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# Human Computer Interaction: A study of preferences between Electronic Commerce Interface (ECI) and Mainframe Text-based Travel Expense System

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## ABSTRACT

One of the major drawbacks of traditional computing is that it casts business processes in concrete, in other words in hard-to-change hardware and software. By modularizing systems into client and server portions, new technology and new software components can be added more easily without affecting the rest of the system, as well as altering the user perception of the interface. On the other hand, microcomputer based interfaces provide low-cost of entry and relative independence from centralized information systems (IS) operations. Modern graphical user interfaces and menu selection by mouse clicks have become the common method for working with pulldown and pull-up menus, in addition to dialogue boxes containing radio buttons, object boxes, text-entry fields, and scrollable list of choices. The graphical environment allows more information to be conveyed in the menu through the use of modern graphical user interfaces as compared to mainframe based static interfaces. The usability test conducted by Burkhart, Hemphill, and Jones (1994) comparing a static based user interface to a GUI interface showed an improved performance of 56% over static based user interface.

**Keywords-** *Mainframe, GUI, Client/Server, Usability, QUIS*

## 1. INTRODUCTION

This research reports on a company that was in the process of introducing Electronic Commerce Travelers Interface System (ECTIS) front end to replace Mainframe text based application system. The two main reasons for deploying the Front-end are: (1) to allow traveling employees to enter their business travel expense remotely, and (2) to improve the friendliness of capturing employee travel expense data in order to persuade traveling employees to enter their own travel expense report. The mainframe base application used for processing employee business expenses, resides on a Unisys A-Series platform. The mainframe is accessible only within the company subsidiary offices. Due to security reasons, the mainframe cannot be accessed remotely (dial-up capability), other than through the company proprietary network. This poses severe restrictions to traveling employees, who are away for several weeks at a time and cannot submit their expense reports weekly. Company employees pay for their travel expenses up-front, then they submit an expense report. Employees are allowed to request a travel advance, but in most cases it takes about two weeks to get it approved. Thus, most employees prefer to use the corporate credit card. It should be noted that it is the employee's responsibility to pay the credit card agency directly. In any case, it is the employee responsibility to bear the expense and later receive reimbursement from the company. Once, the Chapter Three presents a detailed design of the study, including the methods of data collection and the variables to be tested.

## 2. REVIEW OF RELATED LITERATURE

The following review of the literature investigates key human motivators of GUI process applications in relation to conventional text base applications. In essence, are the "system incentives" sufficient for employees to adopt the GUI process application rather than continuing to use their staff for entering employees travel expenses? First, this research investigated the GUI characteristics that facilitate simplification and interface "incentives," such as intuitiveness and straightforwardness aspects that makes it easier to enter travel expense activity. Secondly, interface characteristics of conventional text-based applications will be addressed. Finally, results will be presented to support the presented research conducted.

### 2.1 Interface Intuitiveness

The objective of an application is to support users performing their business tasks. Properly designed graphical applications enable users to learn faster, experience less frustration, enjoy using their application, and improve their overall productivity. Nickerson (1986) related the cognitive interface to forms that information takes for purposes of exchange: menu, commands, and windowing. Shneiderman (1993) established several "golden rules of dialogue design" and conveyed the importance of the first golden rule which is to "strive for consistency." Shneiderman (1993) states that GUI interfaces must be consistent, simple to use, and flexible. The user must always be in control and the interface must be

responsive. The following GUI design principles are the keys to a successful GUI interfaces:

1. Shneiderman (1993) states that consistency is the way a user interface looks, and acts should be consistent throughout the application as well as among applications using similar GUI environment. Consistency helps users by reducing their memory load and helping them to learn the application more quickly. Marcus (1992) states that a good user interface should be designed with the following types of consistency:

**a) Procedural consistency**-A given action must be accomplished in the same way throughout the application.
**b) Physical consistency** - Menu items and objects must have a similar appearance location throughout the application.

**c) Behavioral consistency** -The results of a user's action must match the user's expectation. The content and sequence of commands should be similar across tasks.

**d) Lexical consistence** - A command should perform the same activity in all application modes. No other command should perform the same activity.

**e) External consistency** -The appearance and behavior of the interface should be consistent with upgrades, and follow-up applications should remain consistent with the existing application.

