface design concept resulted from this model.

Validation — To validate the results of the design process, the Questionnaire for User Interaction Satisfaction (QUIS™) was used to evaluate the participants' subjective reactions to the simulation of the Palm interface. The QUIS measured the participants overall satisfaction and their satisfaction of four usability facets: screen factors, terminology and system information, potential learning factors, and general impressions. This study was successful in two key respects as supported by the results from the QUIS. First, the design process including the tools and method applied were correct. Second, the mySIS interface was easy to use and well received.

The results from this questionnaire validate the Author's assumption that a design process can increase the usability success of solutions delivered on a mobile device. The Palm interface design benefited from the application of contextual design techniques and fulfills the usability goals for user satisfaction. The results from this study can be used as a benchmark upon which

continued user interface development, of mySIS, could be based.

4.1 Further Research

The functionality of the prototype is limited because it was designed to be an off-line simulation of a real application for the purposes of evaluating the resulting design process.

The next iteration should consider implementing an on-line prototype that is integrated into a mobile network and tested by a small pilot group. Developing a fully functioning application could be the subject of a more formal usability experiment in a mobile environment. By doing so, the design process developed for this thesis could be tested for repeatability.

References

- 3Com Corporation. (1999). *Web Clipping Developer's Guide*. Retrieved November 3, 1999, from Palm: <http://www.palm.com>
- Beaulieu, M. (2002). *Wireless Internet Applications and Architecture: Building Professional Wireless Applications Worldwide*. Boston, MA: Addison-Wesley.
- Bell.(Authors), & South China Morning Post. (). (2000, November 28). *Report Reveals Missing Links in WAP Sites*. Retrieved January 11, 2002, from South China Morning Post: <http://www.anywhereyougo.com>
- Berney, J. W. (1999). *PalmPilot Usability and Design Issues*. Retrieved September 6, 2001, from The Usability Group: http://www.usability.com/umi_palmpilot.htm
- Blissmer, R. H. (1995). *Introducing Computers: Concepts, Systems, and Applications*. New York, NY: John Wiley & Sons, Inc.
- Borgman, C. L. (2000). From Gutenberg to the Global Information Infrastructure: Access to Information in the Networked World. In *Books24x7* (chap. 3). Retrieved November 15, 2001, from Books24x7: http://www.books24x7.com/viewer_r.asp?bkid=1135&chnkid=817826700
- Cohen, A. (2000, May 29). Wireless Summer. *TIME.com*, 155(22). Retrieved June 7, 2000, from <http://www.time.com/time/magazine/articles/0,3266,45626,00.html>
- Coyle, F. P. (2001). *Wireless Web: A Manager's Guide*. Boston, MA: Addison-Wesley Information Technology Series.
- CyberAtlas staff. (2001, December 10). *Enterprises Continue to Drive Wireless Applications*. Retrieved January 28, 2002, from CyberAtlas: <http://cyberatlas.internet.com/markets/wireless/print/0,,10094-936891,00.html>
- CyberAtlas staff. (2002, January 7). *Wireless Devices Continue to Proliferate*. Retrieved February 28, 2002, from CyberAtlas: http://cyberatlas.internet.com/markets/wireless/print/0,,10094_950001,00.html

- Cysive, Inc. (2001). *Making the Right Technology Choices Today for a Mobile Future*. Retrieved from Cysive, Inc.: <http://www.cysive.com>
- Farrell, T.. *So What IS User Requirements Gathering?* Retrieved December 31, 2001, from Usability InfoCentre:
<http://infocentre.frontend.c.../Infocentre?access=no&page=article&rows=5&id=25>
- Forrester Research. (2000, November 21). *Firms Must Embrace "Microdesign" To Overhaul Today's Woeful WAP Experience, Says Forrester*. Retrieved February 10, 2002, from <http://www.forrester.com/ER/Press/Release/0,1769,440,FF.html>
- Freed, L., & Derfler, Jr., F. J. (1994). *Building The Information Highway*. Emeryville, CA: Ziff-Davis Press.
- Hackos, J. T., & Redish, J. C. (1998). *User and Task Analysis for Interface Design*. Retrieved February 8, 2002, from Amazon.com:
<http://www.amazon.com/exec/obidos/tg/stores/detail/-/books/0471178314/reader/8/103-44311>
- Hjelm, J. (2000). *Designing Wireless Information Services*. New York, NY: John Wiley & Sons, Inc.
- Holtzblatt, K., & Beyer, H. (1993). Making Customer Centered Design Work for Teams. *Communications of the ACM*, 36(10), 93-103.
- Holtzblatt, K., & Beyer, H. (1997, March 22). *Contextual Design: Using Customer Work Models to Drive System Design*. Tutorial presented at CHI 97 Electronic Publications. Retrieved February 3, 2002, from ACM:
<http://www.acm.org/sigs/sigchi/chi97/proceedings/tutorial/kh.htm>
- Holtzblatt, K., & Beyer, H. (1998). *Contextual Design: Defining Customer-Centered Systems*. San Francisco, CA: Morgan Kaufmann Publishers, Inc.

- IDC. Business Users Will Lead Wireless Data Usage: Consumer Adoption Forecast to Take Off in 2003. *Cellular Online*. Retrieved February 3, 2002, from Cellular Online:
http://www.cellular.co.za/news_2001/102201-idc_predicts_84_million_people_i.htm
- INT Media Group. (2001). *Information Appliances and Beyond: Interaction Design for Consumer Products (Part Two)*. Retrieved October 13, 2001, from allNetDevices:
http://www.allnetdevices.com/icom_cgi/print/print.cgi?url=http://www.allnetdevices.com
- Interactions. (1999, January). Contextual Design. *Interactions*. Retrieved October 28, 2001, from Interactions.
- Leebaert, D. (Ed.). (1994). *Technology 2001: the future of computing and communications*. Cambridge, MA: The MIT Press. (Original work published 1991)
- Lindgaard, G., & Narasimhan, S.. Feature bundling in wireless technologies: Introducing Strategic User Needs Analysis (SUNA) [Paper]. *Carleton HCI Institute*. Abstract retrieved October 13, 2001, from Carleton University, Ottawa:
<http://www.carleton.ca.edu>
- Lynch, P. J., & Horton, S. (1999). *Web Style Guide: Basic Design Principles for Creating Web Sites*. New Haven, CT: Yale University Press.
- Macdonald, C. (2001, January 26). *Content in Context* [Speed Delivered at M-Conference]. Retrieved February 28, 2002, from mformobile.com:
<http://www.mformobile.com/print.asp?pk=10668>
- Maxwell, G. (1999). *SAMS Teach Yourself Palm Programming in 24 Hours*. Indianapolis, IN: Sams Publishing.
- Mayhew, D. J. (1997, March 22). *Managing the Design of the User Interface*. Tutorial presented at CHI 97 Electronic Publications. Retrieved February 15, 2002, from ACM:
<http://www.acm.cor/sigs/sigchi/chi97/proceedings/tutorial/djm.htm>
- Mills, M. (2000). *Microdesign - Strategic Design for Mobile Devices*. Retrieved February 7, 2002, from AlterEgo Networks: <http://www.alterego.com>

- Mills, M.. *Microdesign: Challenges and Opportunities*. Retrieved December 6, 2001, from AlterEgo Networks, Inc.
- Negroponte, N. P. (1995). *Being Digital*. New York, NY: Alfred A. Knopf, Inc.
- Newburger, E. C. (2001, September). *Home Computers and Internet Use in the United States: August 2000* [Special Studies].
- Nielsen, J.. What is "Usability"? In *ZDNet Developer* (Design/Usability). Retrieved September 22, 2001, from ZDNet:
<http://www.zdnet.com/devhead/stories/articles/0,4413,2137671,00.html>
- Pastore, M. (2002, January 15). *Wireless Voice Encroaching on Wireline Customers*. Retrieved February 28, 2002, from CyberAtlas:
http://cyberatlas.internet.com/markets/wireless/print/0,,10094_955351,00.html
- Pogue, D. (1999). T. O'Reilly (Ed.), *PalmPilot: The Ultimate Guide*. Sebastopol, CA: O'Reilly & Associates, Inc. (Original work published 1998)
- Preece, J., Rogers, Y., Sharp, H., Benyon, D., Holland, S., & Carey, T. (1994). *Human-Computer Interaction*. Workingham, England: Addison-Wesley Publishing Company.
- Rehaut, CFA, M., & Dwyer, CFA, D. (2001, March 28). *Internet Technology 101.2: Understanding the Internet and Its Technology*. Retrieved from SalomonSmithBarney:
<http://www.SSBiStrategy.com>
- Ruttenbur, B. W., Spickler, G. C., & Lurie, S. (2000, July 6). *eLearning: The Engine of the Knowledge Economy*. Retrieved October, 2000, from Morgan Keegan & Company, Inc.:
<http://outland.masie.com:8080/reports/elearning0700nate2.pdf>
- Seybold, A. M. (1994). *Using Wireless Communications in Business*. New York, NY: Van Nostrand Reinhold, an International Thomson Publishing Company.
- Sharma, C. (2000). *Wireless Internet Applications*. Retrieved December 16, 2001, from Luminant Worldwide Corporation: <http://www.luminant.com>

- Stowell, C. (1999). Designing Web Sites for PDA's. *Webmonkey: the web developer's resource*. Retrieved October 14, 2001, from Webmonkey: the web developer's resource: <http://hotwired.lycos.com/webmonkey/99/20/index2a.html>
- Taylor, Ph.D., D. A. (1990). *Object-Oriented Technology: A Manager's Guide*. Reading, MA: Addison-Wesley Publishing Company, Inc.
- Usability First, U. (2001). *Introduction to Usability* (chap.) Retrieved September 6, 2001, from Usability First : Your Online Guide to Usability Resources: <http://www.usabilityfirst.com/intro/index.txt>
- Weiss, C. (2001). *Designing for the Mobile Worker: Anywhere, Anytime, Take-it-to-go Learning*. Retrieved October 14, 2001, from LiNE Zine: <http://www.linezine.com/3.1/features/cwdfmw.htm>
- Zachariadis, S.-Z. (2001, July 27). *Usability Engineering*. Retrieved September 11, 2001, from Home Page: <http://linuzbenefit.com/papers/usability.html>
- Zetie, C. (1999, September). Design Issues in Repurposing Web Content for Mobile Devices. *Idea Bundle: Giga Information Group*. Retrieved December 7, 2001, from Books24x7: http://www.books24x7.com/viewer_r.asp?bkid=2589&chnkid=779740776
- Zetie, C. (2000, May 5). Moving Existing Applications to WAP: Porting, Reusing, or Rewriting? *Idea Bundle: Giga Information Group*. Retrieved December 7, 2001, from Books24x7: http://www.books24x7.com/viewer_r.asp?bkid=2589&chnkid=201246146
- Zetie, C. (2001, November 19). Context is King. *Informationweek.com*. Retrieved January 28, 2002, from informationweek.com: http://www.informationweek.com/sh.../printableArticle?doc_id=IWK20011115S001

Appendix

A. User Environment Model – Web

2
Information Access Center Home Page

Purpose:
 View options available through RIT's information access center

Functions:

- View Site Hours of Availability
- View ITS Helpdesk instructions
- View requirements for Student Information System
- View description for the Payment Center
- View description for Faculty/Advisor Administrative System
- View requirements for Public use

Links:

- ITS Helpdesk (e-mail)
- ITS Helpdesk (web site)
- Student Information System
- Payment Center
- Faculty/Staff Information/Advising System
- Administrative System request form
- Troubleshooting/Requirements document
- Open/Closed Courses
- Exam Schedule
- Questions/Feedback
- RIT Disclaimer
- RIT Copyright Infringement

Constraints:

- Internet access

3
Student Information System Main Menu

Purpose:
 Navigate to the components of the Student Information System

Functions:

- Register for Classes
- Academic Information
- Financial Information
- Address Information
- Housing Information
- Miscellaneous
- Financial Aid Information
- services@rit.edu

Links:

- Directory
- Search
- Calendar
- RIT News
- Web Help
- SIS

Constraints:

- Internet access
- Requires a DCE Account (DCE username and password)
- Requires SIS Account (PIN number)

4
Register for Classes

Purpose:
 View, select, and delete courses for the available term

Functions:

- View Class Schedule
- Drop Class
- Add Course by Course #
- Select Dropping
- Refresh Open Course List
- Select Open Course from Open Course List
- Add Course

Links:

- Main Menu
- Register
- Academic Information
- Financial Information
- Housing Information
- Miscellaneous
- Financial Aid Information
- services@rit.edu

Constraints:

- Internet access
- Requires a DCE Account (DCE username and password)
- Requires SIS Account (PIN number)
- Access is limited to a set period of time every term

5
Academic Information Main Menu

Purpose:
 List the available Academic options

Functions:

- View Grades
- Class Schedule
- GPA Statistics
- Open and Closed Courses
- Degree Information
- Liberation/Concentration Sign-up
- GPA Model
- Exam Schedule

Links:

- Main Menu
- Register
- Academic Info
- Financial Info
- Address Info
- Housing Info
- Miscellaneous
- services@rit.edu

Constraints:

- Internet access
- Requires a DCE Account (DCE username and password)
- Requires SIS Account (PIN number)

19
Financial Information Main Menu

Purpose:
 List the available Financial Info functions

Functions:

- Account Inquiry Information
- Request Refund
- Transfer of Funds
- Cumulative Loan Borrowing

Links:

- Main Menu
- Register
- Academic Info
- Financial Info
- Address Info
- Housing Info
- Miscellaneous
- services@rit.edu

Constraints:

- Internet access
- Requires a DCE Account (DCE username and password)
- Requires SIS Account (PIN number)

25
Address Information Main Menu

Purpose:
 List the available Address Information functions

Functions:

- Home Address
- Second Home Address
- Local Address
- Next of Kin Address
- Emergency Contact
- Billing Address

Links:

- Main Menu
- Register
- Academic Info
- Financial Info
- Address Info
- Housing Info
- Miscellaneous
- services@rit.edu

Constraints:

- Internet access
- Requires a DCE Account (DCE username and password)
- Requires SIS Account (PIN number)

32
Housing Information Main Menu

Purpose:
 List the available Housing Information functions

Functions:

- Apartment Returning Student Sign-Up
- Dorm Returning Student Sign-Up

Links:

- Main Menu
- Register
- Academic Info
- Financial Info
- Address Info
- Housing Info
- Miscellaneous
- services@rit.edu

Constraints:

- Internet access
- Requires a DCE Account (DCE username and password)
- Requires SIS Account (PIN number)

35
Miscellaneous Main Menu

Purpose:
 List the available Miscellaneous Functions

Functions:

- Pin Number Modification
- Environment Verification
- Financial / Registration Holds

Links:

- Main Menu
- Register
- Academic Info
- Financial Info
- Address Info
- Housing Info
- Miscellaneous
- services@rit.edu

Constraints:

- Internet access
- Requires a DCE Account (DCE username and password)
- Requires SIS Account (PIN number)

40
Financial Aid Info Main Menu

Purpose:
 List the available Miscellaneous functions

Functions:

- Financial Award Information
- Missing Financial Aid Documents

Links:

- Main Menu
- Register
- Academic Info
- Financial Info
- Address Info
- Housing Info
- Miscellaneous
- services@rit.edu

Constraints:

- Internet access
- Requires a DCE Account (DCE username and password)
- Requires SIS Account (PIN number)

cont pg 2

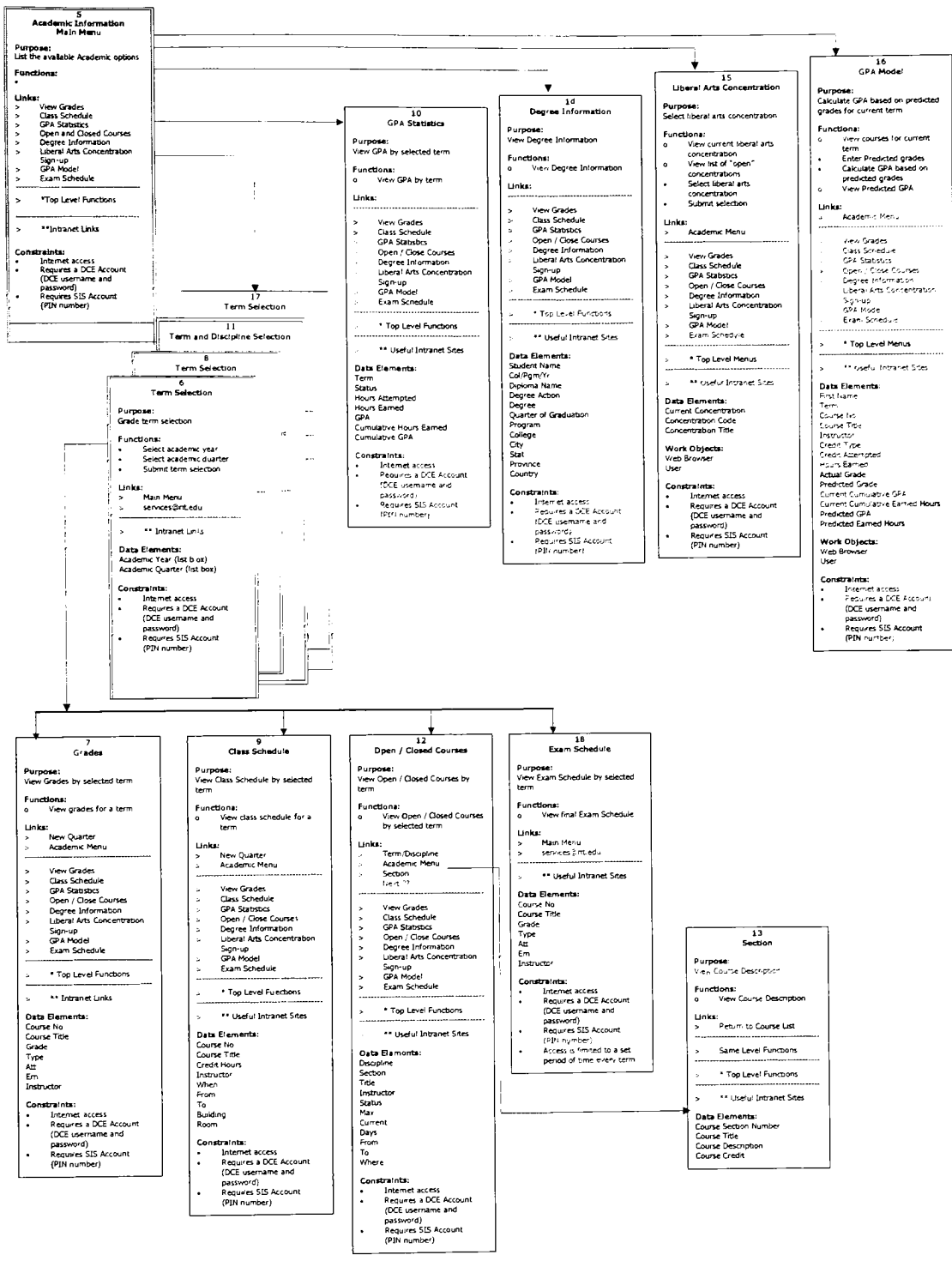
cont pg 3

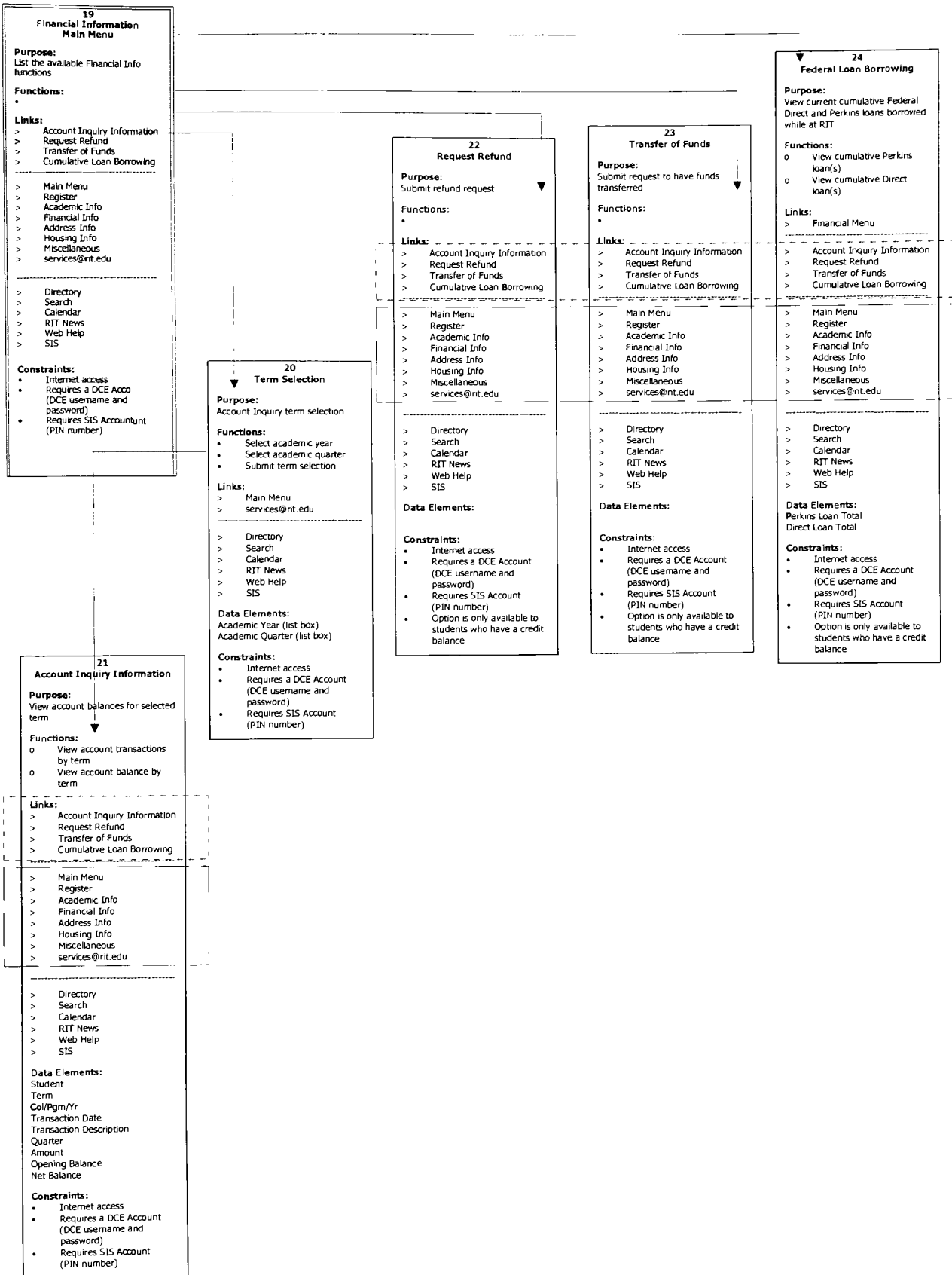
cont pg 4

cont pg 5

cont pg 6

cont pg 7





25
Address Information Main Menu

Purpose:
List the available Address Information functions

Functions:

-

Links:

- > Home Address
- > Second Home Address
- > Local Address
- > Next of Kin Address
- > Emergency Contact
- > Billing Address

- > Main Menu
- > Register
- > Academic Info
- > Financial Info
- > Address Info
- > Housing Info
- > Miscellaneous
- > services@rit.edu

- > Directory
- > Search
- > Calendar
- > RIT News
- > Web Help
- > SIS

Work Objects:
Web Browser
User

Constraints:

- Internet access
- Requires a DCE Account (DCE username and password)
- Requires SIS Account (PIN number)

26
Home Address

Purpose:
Update home address (used for official mailings / primary billing)

Functions:

- o View home address
- Restore Original Information
- Submit Changes
- Clear Form
- Add / Edit Address components

Links:

- >
- > Home Address
- > Second Home Address
- > Local Address
- > Next of Kin Address
- > Emergency Contact
- > Billing Address

- > Main Menu
- > Register
- > Academic Info
- > Financial Info
- > Address Info
- > Housing Info
- > Miscellaneous
- > services@rit.edu

- > Directory
- > Search
- > Calendar
- > RIT News
- > Web Help
- > SIS

Data Elements:
Name
Address: Street / City / State / Zip
Phone: Home / Day / Extension / TTY / Fax
International: Country / Postal Code / Province / Phone

Work Objects:
Web Browser
User

Constraints:

- Internet access
- Requires a DCE Account (DCE username and password)
- Requires SIS Account (PIN number)

27
Second Home Address

Purpose:
Update second home address (used for official mailings / primary billing - 2nd copy)

Functions:

- o View home address
- Restore Original Information
- Submit Changes
- Clear Form
- Add / Edit Address components

Links:

- >
- > Home Address
- > Second Home Address
- > Local Address
- > Next of Kin Address
- > Emergency Contact
- > Billing Address

- > Main Menu
- > Register
- > Academic Info
- > Financial Info
- > Address Info
- > Housing Info
- > Miscellaneous
- > services@rit.edu

- > Directory
- > Search
- > Calendar
- > RIT News
- > Web Help
- > SIS

Data Elements:
Name
Address: Street / City / State / Zip
Phone: Home / Day / Extension / TTY / Fax
International: Country / Postal Code / Province / Phone