2. Shneiderman (1993) states that a user interface should be easy to learn and use. Shneiderman proposes the following design principles that should be inherent in GUI interfaces:

   a) The dialogs design should be designed in such a way that users do not have to remember entry sequences, formats, or other items. Dialogues should display all required or necessary information.
   b) Dialogs should only display information relevant to the user's current activity.
   c) Dialogs should provide cues so that the user always knows what to do next.
   d) Dialogs should provide shortcuts, keys, and macros so users can quickly execute commonly used functions.

3. Nickerson (1986) and Shneiderman (1993) state that GUI interfaces should be flexible, in order to provide menu based commands for novice users and equivalent shortcut commands for expert users. Also, GUI interfaces should provide various levels of on-line help to meet the needs of novice and experienced users. And finally, GUI interfaces should provide configuration options so that users can configure mouse tracking speed, volume, color, and font sizes.

4. Putting the user in control of the GUI interface increases user satisfaction and productivity. Ravden & Johnson (1989) provide the following principles of user control functions:

   a) GUI interface users should be able to initiate actions and control the interaction.
   b) Users should, be able to terminate any process without performing an action, implying that all dialog boxes should have a CANCEL button which closes the dialogue box without performing any further function.
   c) Also, users should be able to easily reverse any action performed.
   d) Users should be able to customize aspects of the user interface, such as color, and saving timeouts should be configurable.
   e) The interface should facilitate the user's tasks rather than calling attention to itself.

5. Shneiderman (1993) stated that GUI process should provide feedback whenever a user performs an action. For frequent and minor expense report is submitted, the company usually reimburses the employee within 2-3 working days. One major problem with this method is that traveling employees cannot submit their travel expenses on a weekly basis because they cannot access the mainframe via remote. Recognizing that mainframe application is somewhat archaic as compared to today's GUI technology. The company will introduce a Client/Server GUI process to the mainframe based application with the expectation that company travelers will enter their own expense report instead of going through the staff. In most cases, company business travelers send their expense receipts and notes to their secretary or assistant, who in turn enters the expense reports on their behalf. This action is contrary to company policy. The purpose of deploying this Client/Server front-end to the mainframe based travel expense system will be to allow remote access to the travel expense system on the mainframe via a GUI process. The later is intended to minimize the resistance of travelers in using the system themselves in accordance to company policy. Therefore, the purpose of this study is to determine if traveling employees will adopt the GUI interface to the travel expense system on the mainframe. Does the GUI interface have the built-in "human factors necessary for employees to adopt the GUI interface? The company intends to motivate employees to use the GUI interface themselves by making it easier to enter their travel expense themselves, rather than ousing staff to accomplish this task. "Human factors" is defined as the discipline that tries to optimize the relationship between technology and the human (Kantowitz & Sorkin, 1983).Galitz (1981) states that "human factors" involves systematically applying knowledge of people's sensory, physical, intellectual, and motivational attributes to the design of the equipment, software, tasks, documentation, and environment. This study is specifically concerned with investigating the "usability" acceptance for the conventional interface compared to the new ECI process.

#### 2.1.1 Mainframe Conventional Interface

Mainframe environments provide powerful software and relative ease of integration with other parts of the organizational information system. Professional support and standardized procedures ensure data integrity and smooth operations. Mitchell and Shneiderman (1989) outlined the following arguments for mainframe based interfaces:

a) A standard static user interface for architecture can reduce learning time if new applications adhere to the conventions of existing interface.
b) Users do not want to take the time to configure their own interface.
c) The user may not be able to develop a coherent model of the system if the system changes frequently.
d) The user may experience a "loss of control" when using a dynamic adaptive user interface.

## 3. RESEARCH METHODOLOGY

This section describes the hypotheses tested, the survey population, the instrument used, and the procedures used in data collection.

### 3.1 Background of the Project

This study was performed in conjunction with the deployment of the ECI interface within the Mexican subsidiary. First, the company for which this researcher used plans to deploy the ECI interface in the oversea subsidiary. Depending on the results, the ECI interface was supposed to be released throughout its subsidiaries.