Constraints:

- Internet access
- Requires a DCE Account (DCE username and password)
- Requires SIS Account (PIN number)

28
Local Address

Purpose:
Update local address (Rochester & surrounding areas)

Functions:

- o View home address
- Restore Original Information
- Submit Changes
- Clear Form
- Add / Edit Address components

Links:

- >
- > Home Address
- > Second Home Address
- > Local Address
- > Next of Kin Address
- > Emergency Contact
- > Billing Address

- > Main Menu
- > Register
- > Academic Info
- > Financial Info
- > Address Info
- > Housing Info
- > Miscellaneous
- > services@rit.edu

- > Directory
- > Search
- > Calendar
- > RIT News
- > Web Help
- > SIS

Data Elements:
Name
Address: Street / City / State / Zip
Phone: Home / TTY

Constraints:

- Internet access
- Requires a DCE Account (DCE username and password)
- Requires SIS Account (PIN number)

29
Next of Kin Address

Purpose:
Update address for next of kin (used only in case of emergency)

Functions:

- o View home address
- Restore Original Information
- Submit Changes
- Clear Form
- Add / Edit Address components

Links:

- >
- > Home Address
- > Second Home Address
- > Local Address
- > Next of Kin Address
- > Emergency Contact
- > Billing Address

- > Main Menu
- > Register
- > Academic Info
- > Financial Info
- > Address Info
- > Housing Info
- > Miscellaneous
- > services@rit.edu

- > Directory
- > Search
- > Calendar
- > RIT News
- > Web Help
- > SIS

Data Elements:
Name
Address: Street / City / State / Zip
Phone: Home / Day / Extension / TTY / Fax
International: Country / Postal Code / Province / Phone

Constraints:

- Internet access
- Requires a DCE Account (DCE username and password)
- Requires SIS Account (PIN number)

30
Emergency Contact

Purpose:
Update secondary emergency contact address (used only in case of emergency)

Functions:

- o View home address
- Restore Original Information
- Submit Changes
- Clear Form
- Add / Edit Address components

Links:

- >
- > Home Address
- > Second Home Address
- > Local Address
- > Next of Kin Address
- > Emergency Contact
- > Billing Address

- > Main Menu
- > Register
- > Academic Info
- > Financial Info
- > Address Info
- > Housing Info
- > Miscellaneous
- > services@rit.edu

- > Directory
- > Search
- > Calendar
- > RIT News
- > Web Help
- > SIS

Data Elements:
Name
Address: Street / City / State / Zip
Phone: Home / Day / Extension / TTY / Fax
International: Country / Postal Code / Province / Phone

Constraints:

- Internet access
- Requires a DCE Account (DCE username and password)
- Requires SIS Account (PIN number)

31
Billing Address

Purpose:
Create / Maintain secondary billing address (used to send bill to optional address)

Functions:

- o View home address
- Restore Original Information
- Submit Changes
- Clear Form
- Add / Edit Address components

Links:

- >
- > Home Address
- > Second Home Address
- > Local Address
- > Next of Kin Address
- > Emergency Contact
- > Billing Address

- > Main Menu
- > Register
- > Academic Info
- > Financial Info
- > Address Info
- > Housing Info
- > Miscellaneous
- > services@rit.edu

- > Directory
- > Search
- > Calendar
- > RIT News
- > Web Help
- > SIS

Data Elements:
Name
Address: Street / City / State / Zip
Phone: Home / Day / Extension / TTY / Fax
International: Country / Postal Code / Province / Phone

Constraints:

- Internet access
- Requires a DCE Account (DCE username and password)
- Requires SIS Account (PIN number)

32
Housing Information Main Menu

Purpose:
 List the available Housing Information functions

Functions:
 •

Links:

- > Apartment Returning Student Sign-Up
- > Dorm Returning Student Sign-Up

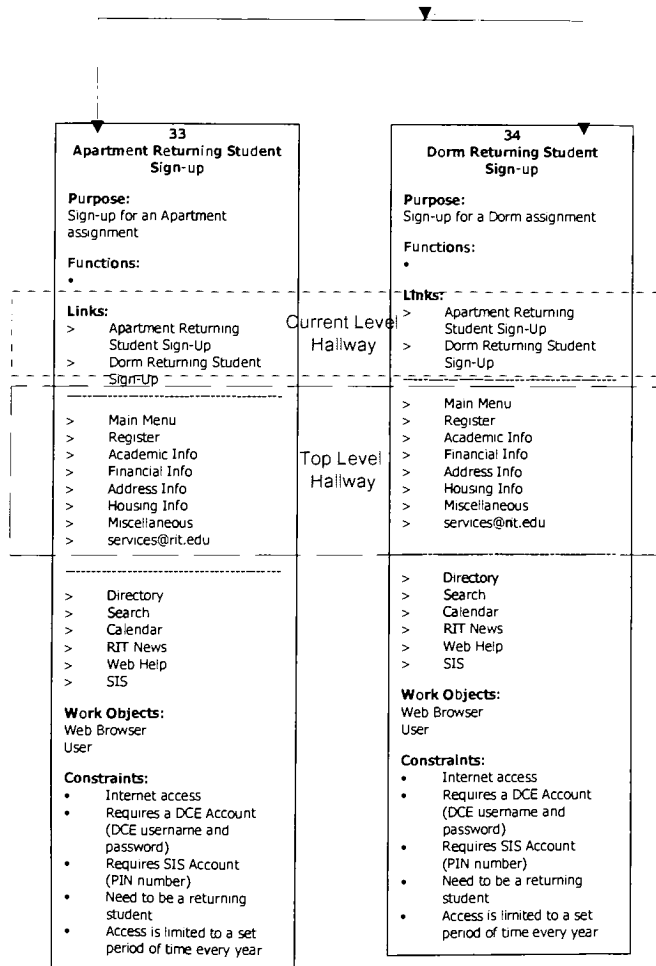
- > Main Menu
- > Register
- > Academic Info
- > Financial Info
- > Address Info
- > Housing Info
- > Miscellaneous
- > services@nt.edu

- > Directory
- > Search
- > Calendar
- > RIT News
- > Web Help
- > SIS

Work Objects:
 Web Browser
 User

Constraints:

- Internet access
- Requires a DCE Account (DCE username and password)
- Requires SIS Account (PIN number)



35
Miscellaneous
Main Menu

Purpose:
 List the available Miscellaneous functions

Functions:
 *

Links:
 > Pin Number Modification
 > Enrollment Verification
 > Financial / Registration Holds
 > Academic Advising

> Main Menu
 > Register
 > Academic Info
 > Financial Info
 > Address Info
 > Housing Info
 > Miscellaneous
 > services@rit.edu

> Directory
 > Search
 > Calendar
 > RIT News
 > Web Help
 > SIS

Work Objects:
 Web Browser
 User

Constraints:
 * Internet access
 * Requires a DCE Account (DCE username and password)
 * Requires SIS Account (PIN number)

36
Pin Number Modification

Purpose:
 Submit PIN number change

Functions:
 * Enter current PIN number
 * Enter new PIN number
 * Submit PIN number change

Links:
 > Pin Number Modification
 > Enrollment Verification
 > Financial / Registration Holds
 > Academic Advising

> Main Menu
 > Register
 > Academic Info
 > Financial Info
 > Address Info
 > Housing Info
 > Miscellaneous
 > services@rit.edu

> Directory
 > Search
 > Calendar
 > RIT News
 > Web Help
 > SIS

Work Objects:
 Web Browser
 User

Constraints:
 * Internet access
 * Requires a DCE Account (DCE username and password)
 * Requires SIS Account (PIN number)

37
Enrollment Verification

Purpose:
 View Enrollment history

Functions:
 o View enrollment data

Links:
 > Pin Number Modification
 > Enrollment Verification
 > Financial / Registration Holds
 > Academic Advising

> Main Menu
 > Register
 > Academic Info
 > Financial Info
 > Address Info
 > Housing Info
 > Miscellaneous
 > services@rit.edu

> Directory
 > Search
 > Calendar
 > RIT News
 > Web Help
 > SIS

Data Elements:
 Term
 Hr
 Time

Work Objects:
 Web Browser
 User

Constraints:
 * Internet access
 * Requires a DCE Account (DCE username and password)
 * Requires SIS Account (PIN number)

38
Student Holds Notification

Purpose:
 View holds found in the student records system (holds prevent student from registering)

Functions:
 o View registration holds

Links:
 > Pin Number Modification
 > Enrollment Verification
 > Financial / Registration Holds
 > Academic Advising

> Main Menu
 > Register
 > Academic Info
 > Financial Info
 > Address Info
 > Housing Info
 > Miscellaneous
 > services@rit.edu

> Directory
 > Search
 > Calendar
 > RIT News
 > Web Help
 > SIS

Data Elements:

Work Objects:
 Web Browser
 User

Constraints:
 * Internet access
 * Requires a DCE Account (DCE username and password)
 * Requires SIS Account (PIN number)

39
Academic Advising

Purpose:
 View all RIT courses taken or currently being taken since 1976

Functions:
 o View course history

Links:
 > Return to Miscellaneous...

> Pin Number Modification
 > Enrollment Verification
 > Financial / Registration Holds
 > Academic Advising

> Main Menu
 > Register
 > Academic Info
 > Financial Info
 > Address Info
 > Housing Info
 > Miscellaneous
 > services@rit.edu

> Directory
 > Search
 > Calendar
 > RIT News
 > Web Help
 > SIS

Data Elements:
 Today's Date
 Student Name
 Advisor Name(s)
 Course
 Term
 Title
 Grd Typ
 Grd
 Hrs Att
 Hrs Em
 QPTS

Work Objects:
 Web Browser
 User

Constraints:
 * Internet access
 * Requires a DCE Account (DCE username and password)
 * Requires SIS Account (PIN number)

Current Level
 Top Level
 Hallway

40
Financial Aid Info
Main Menu

Purpose:
List the available Miscellaneous functions

Functions:
•

Links:

- > Financial Award Information
- > Missing Financial Aid Documents

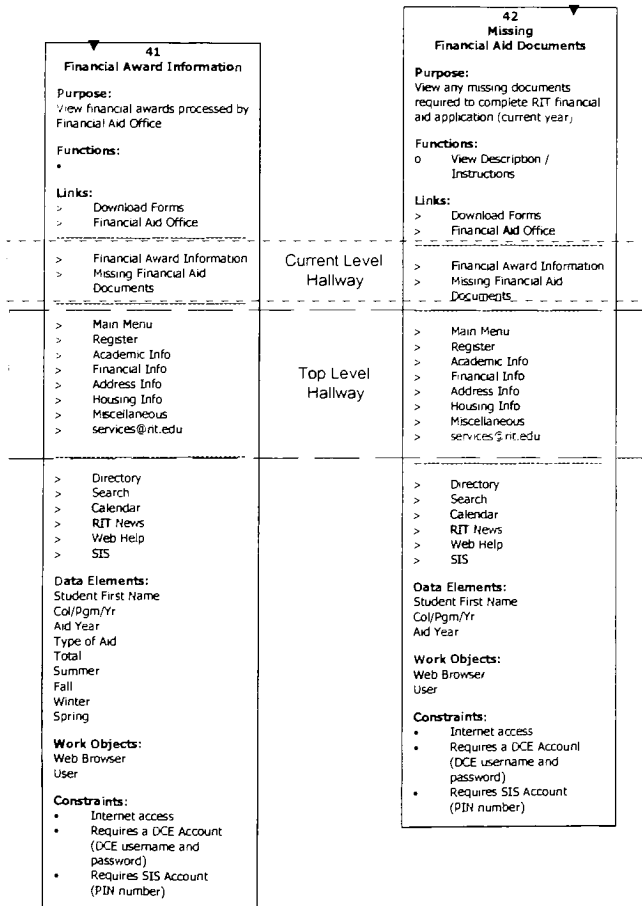
- > Main Menu
- > Register
- > Academic Info
- > Financial Info
- > Address Info
- > Housing Info
- > Miscellaneous
- > services@rit.edu

- > Directory
- > Search
- > Calendar
- > RIT News
- > Web Help
- > SIS

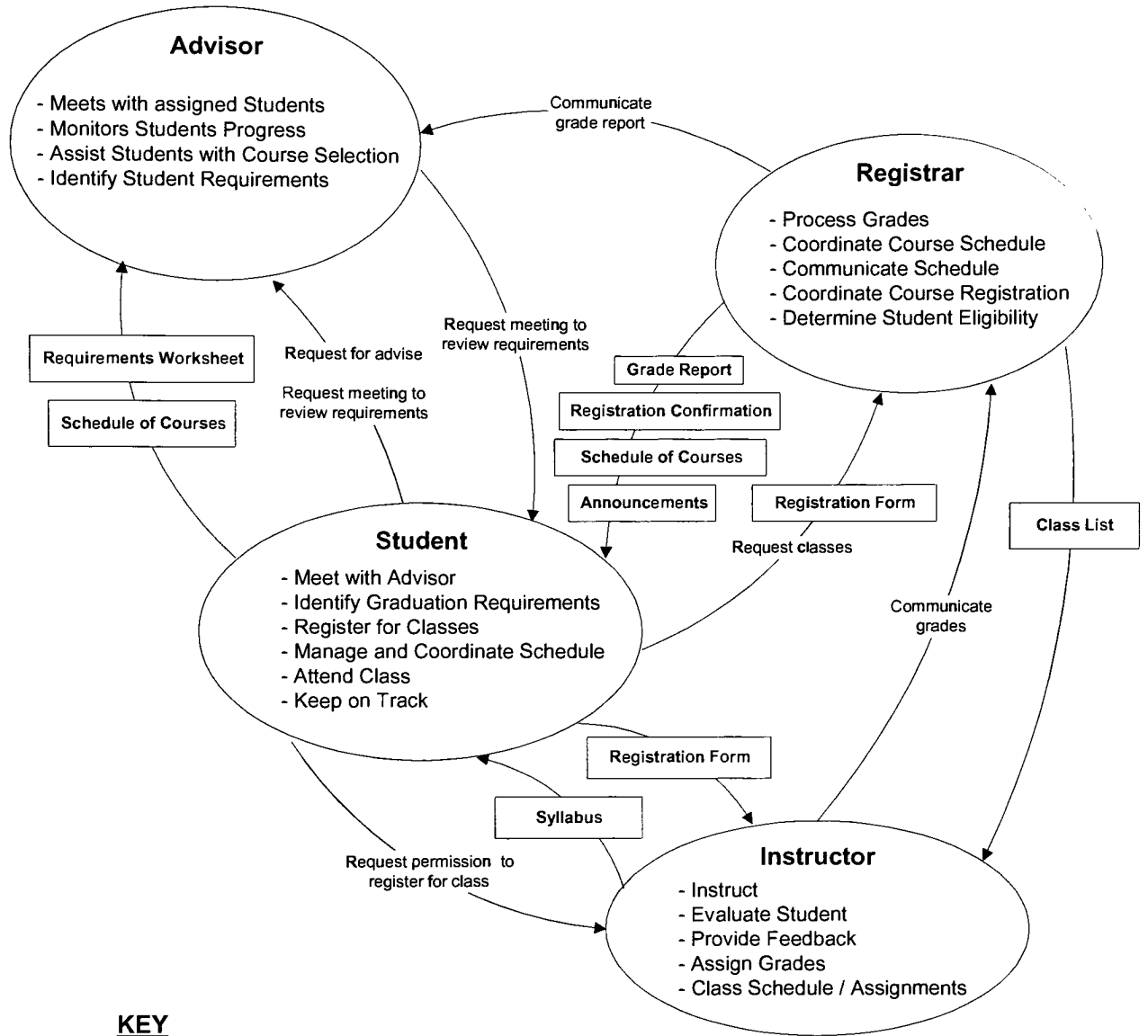
Work Objects:
Web Browser
User

Constraints:

- Internet access
- Requires a DCE Account (DCE username and password)
- Requires SIS Account (PIN number)



B. Flow Model



KEY

- Artifacts
- Person or Group
- Aaaa Responsibilities
- ◀Text Communication Action/Topic

C. Participant Profile – Questionnaire

The purpose of the Participant Profile is to obtain background information on the participant who will be supporting the Thesis work being done by Lynn Bajowski. I understand that my participation is voluntary and that the information I provide will only be used and/or shared in an academic environment.

Participant Signature: _____

Background Information

1. What is your age ?

<input type="checkbox"/> 18 - 24	<input type="checkbox"/> 31 - 50
<input type="checkbox"/> 25 - 30	<input type="checkbox"/> Over 50

2. What is your gender ?

<input type="checkbox"/> male	<input type="checkbox"/> female
-------------------------------	---------------------------------

3. What was the last year of school you completed ?

<input type="checkbox"/> Some high school or less	<input type="checkbox"/> Some college	<input type="checkbox"/> Some post-graduate work
<input type="checkbox"/> High school graduate	<input type="checkbox"/> College graduate	<input type="checkbox"/> Post-graduate degree

4. Have you ever registered for a class ?

<input type="checkbox"/> yes	<input type="checkbox"/> no
------------------------------	-----------------------------

5. Which of the following registration methods have you used ?
(check all that apply)

<input type="checkbox"/> Telephone	<input type="checkbox"/> Mail-In	<input type="checkbox"/> Fax
<input type="checkbox"/> In-Person	<input type="checkbox"/> Web Site	

6. Which registration method do you prefer ?

<input type="checkbox"/> Telephone	<input type="checkbox"/> Mail-In	<input type="checkbox"/> Fax
<input type="checkbox"/> In-Person	<input type="checkbox"/> Web Site	

7. Why do you prefer this registration method ?

Computer and Internet Usage

8. Do you use a Computer ?
(check all that apply)

- Yes, at home Yes, at school
 Yes, at work No

9. What size Monitor do you use ?
(check ONLY one)

- 14 " 17"
 19 " 21" Do not know

10. Which of the following Input Devices do you use ?

Device	Never	Less Than Once a Month	Once or Twice a Month	1 - 3 Days a Week	4 or More Days a Week
Keyboard	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mouse	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Game Controller	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tablet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stylus	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

11. Do you use the Internet ?
(check all that apply)

- No Yes, at home
 Yes, at work Yes, at school

Mobile Device Usage

12. Which of the following Mobile Devices have you used ?
(check all that apply)

Notebook Computer Cellular Phone None
 Pager PDA Other _____

13. Please identify the number of Mobile Devices you own

_____ Notebook(s) + _____ Cellular Phone(s) + _____ Pager(s) + _____ PDA(s) =
Total _____

14. Which of the following Mobile Devices would you be interested in owning?
(check all that apply)

Notebook Computer Cellular Phone None
 Pager PDA Other

15. If you **do** own any Mobile Devices, please go to Page 4 and answer questions (17 – 20)
16. If you **do not** own any Mobile Devices, please go to Page 5 and answer questions (21 – 22)

Mobile Device Functionality

17. Which of the following functions do you use on your Mobile Devices ?

Function	Never	Less Than Once a Month	Once or Twice a Month	1 – 3 Days a Week	4 or More Days a Week
Calendar	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Address book	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
To Do lists	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Memos	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Voice Mail	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
E-Mail	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Web Browsing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Games	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Specialized Apps	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

18. Where do you primarily use your Mobile Devices ?
(order from 1 to 3 where 1 is Most Used and 3 is least Used)

- Business Personal School

19. Does any of your Mobile Devices have Internet access ?

- yes no

a. If yes, which Mobile Device(s) have Internet access ?

20. What is your preference for having Internet access on your Mobile Devices ?

- No Preference Do not want it
 Glad I have it Would like to have

THANK YOU FOR YOUR PARTICIPATION !

Mobile Device Tendencies

21. What are the reasons you would choose not to own a Mobile Device ?
 (check all that apply)

- No Need Difficult to Read Over Priced
 Difficult to Use Limited Invasion of Privacy

22. If you owned a Mobile Device, which of the following functions would be of interest ?

Function	Never	Less Than Once a Month	Once or Twice a Month	1 - 3 Days a Week	4 or More Days a Week
Calendar	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Address book	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
To Do lists	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Memos	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Voice Mail	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
E-Mail	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Web Browsing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Games	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Specialized Apps	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

THANK YOU FOR YOUR PARTICIPATION !

D. Participant Profile – Results

Question	Values	Score	Count	Percent
1. Age	18 – 24		0	0%
	25 - 30	B/D/E/F	4	67%
	31-50	A/C	2	33%
	Over 50		0	0%
2. Gender	Male	A/B/F	3	50%
	Female	C/D/E	3	50%
3. School Completed	Some high school or less		0	0%
	High school graduate		0	0%
	Some College	A	1	17%
	College Graduate	C/E/F	3	50%
	Some post-graduate work	B	1	17%
	Post graduate degree	D	1	17%
4. Ever Registered	Yes	A/B/C/D/E/F	6	100%
	No		0	0%
5. Registration Methods Used	Telephone	C/E/F	3	50%
	In-person	A/B/C/E/F	5	83%
	Mail-in	B/C/D/F	4	67%
	Web Site	B/C/D	3	50%
	Fax	C	1	17%
6. Registration Methods Preferred	Telephone	F	1	17%
	In-person	A	1	17%
	Mail-in		0	0%
	Web Site	B/C/D/E	4	67%
	Fax		0	0%
7. Reason for Preference	Most Direct	A	1	17%
	Ease	B/F	2	33%
	Timeliness	C	1	17%
	Convenience	D/E	2	33%
	Efficient	D	1	17%
8. Computer Usage	At Home	A/B/C/D/E/F	6	100%
	At Work	A/B/C/D/E/F	6	100%
	At School	B	1	17%
	None		0	0%
9. Monitor Size	14"	E	4	67%
	17"	B/C	2	33%
	19"	A/F	2	33%
	21"	B/C/D/E	4	67%
	Don't Know		0	0%
10. Input Devices Used				
11. Intranet Usage	No		0	0%
	At Work	A/B/C/D/E/F	6	100%
	At Home	B/C/D/E/F	5	83%

Question	Values	Score	Count	Percent
12. Mobile Devices Used	At School	B	1	17%
	Notebook	A/B/C/D/E/F	6	100%
	Pager	A/B/C/D/E/F	6	100%
	Cellular Phone	A/B/C/D/E/F	6	100%
	PDA	A/E	2	33%
	None		0	0%
	Other		0	0%
13. Mobile Devices Owned	Notebook	A = 0 B = 1 C = 2 D = 1 E = 0 F = 0		
	Pager	A = 0 B = 1 C = 2 D = 1 E = 0 F = 0		
	Cellular Phone	A = 0 B = 1 C = 2 D = 2 E = 1 F = 1		
	PDA	A = 0 B = 0 C = 0 D = 0 E = 1 F = 0		
	None		0	0%
	Other		0	0%
14. Mobile Devices desired	Notebook	A/B/C/E/F	5	83%
	Pager	C	1	17%
	Cellular Phone		0	0%
	PDA	B/C/D/F	4	67%
	None		0	0%
	Other		0	0%
15. Mobile Device functions used				
16. Mobile Device primary usage	Business	B = 1 C = 1 D = 1 E = 2		
	Personal	B = 2 C = 2 D = 2 E = 1		
	School	B = 3 C = 3 D = 3		

Question	Values	Score	Count	Percent
17. Mobile Devices have Internet Access	Yes	E = 3 B/C/D/E	4	67%
	No		0	0%
18. Which Mobile Devices have Internet Access	Cell Phone	B/D/E	3	50%
	Notebook	C	1	17%
19. Preference for Internet Access on Mobile Device	No Preference	B/D/E	3	50%
	Glad to have it		0	0%
	Do not want it		0	0%
	Would like to have it	C	1	17%
20. Reasons not to own a Mobile Device	No Need		0	0%
	Difficult to Use		0	0%
	Difficult to Read		0	0%
	Limited		0	0%
	Over Priced	F	1	17%
	Invasion of Privacy	A	1	17%
	No Desire	A	1	17%
21. If owned a Mobile Device, desired functions				

E. Participant Tasks - Web

I will be giving you a series of tasks, which a student Rochester Institute of Technology, can complete using the on-line registration system.

I will not answer questions about how the tasks should be accomplished; I am observing how you use this system, and whether or not it is easy to use.

REMEMBER: I want you to think aloud, like, "where the heck is the back button?"

Once we have finished, I may have a few follow-up questions.

Task I: Register for 4 Classes

Scenario:	You are a Returning Student to RIT and would like to register for 4 Classes. You have decided to register for these classes by using the internet by accessing the on-line registration system, otherwise known as "SIS" or "Student Information System."
Useful Info:	Each of the classes you are interested in registering for are offered through the College of Computing and Information Services
Task:	<p>Using the on-line registration system, complete the following:</p> <ul style="list-style-type: none"> ➤ Your Home Address has changed: 10 Birch St West Springfield, MA 01089 ➤ Course Title: Programming for WWW Course No: 4004 739 01 ➤ Course Title: Windows Programming Course No: 4002 590 01 ➤ Course Title: Usability Engineering Course No: 4004 748 01 ➤ Course Title: Web Site Design & Tech Course No: ????