### 3.2 Selection of the Population

It is a corporate directive that all employees within the Mexican subsidiary who travel on behalf of the company will use the new ECI interface to the travel expense system. All other travelers will continue to use the conventional travel expense interface. As a result, all 47 Mexican employees who will be traveling will be approached to participate in this study. All 53 non-traveling employees, those who will incur business expenses, will also be approached and asked to participate in this study. The intent is to gather information from both user groups, company travelers, and non-company travelers and gather usability satisfaction information for both the new ECI process and the conventional mainframe based interface.

### 3.3 Instrumentation

Hiltz (1983) states that there are many productive avenues for assessing user performance and attitudes. Shneiderman's Questionnaire for User Interface Satisfaction (QUIS) will be used for this study. There are several versions of the QUIS survey instrument, therefore, the long form, enhanced by the University of Maryland, will be used for this study (compare both user interfaces). Two distinct types of users will be evaluated: a) non-company travelers using the conventional mainframe interface, and b) company travelers using the new ECI interface. For non-company travelers who will be incurring business expenses, the QUTS survey instrument will be administered only once. For company travelers, the QUIS will be administered twice, once prior to the two-hour mandatory training and once after a 30 day use of the GUI instrumentation. The intent of this procedure is to determine the level of satisfaction on the mainframe conventional interface prior to exposing these test groups to the GUI module. Additional operational statistical information will be derived from the system itself. The ECI interface has the ability to capture dialogue access, the number of times an error is prompted to the user, what type of assistance the user requests most; time delay in completing a business expense transaction, and so forth. The mainframe based application also has the ability to capture operational information. Statistical analysis will be performed on the two distinct groups; non-business travelers who will incur business expense and the company business travelers. The QUIS administered to non-travelers will provide a measure of user satisfaction for the mainframe conventional interface. To corroborate the validity of statistical user satisfaction findings for non-travelers, system operational statistical data will be used as well. As stated previously, for company business travelers, the QUIS will be administered twice, one prior to the employee training of the GUI interface and once after a 30 day usage. The purpose of the first QUIS survey will be to determine the level of satisfaction with the mainframe based interface; it will be the same for travelers as for non-travelers. Again, system operational captured statistics will be used to corroborate the findings. The second QUIS questionnaire will be used to determine the satisfaction level of company business travelers with the new GUI process. Also, operational statistical captured data from the ECI process will be used to corroborate the QUIS survey results.

## 4. RESULTS AND DISCUSSION

The ratings of CLS and ECI were compared in an item analysis, t-tests performed on the overall reaction and the main component questions revealed many differences (See Table 3). In general, all the MDA mean ratings were higher than CLS. All of the overall reaction items were significant, with the exception of "easy/difficult" and "inadequate power/adequate power" at the .00 1 level. Eight of the 21 main component items were significant at the .001 level: 1) "information organization," 2) "screen sequence," 3) "position of messages, 4) "status of computer," 5) "error messages," 6) "help," 7) "error correction," and 8) "experienced and inexperienced users."

**TABLE 1: Means of Ratings for Command Line System (CLS) vs. Menu Driven Application (ECI)**

| Overall Reaction to the System | CLS Mean | CLS Std.Dev | ECI Mean | ECI Std.Dev |
|---|---|---|---|---|
| 1. Terrible / Wonderful | 5.33 | 1.47 | 7.32 | 1.01 |
| 2. Frustrating / Satisfying | 5.03 | 1.91 | 6.84 | 1.50 |
| 3. Dull / Stimulating | 4.60 | 2.23 | 5.86 | 1.55 |
| 4. Difficult / Easy | 4.50 | 1.54 | 5.28 | 1.58 |
| 5. Rigidity / Flexibility | 4.88 | 2.19 | 6.85 | 1.54 |
| **SCREEN** Character on the screen (hard / easy) | 7.60 | 1.23 | 5.34 | 1.87 |
| Task simplification (at all / very ) | 6.73 | 1.82 | 5.48 | 1.36 |
| Screen Sequence ( confusing / clear) | 5.33 | 1.69 | 7.21 | 1.11 |
| **LEARNING** Operating the system (difficult / easy) | 3.35 | 1.67 | 5.04 | 2.21 |
| New features ( difficult / easy) | 4.33 | 2.21 | 5.56 | 1.97 |
| Use of Command ( difficult / easy) | 4.44 | 2.18 | 5.01 | 2.33 |
| Performed task in straight-forward manner (yes / no) | 4.72 | 2.98 | 6.54 | 1.34 |
| Help message on the screen (unhelpful / helpful) | 3.38 | 2.14 | 5.83 | 1.66 |
| Reference material (confusing / clear) | 4.30 | 2.27 | 5.88 | 1.62 |