Task II: Check for a Course taught by a Specific Instructor

Scenario:	You ran into a friend who told you about a great class, but your friend told you if you take the class you need to take it with Prof. Axelrod.
Task:	<p>Using the on-line registration system, look up to verify whether or not Prof. Axelrod is teaching the following course this Semester / Quarter:</p> <p style="text-align: right;">Course No.: 4002-890-01 Course Title: Fund of Web Based Multimedia</p>
Question(s)	<p>Is Prof. Axelrod teaching this course this Semester / Quarter ?</p> <p style="text-align: center;">Yes _____ No _____</p> <p>If yes, the when is this class scheduled for:</p> <p style="text-align: center;">Day(s) _____</p> <p style="text-align: center;">Time _____</p>

Task III: Check Open / Closed Courses

Scenario:	You just left a meeting with your Advisor and are thinking about switching your Major. To do this, you will need to take a specific Core Course. Since the registration period is over on Friday, you need to find out whether or not there are any seats still available for this course.
Task:	<p>Look up the following course and verify whether or not the course is open and does it have seats available:</p> <p style="text-align: center;">Course No.: 4004-742-70 Course Title: Interactive Multimedia Development</p>
Question(s)	<p>Is this course Open / Closed this Semester / Quarter ?</p> <p style="text-align: center;">Open_____ Closed_____</p> <p>If this course is Open, then how many seats are still available?</p> <p style="text-align: center;"># of Seats_____</p>

Task IV: Read a Course Description

Scenario:	You heard about a course while buying books at the bookstore. It sounds interesting and you would like to find out what the course is about.
Task:	Please read and print the course description for: Course No.: 4004-742-70 Course Title: Interactive Multimedia Development

You have now finished all the tasks, I greatly appreciate your time!

F. Contextual Interview - Summary

Participant P1

- The participant quickly studied the structure of the Schedule of Courses booklet, identifying the contents contained on each page and how it was organized
- Had question about what is the Course Number
- The participant referred to the “How to Read the Schedule of Courses” page of the Schedule of Courses booklet to learn the definition for Course Number
- Noticed that the Registration form only has room to write down 3 Course Requests, when it is possible to register for more
- Unsure how to find the 2D Graphics course when courses are only listed Alphabetically by Course # in the Schedule of Courses booklet
- The Schedule of Courses booklet does not provide a means for looking up a Course by Title
- Participant identified the Course when only given its title by manually scanning through the courses until he found it (approx 4 minutes later)
- Prior to adding a course via the web application, the participant asked how the system knew who he was
- After adding the first of four courses the participant asked if it mattered that he didn’t verify/modify his Home Address first (sequence of events)
- The web interface did not provide the participant with an understanding of how to enter the course number (formatting)
- The participant was interrupted before finishing entering all the courses and the system timed out and did not provide him with that information until after he entered information for the fourth course
- After the system timed out, the information entered about the fourth course was lost (needed to be re-entered)
- Participant concerned by language used for the buttons
- Would prefer that when submitting information the button be labeled as “Submit”
- The navigation bar does not clearly indicate where you are in the application (e.g. If you are at the Open/Closed Courses screen the link for this screen should be highlighted)
- User finds numbers easier to reference

Additional Comments

- The Participants Registration Tendencies is that he would register for his courses upon hearing about the course / registration period opens to guarantee his seat.

Facilitator’s Notes

- Course Number has 4 distinct parts of information which may or may not be completely understood by the student
- IT people seem to overuse numbers as keys to make searching and displaying data easier. People associate easier with words than numbers
- This participant looks at the information in a very structured / hierarchical way
- This participant used the forward and back buttons to navigate through the system
- This participant navigated back to the Student Information System home page before completing each step
- Participant did not appear confident not appear comfortable with the web based system

Participant P2

- The participant proceeded to fill out the Registration Form without reading the instructions
- The participant stumbled on finding the Section Number (took approximately 4 minutes to resolve)
- The participant referred to the “How to Read the Schedule of Courses” page of the Schedule of Courses booklet to learn the definition for Course Number
- The participant identified that the Registration form only has room to write down 3 Course Requests, when it is possible to register for more
- The participant identified that the space provided to enter the Course Title on the Registration form was not long enough
- Participant thought that the process for locating a Course when not given a Course #, using the Course Selection booklet a tedious process
- Participant quickly realized that there were more than one address which could be viewed/modified
- Participant looked to find a definition for each address
- Participant thought that the placement of the definition for each Address was difficult to find / see
- While working on modifying the Home Address, the Participant wanted to check and see if the Billing Address was correct
- Discovered that the Billing Address was blank (contained no data), was puzzled because he assumed that it would be the same as the Home Address and would contain the same data
- When the task only provided the participant with the Course Title, the participant elected to navigate to the Open/Closed Courses to find the course
- The participant was frustrated by the results of the Open/Closed Course selection because the Courses were listed in order by Course Number
- Participant Commented on how slow the response time of the system was
- The participant would have preferred to see the list of courses in Alphabetical order by Course Title
- Participant was surprised to learn that he was unable to select the course from the Open/Closed Course listing and have that information carry over to the Registration Screen
- When asked to find a Course based on Instructor he identified that he assumed that the Course was being offered in the current Term since he has previous knowledge that Courses are sequenced over the course of a year and a particular course may only be offered during a specific Term
- To complete looking up a Course by Instructor, the participant would elect to see the courses for that Instructor by Course Number ????? (question based on previous comment, should have the option to view by either Number or Title)

Additional Comments

- Participant prefers web based registration because of its ease and convenience
- Determined that if a Course has restrictions neither the Registration Form nor the web based registration system would help in completing the registration process
- Believes the web based system would benefit from a Search Engine
- User looks for information based on words not numbers

Facilitator’s Notes

- This participant used the functional menus to navigate within the system
- The participant moved around the system with confidence and ease did not have any notable issues

Participant P3

- Participant made a connection with the first part of the Course Number (4004) and proceeded to the Table of Contents of the Course Instruction booklet
- Did not make a connection to the number and proceeded to the section of the of the Course Instruction booklet that was applicable to the College of Computing and Information Sciences
- Determined how the page content was organized by using the column headers as a reference point (*Site Map*)
- Proceeded to complete the Form
- Commented that there is not enough room on the form
- Proceeded to a page in the Course Instruction booklet to locate the Section Number associated to the Course by looking at the Page Headers
- Identified that the Section Number is not a Page Header (puzzled)
- Commented that the Course Number may not be a “whole number”
- Referred to referred to the “How to Read the Schedule of Courses” page of the Schedule of Courses booklet to learn the definition for Course Number
- Determined that the Course Number is a whole number with meaning built into the visually distinct 4 parts
- Questioned if there was another way to use the Schedule of Course booklet to find a Course by its Course Title
- Deduced that the Schedule of Course booklet is organized by Course Number presented in Ascending order
- Based on that information she began to look page by page for the Title (approx 4 min)
- Participant Commented on how slow the response time of the system was
- Participant was interrupted before finishing entering all the courses and the system timed out
- Participant need to re-login
- Entered the second Course by adding its Course Number, twice, (didn’t catch what went wrong)
- After successfully adding the second course, received the message that the course required Dept Signature, identified that there were no instructions as to how to proceed
- After adding the third course, the participant was confused by the information provided on the Course Schedule
- The presentation of Day and Time appeared on different lines
- The participant questioned its meaning to be that there was an additional selection which needed to be made (had the choice between days)
- NOTE: The reason why the information was on different lines is that the Class would be held in a Different Location on each of those days (Bldg No. and Room No.)
- To register for the Course when only provided with the Course Title, the participant used the Schedule of Courses to identify the Course Number then used that number to enter into the Course Registration System
- The Participant never used the system to look up the Course Information

Additional Comments

- The Participant has a DSL connection at home
- The Participant would prefer to register over the phone “Can’t beat a good person on the phone”
- The Participants previous experience with using the web as the registration tool is that the Registration information is not up to date
- For this participant the registration process boils down to “Time and Convenience”
- The Participants Registration Tendencies is that she would register for her courses upon hearing about the course / registration period opens to guarantee her seat.

Participant P3

Facilitator's Notes

- Like working with software and/or the internet, the Pattern for the Organization of the Content is Key and is the starting point with human interaction and data
- The form separates the Section Number from the Course Number, where as the Course Number includes the Section Number when referring to it in other Contexts.
- The Course Number is made up of 4 distinct data points and is consistently presented in 4 parts when displayed visually. The web app uses the part to breakdown the data for searching purposes
- The anatomy of a Course Number needs to be more clearly communicated
- This participant used the forward and back buttons to navigate through the system
- Neither the Registration Form/Course Schedule booklet or Web Based System CLEARLY present the user with the required prerequisites or class restrictions (web system presents AFTER the effort)
- The Course Title differs between the Schedule of Courses and the Web Based System (E.G. Adv Con In Comp Int Des a.k.a. Usability Engineering)

Participant P4

- The Participant commented that there was not much room to write on the Registration Form
- The Participant proceeded to open to a non-specific page and attempted to locate the course number on that page, she then proceeded to open a couple of other pages and quickly determined that she needed to find another route to find the course number
- The Participant turned to the Table of Contents
- She scanned the Table of Contents and narrowed her search by making the assumption that the Course with the Title “Programming for the WWW” would most likely be located
- Participant questioned how to find a class by name if you do not have a course number
- After adding the first course, the participant questioned how the system knew who she was
- Participant identified that the second course was CLOSED
- While trying to add the fourth course, participant attempted to locate the course by using the second method offered through registration screen
- Struggles with the method, concerned with not having the Course Number to enter
- Navigates back to the SIS Main Menu / Academic Menu / Open/Closed Courses
- At the Course List Term and Discipline Selection, participant was searching for College (expected) yet presented with Discipline (she was confused)
- Thinking about the Course Catalog she identifies the link for Directory and selects this
- This selection logs her off the SIS connection
- Logs back in and navigates to Register for Courses
- Using method 2, incorrectly selects a Course and can not cancel out of the action, required to wait until the request has been processed

Additional Comments

- The participant navigates through the system by the Menus
- The participant would prefer registering for classes using the web over a form

Facilitator’s Notes

- The Registration Form required the Participants to locate on bit of data using the Schedule of Courses booklet to complete the Registration Form.
- All of the participants put forth only the effort needed to complete the “Task at Hand” which was completing the Registration Form and all seemed comfortable and confident when the form was completed
- No one seemed concerned with the potential pitfalls (ignorance is bliss)
- This participant applies the same sequence used for registering for a course with a form when registering for a course by the web
- Even though Method 2 spells out each of the Steps required for the method of registration, every participant missed this text.

Participant P5

- The participant questioned how to identify the Section #
- Participant determines that she needs to know how to read the schedule and proceeds to look for the instructions in the Schedule of Courses booklet
- Participant identifies using the booklet that the Course # is actually the first four digits
- Participant comments that there is not much room to write on the Registration form
- While adding the second course the participant is concerned that she may be double booking herself and decides to use the blank Schedule to identify the days and times of the courses she is registering for
- While adding the third course using the Schedule of Courses booklet, the participant identifies additional numbers below the course title (Course Prerequisite)
- After adding the third course, the participant questioned the split in days where the class time was the same, identified that the Bldg and Room assignments were different
- To identify the course which did not have a Course #, the participant assumed that she would need to scan the page until she found the Course Title she was looking for
- After find the fourth course and transferring her information to her Schedule sheet, she identified that there was a Course Conflict, the day and times for the third and fourth classes was the same
- When asked to find the Course Description, participant navigated back to Main Menu / Academic Info
- Comments whether or not shed is in Academic Info, since the Menu Option does not provide users with feedback as to where they are in the system

Additional Comments

- Participant navigates through system using the Menu options
- For proof, the Participant commented that she would print a copy of the final courses she had added as proof that she had been registered

Facilitator's Notes

- Presentation of the Room assignment is not clearly presented on the web application
- The Course Conflict was not identified until the courses were laid out on an actual schedule
- Participant was quick and confident completing all tasks using both the Registration form and web based Registration system

Participant P6

- Participant comments that once he as selected the “Add Courses” button, would a paper confirmation be generated each time a course was added
- Commented about the wording associated with the 2 web methods for registering, “Slowly and Surely” vs “Quick and Dirty”, he was concerned about messing up and elects to use the Quick and Dirty because he assumes the other method may take too much time
- Commented that the time it was taking was slow
- Upon adding the Course which was Closed, he said he would finish adding the remaining classes and then he would go back at the end to see if there was another class time available
- Participant tries using <CTRL F> to expedite the process of finding a class in the class list results
- Determines that <CTRL F> doesn’t work so he uses the Tab key to navigate through the drop down list
- Identified that the Credit Hours is concatenated to the Title on the list of courses presented to the user, asked if the number 4 was a part of the Title