**(Table 1 cont.) SYSTEMS CAPABILITY**

| | | | | |
|---|---|---|---|---|
| System speed (too slow / fast) | 5.31 | 2.38 | 6.85 | 1.37 |
| Reliability (unreliable /reliable) | 7.18 | 1.76 | 7.47 | 1.38 |
| Corrections (difficult / easy) | 5.24 | 2.01 | 7.44 | 1.29 |
| Consideration for users' need (never / always) | 3.84 | 2.11 | 6.01 | 1.52 |

The results show that the questionnaire has maintained a high degree of reliability as the number of items were decreased in successive versions. The low variability of the reliability values of each item indicates a high degree of stability. The factor analysis revealed that both the learning and terminology sections of the questionnaire corresponded well with the latent factors. System capability questions appeared to break down into two different factors: one concerning the system output and the other focusing on system characteristics. However, two questions concerning error messages and highlighting on the screen did not seem to fit any category. The item analysis using t-tests show that the QUIS has good relashionship in the overall reaction ratings between the follows pairs: 1) like vs. dislike and 2) command line system vs. menu driven application. Both like and ECI ups had consistently higher ratings compared to dislike and CLS groups, respectively.

Although there were strong differences found between like vs. dislike and CLS vs. ECI the overall reactions, more significant differences were found between CLS vs. ECI the specific main component questions in comparison to the liked vs. dislike group. The lack of significant differences in the like vs. dislike groups in the specific main component questions may be due to evaluating a large number of different software products. Each product differs in its strengths and weaknesses. The aggregation of the evaluations of different products that were may have canceled the rating differences between like and disliked groups in the 21 main component questions.

There are many reasons why ECI was rated higher than CLS. Shneiderman (1987) lists five advantages of MDA: 1) shortens learning, 2) reduces keystroke, 3) structure decision-making, 4) permits the use of dialog management, and 5) supports error handling well. Surprisingly, although CLS are known for their flexibility and appeal to "power" users (Shneiderman, 1987), the overall ratings of MDA suggests that these frequent and sophisticated PC users rated MDA more powerful and flexible than CLS. Although this study did not attempt to establish any construct or predictive validity. Future research on the QUIS should concentrate on this area. There are several reasons for the difficulty in

establishing validity. First, there is lack of theoretical constructs about interfaces to test the QUIS. Second, there few if any other established questionnaires to cross validate the findings of the QUIS. Future plans to establish validity of the questionnaire include the use of a standard interface to calibrate the QUIS ratings. Calibration of the QUIS can be accomplished by comparing successive ratings with corresponding degradations of the interface standard.

## 5. FUTURE APPLICATIONS

All previous questionnaires have been paper and pencil tasks. The media with which the questionnaires will be administered will be likely to change in many ways. Future questionnaires could be presented on computers to facilitate user evaluations of a computer system. Computerized questionnaires would allow tailoring of questions that are specific to particular systems as a supplement to the QUIS. Data collection on computers would eliminate data encoding errors and speed statistical analysis. At present a computerized version of the current questionnaire for the IBM PC has been implemented and distributed. Telephone questionnaires administered by computers may also be feasible. Currently there are specialized software/hardware packages for telemarketing.

These packages can easily be modified to automatically:

1) Dial a list of phone numbers at a designated time of the day,
2) Ask a set of prerecorded questions, and
3) Collect the respondent's answers (verbal or touchtone).

The advantages of telesurveys include:

1) The possibility of collecting data from a large and diverse population,
2) An automated and standardized orally presented questionnaire, and
3) A cost effective and convenient method of data collection. However, there are problems with telesurveys. People may not be very comfortable responding to a machine, thus, people may be less likely to agree to be respondents. Moreover, a tele-survey may be viewed as an unsolicited invasion of privacy. Nevertheless, automated tele-surveys may be an effective way to administer a questionnaire for future research centers at the University of Maryland.

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