Additional Comments

- Participant navigates through the system using the Menu options

Facilitator’s Notes

-

G. Requirements Worksheet – MS/IT

Rochester Institute of Technology

Master of Science in Information Technology

Name: _____ SS#: _____
 Address: _____ Phone (H): _____

 Employer: _____ Phone (W): _____
 Entry Term: _____ Full Time/Part Time _____
 Email: _____

Prerequisite or Equivalent

Prerequisite courses do not count towards the degree requirements of the MS

2 Course Programming Sequence	
0602-709 Fundamentals of Computer Hardware -or- 0602-340 Computer Concepts and Systems Software (formerly 0602-410)	
0602-717 Information Integration	

Core Courses:

Quarter

Grade

Comments

Core Courses:	Quarter	Grade	Comments
0602-718 Current Themes in Information Technology			
0602-733 Fundamentals of Telecommunications Tech.			
0604-741 Fundamentals of Interactive Multimedia			

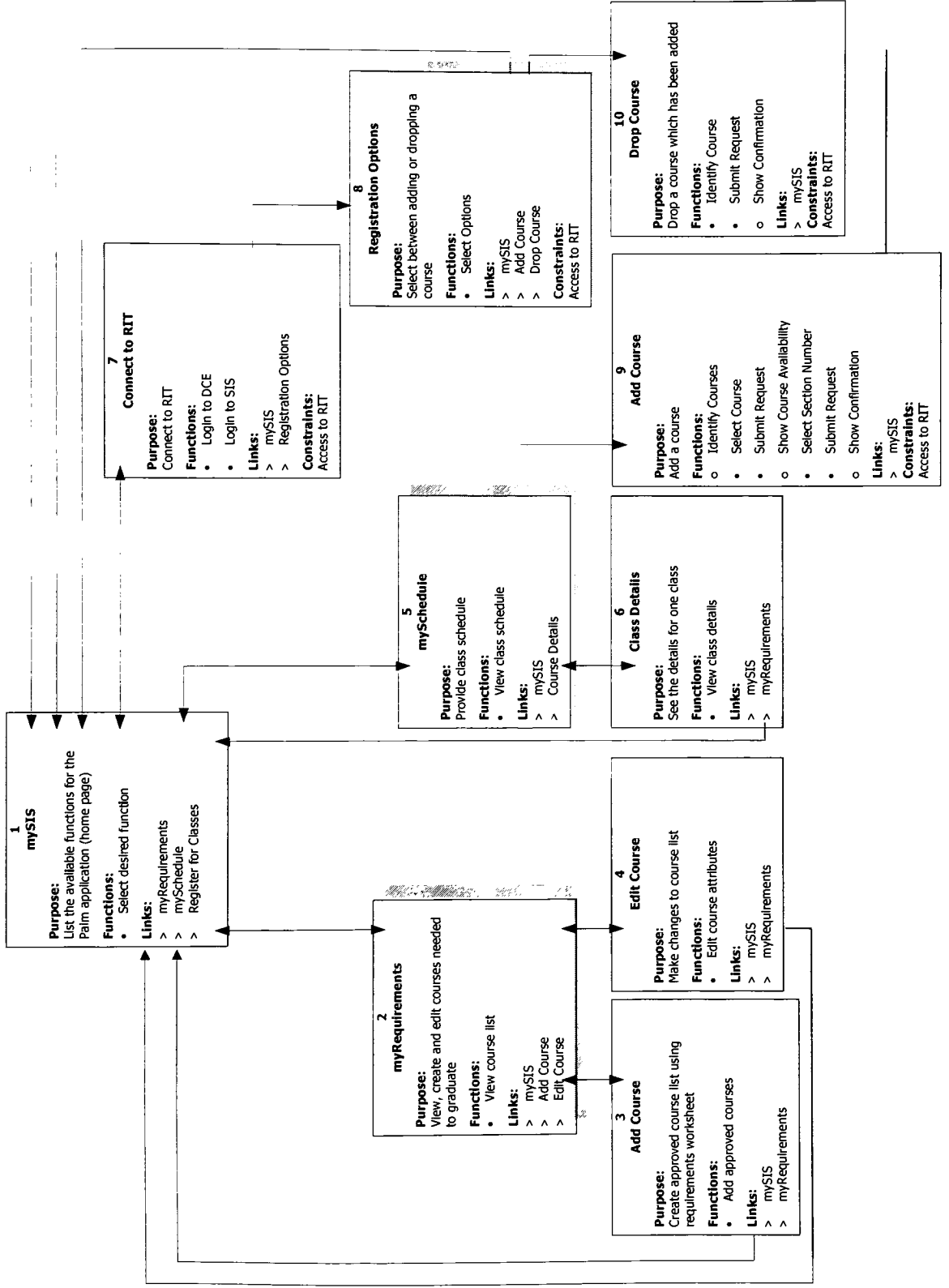
Concentration: (1st)

Concentration: (2nd)

Electives Courses: (4 or 8 cr. hrs.)

Capstone: (4 or 8 cr. hrs.)

H. User Environment Model – Palm



I. User Interface Design – Initial

RIT

my S·I·S

Grad Requirements

mySchedule

Registration

1/25/2002 Last Day to Withdraw

Req Summary

MS Information Technology

Category	Req'd	Taken	Remain
Prerequisite	16	16	0
Core Courses	12	12	0
1st Concentration	12	4	8
2nd Concentration	12	4	8
Electives	8	8	0
Capstone	4	0	4
Total Credit Hours	64	44	20

Add Course Add Course Remove Course

Courses Needed

1st Concentration Need

Course #	Title
0602 850	Network Planning & Control
0602 855	Telecom Policy & Standards
0602 860	Enabling Tech & Trends

HR 12

OK Add Course Save List

Courses Taken

Core Taken

Course #	Title
0602 717	Information Integration
0602 733	Fundamentals of Telecom
0602 745	Theories of Interactiv Comp

Select course # for details

HR 0

OK Add Course Save List

Course Grade

Fundamentals of Telecom

Course #	Sec #	CR	Term	Grade
0602 717	01	4	19952	A

OK Add Grade

Add Grade

Fundamentals of Telecom

Course # 0602 717

Sec # 01

CRs Earned 4

Term: 20021

CR	20021	20022	20023	20024
Grade	1			

OK Add Grade Done Clear Criteria

Add Course

1 require Core

Title: _____ (25 char)

Course #: _____ (7 char)

0 1 2 3 4 5 6 7 8 9

HR's Attempted: 3 1 2 3 4

Enter Course Cancel Clear Criteria

Courses Needed

1st Concentration Need

Course #	Title
0602 850	Network Planning & Control
0602 855	Telecom Policy & Standards
0602 860	Enabling Tech & Trends

HR 12

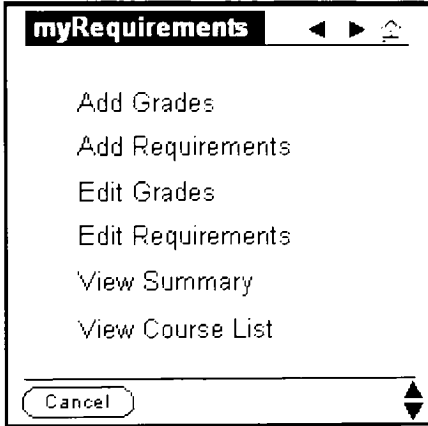
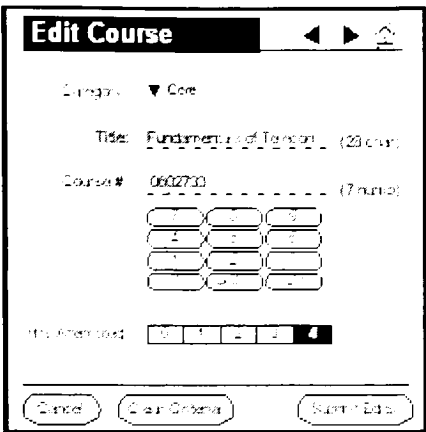
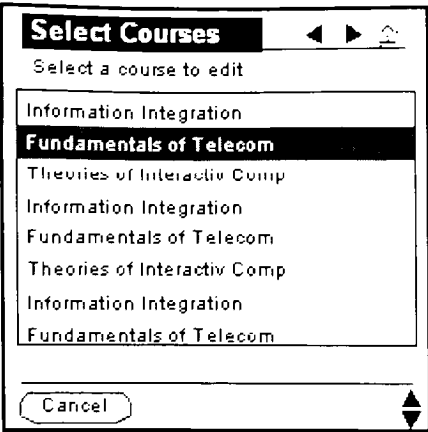
OK Add Course Save List


Course Grade

Fundamentals of Telecom


Course #	Sec #	CR	Term	Grade
0602 717	0	4	0	1


Done Add Grade




RIT 


myS·I·S

 Grad Requirements

 mySchedule

 **Registration**


1/25/2002 Last Day to Withdraw

Registration 

Registration Instructions

The mySIS Registration process consists of the following steps:


1. Select requirements
2. Connect to RIT to obtain availability
3. Select courses based on availability
4. Verify schedule
5. Submit registration request to RIT
6. Receive confirmation from RIT

Select Requirements 


▼ All Categories ▼ Need

- 0602 860 Enabling Tech & Trends
- 0604 742 Interactive Multimedia Design
- 0602 850 Network Planning & Control
- 0602 855 Telecom Policy & Standards


HR
8

Connect to RIT 


DCE Login

Connect to RIT 

SIS Login

Connect to RIT 


Sync with RIT

Select Courses 

▼ All Categories


Course #	Sec #	Map	Avail	Days	From	To
<input type="checkbox"/> 0602 860	70	30	10	W	6:00P	9:00P
<input type="checkbox"/> 0602 860	01	30	2	F	9:00A	9:50A
<input type="checkbox"/> 0602 855	02	18	3	TR	11:00A	11:50A
<input type="checkbox"/> 0602 860	70	30	6	MW	6:00P	9:20P

These courses are open **HR**
0

Verify Schedule 

Course #	Days	Time
<input type="checkbox"/> 4002 590 01	T R	4:00 5:30
<input type="checkbox"/> 4004 739 01	M W	2:00 3:30
<input type="checkbox"/> 4004 742 01	T R	4:00 5:30
<input type="checkbox"/> 4002 734 01	R	6:00 9:50

The selected courses will be added **HR**
0

Registration 

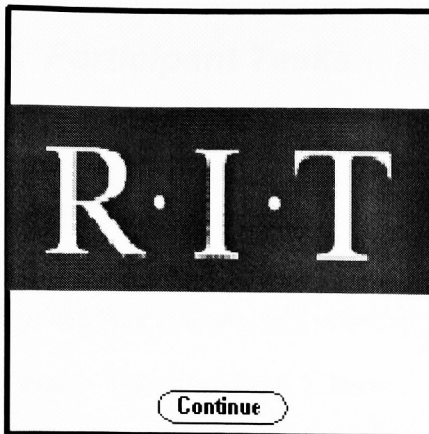
You will now be connected with RIT to have your registration request processed.

RIT Confirmation ◀ ▶ 📄

	<u>Course #</u>	<u>Days</u>	<u>Time</u>	
R	4002 590 01	T R	4:00	5:30
R	4004 739 01	M W	2:00	3:30
	4004 748 01	T R	4:00	5:30
R	4002 734 01	R	6:00	9:50

Accepted: 1/18/2002 1:01:54 PM **HR**
0

OK



myRequirements

Select course title to edit class

All	Summary	Prereq	Core	1st Conc	2nd Conc
Fundamentals of Comp Hard		Prereq	Core	1st Conc	2nd Conc
Fundamentals of Telecom		Core	Core	1st Conc	2nd Conc
Fundamentals of Interact		Core	Core	1st Conc	2nd Conc
Current Themes in Info Tech		Core	Core	1st Conc	2nd Conc
Enabling Tech & Trend in Te		1st Conc	Core	1st Conc	2nd Conc
Interactive Multimedia		2nd Conc	Core	1st Conc	2nd Conc
Network Planning & Control		2nd Conc	Core	1st Conc	2nd Conc
Programming I		Prereq	Core	1st Conc	2nd Conc
Programming II		Prereq	Core	1st Conc	2nd Conc
Programming for Interact M		2nd Conc	Core	1st Conc	2nd Conc

Cancel Add Class

Course	Instructor	Location	Description
Title:	Seminar in UG App Comps		
Course #:	4002 590		
Section:	01		
Term:	Fall	Winter	Spring Summer
Hours:	0	1	2 3 4
Category:			

RIT

my S · I · S

- myRequirements
- mySchedule
- Registration

2/4/2002 Registration Begins, Year 2

J. Participant Tasks – Palm

I will be giving you a series of tasks that are typical to the on-line registration system currently used by students attending Rochester Institute of Technology.

I will not answer questions about how the tasks should be accomplished; I am observing how you use this system, and whether or not it is easy to use.

Task I: Register for 2 Classes

Scenario:	You are a returning student to RIT and received notice that the registration period for Spring quarter just opened. You only have 20 credits remaining and want to ensure you get the classes you need. To save time you decide to register for these classes by using your palm pilot.
Task:	<p>Using the palm pilot prototype, register for the following courses:</p> <ul style="list-style-type: none"> ➤ Course Title: Telecom Policy & Stnds Course #: 0602 855 Section #: 02 ➤ Course Title: Thesis Course No: 0602 971 Section #: 01

Task II: Reference your Schedule

Scenario:	Your boss is making next weeks schedule and asks you when you will be available to work, since you will be back in school for Winter Quarter. You pull out your palm pilot to check your schedule.
Task:	<p>Using the palm pilot prototype, check your schedule for the following:</p> <ul style="list-style-type: none"> ➤ What days are you available to work? ➤ When is Enabling Technology & Trends scheduled for? ➤ Who is the Instructor for Network Planning & Control

Task III: Drop a Course

Scenario:	While checking out your schedule for your boss, you realize that you are only scheduled for one class on Mondays. You decide to drop this class so you can work a full shift to save for Spring Break.
Task:	Using the palm pilot prototype, drop the following course: ➤ Course Title: Fund of Interact Multimedia Course #: 0604 741 Section #: 01

K. QUIS Questionnaire

User Evaluation of RIT's mobile registration system

Date: _____

Name: _____

Please circle the numbers which most appropriately reflect your impressions about using this prototype.
Not Applicable = NA.

Overall reactions to the system:	unimpressive 1 2 3 4 5 6 7 8 9	impressive	NA
	frustrating 1 2 3 4 5 6 7 8 9	satisfying	NA
	dull 1 2 3 4 5 6 7 8 9	stimulating	NA
	difficult 1 2 3 4 5 6 7 8 9	easy	NA
	ineffective 1 2 3 4 5 6 7 8 9	powerful	NA
	rigid 1 2 3 4 5 6 7 8 9	flexible	NA

PART A: Screen

1. Characters on the computer screen	hard to read 1 2 3 4 5 6 7 8 9	easy to read	NA
1.1 Image of characters	fuzzy 1 2 3 4 5 6 7 8 9	sharp	NA
1.2 Character shapes (fonts)	barely legible 1 2 3 4 5 6 7 8 9	very legible	NA
1.3 Contrast with the background	irritating 1 2 3 4 5 6 7 8 9	pleasing	NA
2. Screen layouts make task easier	never 1 2 3 4 5 6 7 8 9	always	NA
2.1 Amount of information displayed on screen	inadequate 1 2 3 4 5 6 7 8 9	adequate	NA
2.2 Arrangement of information on screen	illogical 1 2 3 4 5 6 7 8 9	logical	NA

2.3	Consistent arrangement of information	never 1 2 3 4 5 6 7 8 9	always 1 2 3 4 5 6 7 8 9	NA
3.	Sequence of screens	confusing 1 2 3 4 5 6 7 8 9	clear 1 2 3 4 5 6 7 8 9	NA
3.1	Next screen in a sequence	unpredictable 1 2 3 4 5 6 7 8 9	predictable 1 2 3 4 5 6 7 8 9	NA
3.2	Going back to the previous screen	difficult 1 2 3 4 5 6 7 8 9	easy 1 2 3 4 5 6 7 8 9	NA
3.3	Going back to the main screen	difficult 1 2 3 4 5 6 7 8 9	easy 1 2 3 4 5 6 7 8 9	NA
3.5	Knowing where you are in the task (what you have done, and what you need to do)	confusing 1 2 3 4 5 6 7 8 9	clearly marked 1 2 3 4 5 6 7 8 9	NA
4.	Screen items are easy to select	never 1 2 3 4 5 6 7 8 9	always 1 2 3 4 5 6 7 8 9	NA
4.1	Items are easy to find	never 1 2 3 4 5 6 7 8 9	always 1 2 3 4 5 6 7 8 9	NA
4.2	Size of item selection area (size is enough)	too small 1 2 3 4 5 6 7 8 9	large 1 2 3 4 5 6 7 8 9	NA
4.3	Knowing whether an item is selected	difficult 1 2 3 4 5 6 7 8 9	easy 1 2 3 4 5 6 7 8 9	NA
4.4	System responds to selection when Stylus is pulled away from screen	unreliably 1 2 3 4 5 6 7 8 9	reliably 1 2 3 4 5 6 7 8 9	NA

Please write your comments about the screens here:

PART B: Terminology and System Information

5.	Use of terms throughout system	inconsistent 1 2 3 4 5 6 7 8 9	consistent 1 2 3 4 5 6 7 8 9	NA
5.1	Screen headings	inconsistent 1 2 3 4 5 6 7 8 9	consistent 1 2 3 4 5 6 7 8 9	NA

5.2	Terms on the screen (item labels)	ambiguous 1 2 3 4 5 6 7 8 9	precise 1 2 3 4 5 6 7 8 9	NA
6.	Messages (feedback) which appears on screen	inconsistent 1 2 3 4 5 6 7 8 9	consistent 1 2 3 4 5 6 7 8 9	NA
6.1	Location of messages on the screen	inconsistent 1 2 3 4 5 6 7 8 9	consistent 1 2 3 4 5 6 7 8 9	NA
7.	Instructions to the user	confusing 1 2 3 4 5 6 7 8 9	clear 1 2 3 4 5 6 7 8 9	NA
7.1	Instructions for commands or choices	confusing 1 2 3 4 5 6 7 8 9	clear 1 2 3 4 5 6 7 8 9	NA
7.2	Instructions for correcting errors	confusing 1 2 3 4 5 6 7 8 9	clear 1 2 3 4 5 6 7 8 9	NA
8.	System keeps you informed about what it is doing	never 1 2 3 4 5 6 7 8 9	always 1 2 3 4 5 6 7 8 9	NA
8.1	Performing an operation leads to a predictable result	never 1 2 3 4 5 6 7 8 9	always 1 2 3 4 5 6 7 8 9	NA
8.2	User can control amount of feedback	impossible 1 2 3 4 5 6 7 8 9	easy 1 2 3 4 5 6 7 8 9	NA
9.	Error messages	unhelpful 1 2 3 4 5 6 7 8 9	helpful 1 2 3 4 5 6 7 8 9	NA
9.1	Error messages clarify the problem	never 1 2 3 4 5 6 7 8 9	always 1 2 3 4 5 6 7 8 9	NA
9.2	Phrasing of error messages	unpleasant 1 2 3 4 5 6 7 8 9	pleasant 1 2 3 4 5 6 7 8 9	NA

Please write your comments about terminology and system information here:

PART C: Learning

10. Learning to operate the system	difficult 1 2 3 4 5 6 7 8 9	easy 1 2 3 4 5 6 7 8 9	NA
10.1 Getting started	difficult 1 2 3 4 5 6 7 8 9	easy 1 2 3 4 5 6 7 8 9	NA
10.2 Learning advanced features	difficult 1 2 3 4 5 6 7 8 9	easy 1 2 3 4 5 6 7 8 9	NA
10.3 Time to learn to use the system	too long 1 2 3 4 5 6 7 8 9	just right 1 2 3 4 5 6 7 8 9	NA
11. Exploration of features by trial and error	discouraged 1 2 3 4 5 6 7 8 9	encouraged 1 2 3 4 5 6 7 8 9	NA
11.1 Exploration of features	uncomfortable 1 2 3 4 5 6 7 8 9	enjoyable 1 2 3 4 5 6 7 8 9	NA
11.2 Discovering new features	difficult 1 2 3 4 5 6 7 8 9	easy 1 2 3 4 5 6 7 8 9	NA
12. Remembering names and use of commands	difficult 1 2 3 4 5 6 7 8 9	easy 1 2 3 4 5 6 7 8 9	NA
12.1 Remembering specific rules about entering commands	difficult 1 2 3 4 5 6 7 8 9	easy 1 2 3 4 5 6 7 8 9	NA
13. Tasks can be performed in a straight-forward manner	never 1 2 3 4 5 6 7 8 9	always 1 2 3 4 5 6 7 8 9	NA
13.1 Number of steps per task	too many 1 2 3 4 5 6 7 8 9	just right 1 2 3 4 5 6 7 8 9	NA
13.2 Steps to complete a task follow a logical sequence	never 1 2 3 4 5 6 7 8 9	always 1 2 3 4 5 6 7 8 9	NA
13.3 Feedback on the completion of task	unclear 1 2 3 4 5 6 7 8 9	clear 1 2 3 4 5 6 7 8 9	NA

Please write your comments about learning here:

PART D: System Capabilities

14.	Correcting your mistakes	difficult 1 2 3 4 5 6 7 8 9	easy	NA
14.1	Correcting typos	complex 1 2 3 4 5 6 7 8 9	simple	NA
14.2	Ability to undo what you just did	inadequate 1 2 3 4 5 6 7 8 9	adequate	NA
15.	Ease of operation depends on your level of experience	never 1 2 3 4 5 6 7 8 9	always	NA
15.1	You can accomplish tasks knowing only a few commands	with difficulty 1 2 3 4 5 6 7 8 9	easily	NA
15.2	You can use features/shortcuts	with difficulty 1 2 3 4 5 6 7 8 9	easily	NA

Please write your comments about system capabilities here:

PART E: General Impressions

16.	Screens are aesthetically pleasing	not at all 1 2 3 4 5 6 7 8 9	very much	NA
16.1	Screen designs and layout are attractive	not at all 1 2 3 4 5 6 7 8 9	very much	NA
16.2	Use of colors	unattractive 1 2 3 4 5 6 7 8 9	attractive	NA
17.	System is impressive	never 1 2 3 4 5 6 7 8 9	always	NA
17.1	System can do a great deal	not at all 1 2 3 4 5 6 7 8 9	very much so	NA
17.2	Such a system at school would be	useless 1 2 3 4 5 6 7 8 9	very useful	NA
18.	System is fun to use	not at all 1 2 3 4 5 6 7 8 9	very much so	NA
18.1	System maintains ones interest	never	always	

		1 2 3 4 5 6 7 8 9	NA
18.2	System would remain interesting	unlikely likely 1 2 3 4 5 6 7 8 9	NA
19.	System is useful	not at all very much so 1 2 3 4 5 6 7 8 9	NA
19.1	System would support my registration needs	not at all very much so 1 2 3 4 5 6 7 8 9	NA
19.2	System content is specific to my needs (personalized)	not at all very much so 1 2 3 4 5 6 7 8 9	NA

Please write your comments about general impressions here:

PART F: Other Reactions, Impressions, and Comments

L. QUIS Questionnaire - Results

Overall Reaction

Question #	Test Factor	Scale	
		1	9
A	How impressed they were with the system	unimpressive	impressive
B	Satisfaction with the system	frustrating	satisfying
C	How stimulated they were with the system	dull	stimulating
D	Ease of use	difficult	easy
E	Perceived "power" of the system	ineffective	powerful
F	Flexibility of the system	rigid	flexible

Summary Statistics

n	MEAN	STDEV	MIN	MAX
5	8.00	0.7071	7	9
5	8.00	0.7071	7	9
4	7.50	1.0000	7	9
5	8.20	0.8367	7	9
5	8.00	0.7071	7	9
5	7.80	0.8367	7	9

Participants

Normal Distribution

P1	P2	P3	P4	P5	P6	+1	-1
8	7	8	NA	9	8	8.7071	7.2929
8	8	7	NA	9	8	8.7071	7.2929
7	7	7	NA	9	NA	8.5000	6.5000
8	8	7	NA	9	9	9.0367	7.3633
8	8	7	NA	9	8	8.7071	7.2929
8	7	7	NA	9	8	8.6367	6.9633

PART A: Screen

Question #	Test Factor	Scale	
		1	9
1.0	Characters on the computer screen	hard to read	easy to read
1.1	Image of characters	fuzzy	sharp
1.2	Character shapes (fonts)	barely legible	very legible
1.3	Contrast with the background	irritating	pleasing
2.0	Screen layouts make task easier	never	always
2.1	Amount of information displayed on screen	inadequate	adequate
2.2	Arrangement of information on screen	illogical	logical
2.3	Consistent arrangement of information	never	always
3.0	Sequence of screens	confusing	clear
3.1	Next screen in a sequence	unpredictable	predictable
3.2	Going back to the previous screen	difficult	easy
3.3	Going back to the main screen	difficult	easy
3.4	Knowing where you are in the task (what you have done, and what you need to do)	confusing	clearly marked
4.0	Screen items are easy to select	never	always
4.1	Items are easy to find	never	always
4.2	Size of item selection area (size is enough)	too small	large
4.3	Knowing whether an item is selected	difficult	easy
4.4	System responds to selection when Stylus is pulled away from screen	unreliably	reliably

Summary Statistics				
n	MEAN	STDEV	MIN	MAX
6	8.00	1.2649	6	9
6	8.17	0.9832	7	9
6	8.17	0.9832	7	9
6	8.17	0.9832	7	9
6	8.33	0.8165	7	9
6	8.33	0.8165	7	9
6	8.00	0.6325	7	9
6	8.17	0.4082	8	9
6	7.50	1.3784	5	9
6	7.83	0.7528	7	9
6	7.67	0.5164	7	8
6	8.50	0.5477	8	9
6	8.00	0.6325	7	9
6	8.00	0.6325	7	9
6	7.83	0.7528	7	9
6	7.83	0.7528	7	9
6	7.67	1.0328	6	9
2	7.00	1.4142	6	8

Participants						Normal Distribution	
P1	P2	P3	P4	P5	P6	+1	-1
6	7	9	8	9	9	9.2649	6.7351
7	8	9	7	9	9	9.1499	7.1835
7	8	9	7	9	9	9.1499	7.1835
7	8	9	7	9	9	9.1499	7.1835
8	7	9	9	9	8	9.1498	7.5168
8	7	8	9	9	9	9.1498	7.5168
8	7	8	8	9	8	8.6325	7.3675
8	8	8	8	9	8	8.5749	7.7584
8	7	8	5	9	8	8.8784	6.1216
8	7	8	7	9	8	8.5861	7.0806
8	7	8	7	8	8	8.1831	7.1503
8	8	9	8	9	9	9.0477	7.9523
8	7	8	8	9	8	8.6325	7.3675
8	8	8	7	9	8	8.6325	7.3675
8	7	8	7	9	8	8.5861	7.0806
8	7	9	8	7	8	8.5861	7.0806
8	6	8	7	9	8	8.6995	6.6339
NA	6	8	NA	NA	NA	8.4142	5.5858

PART B: Terminology & System Information

Question #	Test Factor	Scale	
		1	9
5.0	Use of terms throughout system	inconsistent	consistent
5.1	Screen headings	inconsistent	consistent
5.2	Terms on the screen (item labels)	ambiguous	precise
6.0	Messages (feedback) which appears on screen	inconsistent	consistent
6.1	Location of messages on the screen	inconsistent	consistent
7.0	Instructions to the user	confusing	clear
7.1	Instructions for commands or choices	confusing	clear
7.2	Instructions for correcting errors	confusing	clear
8.0	System keeps you informed about what it is doing	never	always
8.1	Performing an operation leads to a predictable result	never	always
8.2	User can control amount of feedback	impossible	easy
9.0	Error messages	unhelpful	helpful
9.1	Error messages clarify the problem	never	always
9.2	Phrasing of error messages	unpleasant	pleasant

Summary Statistics				
n	MEAN	STDEV	MIN	MAX
6	8.00	0.6325	7	9
6	8.00	0.6325	7	9
6	8.33	0.5164	8	9
6	8.17	0.7528	7	9
6	8.17	0.7528	7	9
5	7.60	0.8944	7	9
5	8.00	0.7071	7	9
3	8.33	0.5774	8	9
4	7.25	1.7078	5	9
6	8.33	0.5164	8	9
3	7.67	1.5275	6	9
2	8.50	0.7071	8	9
2	8.50	0.7071	8	9
2	8.00	1.4142	7	9

Participants						Normal Distribution	
P1	P2	P3	P4	P5	P6	+1	-1
8	7	8	8	9	8	8.6325	7.6325
8	7	8	8	9	8	8.6325	7.6325
8	8	8	8	9	9	8.8497	8.5164
8	7	8	8	9	9	8.9194	7.7528
8	7	8	8	9	9	8.9194	7.7528
NA	7	8	7	9	7	8.4944	7.8944
8	NA	8	8	9	7	8.7071	7.7071
NA	NA	8	8	9	NA	8.9107	8.5774
NA	5	8	7	9	NA	8.9578	6.7078
8	8	8	8	9	9	8.8497	8.5164
NA	NA	NA	6	9	8	9.1942	7.5275
NA	NA	NA	8	9	NA	9.2071	8.7071
NA	NA	NA	8	9	NA	9.2071	8.7071
NA	NA	NA	7	9	NA	9.4142	8.4142

PART C: Learning

Question #	Test Factor	Scale	
		1	9
10.0	Learning to operate the system	difficult	easy
10.1	Getting started	difficult	easy
10.2	Learning advanced features	difficult	easy
10.3	Time to learn to use the system	too long	just right
11.0	Exploration of features by trial and error	discouraged	encouraged
11.1	Exploration of features	uncomfortable	enjoyable
11.2	Discovering new features	difficult	easy
12.0	Remembering names and use of commands	difficult	easy
12.1	Remembering specific rules about entering commands	difficult	easy
13.0	Tasks can be performed in a straight-forward manner	never	always
13.1	Number of steps per task	too many	just right
13.2	Steps to complete a task follow a logical sequence	never	always
13.3	Feedback on the completion of task	unclear	clear

Summary Statistics				
n	MEAN	STDEV	MIN	MAX
6	8.17	0.4082	8	9
6	8.17	0.4082	8	9
3	8.00	1.0000	7	9
5	8.20	0.4472	8	9
4	8.00	0.8165	7	9
5	8.00	0.7071	7	9
5	8.00	0.7071	7	9
6	8.33	0.5164	8	9
6	8.17	0.7528	7	9
6	8.17	0.4082	8	9
6	8.17	0.7528	7	9
6	8.33	0.5164	8	9
5	8.00	1.2247	6	9

Participants						Normal Distribution	
P1	P2	P3	P4	P5	P6	+1	-1
8	8	8	8	9	8	8.5749	8.4082
8	8	8	8	9	8	8.5749	8.4082
NA	NA	8	7	9	NA	9.0000	8.0000
NA	8	8	8	9	8	8.6472	8.4472
NA	NA	8	7	9	8	8.8165	7.8165
NA	7	8	8	9	8	8.7071	7.7071
NA	7	8	8	9	8	8.7071	7.7071
8	8	8	8	9	9	8.8497	8.5164
8	7	8	9	9	8	8.9194	7.7528
8	8	8	8	9	8	8.5749	8.4082
8	7	9	8	9	8	8.9194	7.7528
8	8	9	8	9	8	8.8497	8.5164
8	6	9	8	9	NA	9.2247	7.2247

PART D: System Capabilities

Question #	Test Factor	Scale	
		1	9
14.0	Correcting your mistakes	difficult	easy
14.1	Correcting typos	complex	simple
14.2	Ability to undo what you just did	inadequate	adequate
15.0	Ease of operation depends on your level of experience	never	always
15.1	You can accomplish tasks knowing only a few comands	with difficulty	easily
15.2	You can use features shortcuts	with difficulty	easily

Summary Statistics

n	MEAN	STDEV	MIN	MAX
4	8.25	0.5000	8	9
2	8.00	0.0000	8	8
4	8.50	0.5774	8	9
6	7.17	2.5626	2	9
6	8.00	0.0000	8	8
4	7.50	0.5774	7	8

Participants**Normal Distribution**

P1	P2	P3	P4	P5	P6	+1	-1
NA	NA	8	8	9	8	8.7500	8.5000
NA	NA	8	8	NA	NA	8.0000	8.0000
NA	NA	8	9	9	8	9.0774	8.5774
2	8	8	8	9	8	9.7292	4.5626
8	8	8	8	8	8	8.0000	8.0000
NA	7	8	8	7	NA	8.0774	7.5774

PART E: General Impressions

Question #	Test Factor	Scale	
		1	9
16.0	Screens are aesthetically pleasing	not at all	very much
16.1	Screen designs and layout are attractive	not at all	very much so
16.2	Use of colors	unattractive	attractive
17.0	System is impressive	never	always
17.1	System can do a great deal	not at all	very much so
17.2	Such a system at school would be	useless	very useful
18.0	System is fun to use	not at all	very much so
18.1	System maintains ones interest	never	always
18.2	System would remain interesting	unlikely	likely
19.0	System is useful	not at all	very much so
19.1	System would support my registration needs	not at all	very much so
19.2	System content is specific to my needs (personalized)	not at all	very much so

Summary Statistics				
n	MEAN	STDEV	MIN	MAX
6	7.67	1.0328	6	9
6	7.67	1.2111	6	9
6	7.67	1.2111	6	9
6	8.33	0.5164	8	9
6	7.67	1.0328	6	9
6	8.50	0.5477	8	9
6	7.17	2.2286	3	9
6	8.00	0.8944	7	9
6	7.67	1.2111	6	9
6	8.33	0.5164	8	9
6	8.33	0.8165	7	9
6	8.33	0.8165	7	9

Participants						Normal Distribution	
P1	P2	P3	P4	P5	P6	+1	-1
6	8	9	7	8	8	8.6995	7.0328
6	7	9	7	9	8	8.8777	7.2111
6	7	9	7	8	9	8.8777	7.2111
8	8	8	8	9	9	8.8497	8.5164
8	7	8	8	9	6	8.6995	7.0328
8	8	9	8	9	9	9.0477	8.5477
8	7	9	7	9	3	9.3953	5.2286
8	7	9	7	9	8	8.8944	7.8944
8	7	9	7	9	6	8.8777	7.2111
8	8	9	8	9	8	8.8497	8.5164
8	8	9	7	9	9	9.1498	7.8165
8	8	9	7	9	9	9.1498	7.8165

M. Facilitator Script – Contextual Interview

Hi, my name is Lynn Gordon, I will be facilitating this session.

Background

I am working to complete my requirements to obtain my Masters Degree in Information Technology from Rochester Institute of Technology. My final requirement is the completion of a Thesis project. My Thesis project is looking at:

“Developing an existing web application for a Palm Pilot.”

The existing web application I chose to look at is the on-line registration system used at Rochester Institute of Technology.

User Participation

I have selected you to participate in my Thesis because I believe that your background is representative of the typical user of the system I am evaluating. The first thing I will have you complete is a Participant Profile. This profile consists of 20 questions which will be used to confirm that you fit the user profile of a person who would use the registration system and would be likely to benefit from a mobile version of this application.

You may be needed to participate in additional sessions. Each session you are asked to participate in should take no longer than ½ hour of your time. At the top of the profile is a release statement. Your signature gives me permission to have you participate in my study. If after reading the statement you choose not to participate, this will end our session.

I will be using a tape recorder to record our sessions. These tapes will not be shared and will only be used to assist me in capturing our sessions.

Session 1

As part of my Thesis, this session is referred to as the Contextual Interview. The rules for this type of interview is as follows:

- You will be conducting a set of tasks which I will give you
- I will be observing you while you complete the tasks
- I will be taking notes while I am observing
- I encourage you to ask questions
- I may interrupt whenever I see something of interest
- While trying to work out any task which may be unclear, I encourage you to talk out loud the thoughts you are having

Materials

I will provide you with the following:

1. A packet of material which might be of assistance when completing each task
2. Task to be completed (written and spoken)

N. Facilitator Script – Prototype Interview

Hi, my name is Lynn Gordon, I will be facilitating this session.

Background

I am working to complete my requirements to obtain my Masters Degree in Information Technology from Rochester Institute of Technology. My final requirement is the completion of a Thesis project. My Thesis project is looking at:

“Developing an existing web application for a Palm Pilot.”

The existing web application I chose to look at is the on-line registration system used at Rochester Institute of Technology.

User Participation

You are being asked to participate in an additional session. This session is referred to as the Prototype Interview.

This session should take no longer than ½ hour of your time

Once again, I will be using a tape recorder to record this. These tapes will not be shared and will only be used to assist me in capturing our sessions.

Session 1 – Contextual Interview

During the first session, you were asked to partake in a Contextual Interview. During this session you were:

- Asked to complete a set of tasks
- Observed completing the tasks
- Encouraged to ask questions
- Interrupted whenever something of interest occurred
- Encouraged to vocalize the thoughts you were having

Session 2 – Prototype Interview

The goal of session 2 is to find out why the interface design I have developed works or doesn't work for you. During this session we will work together to discover issues associated with this design.

During this session:

- You will be asked to interact with the prototype to complete a set of tasks
- While completing these tasks, you are encouraged to communicate your expectations for that task (Critique whether or not the design works for you!)
- You are encouraged to raise problems or suggest different ways to do things
- I will act as your guide and will try to offer alternative solutions to any issues you may discover

My goal is to find out whether or not the prototype matches your expectations.

At the end of the session, you will be asked to complete a questionnaire. This questionnaire will be used to measure your subjective satisfaction with specific aspects of the mobile registration system.

Materials

- Task to be completed (written and spoken)
- Questionnaire for User Interaction Satisfaction

O. User Environment Model – Final

