Usability of ERP Error Messages

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Abstract— **Usability of complex information system like enterprise resource planning (ERP) system is still a challenging area. This is why many usability problems have been found in the ERP system. In this article, we tried to highlight the 21 usability problems in ERP error messages by using Nielsen's heuristics and inquiry questionnaire methods. Nielsen's heuristics is a better for finding a large number of unique usability problems in different areas. The inquiry questionnaire method has some constraints, but it is useful for comprehending how the actual end-users perceive an application.**

Keywords-component; Usability; Nielsen's heuristics method; Inquiry questionnaire method

I. INTRODUCTION

There has been a lack of research on the evaluation of complex information system such as the enterprise resource planning (ERP) system. Evaluating the ERP application is an emerging area and it is particularly challenging because of system complexity, business processes integration, and variability of users in different countries. Nowadays, it has become the fashion to use ERP and other systems like supply chain management and customer resource management in the industrial context. The ERP system has shown great promise but the benefits of cost saving, processes automation, declines in inventory, reduction in working capital, increased productivity and operational benefits of the organisation have been achieved in the face of daunting usability problems [1]. Some of the usability problems mentioned in the existing literature are transaction execution problems, identification and access to the correct functionality, lack of support in error situations, terminology problems, learnability problems and lack of ability to cut and paste [1,2].

Over the last 20 years, many usability evaluation methods (UEMs) – such as user centric, expert centric, inquiry based and analytical based methods – have been developed and implemented in order to improve human interaction with the product. The aim of these methods is to identify issues or areas of improvement for the interaction so that increased usability could be achieved [3]. The current usability evaluation method is shown in Figure 1.

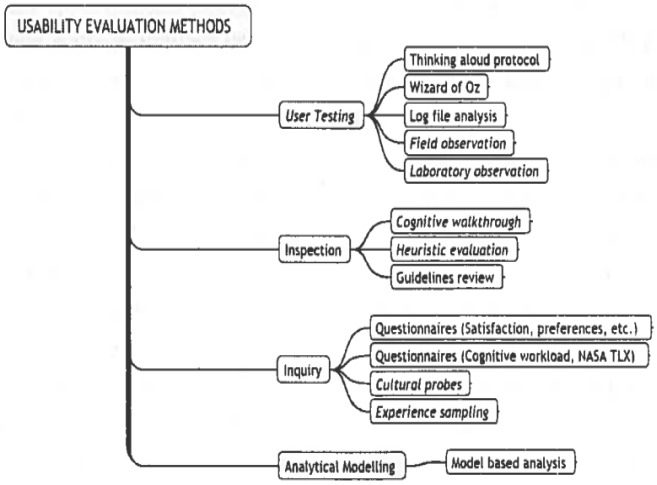

Figure 1. Usability evaluation method [4]

Four categories of usability evaluation methods are: user testing, inspection oriented, inquiry oriented and analytical modelling.

A. *User Testing*

This category includes a set of methods that involves users. The main purpose is to record the performance measurements to determine whether or not usability goals have been achieved. Usability testing in the laboratory has several advantages, for example the condition for conducting the test can be controlled and all participants share the same experience. By conducting usability in the field, it is possible to find the usability problems related to the context of use [3, 4].

B. *Inspection Based Methods*

The inspection based method involves a small group of evaluators identifying the usability problems. This kind of method is commonly used in industry because it is said to be fast and cheap. The usability inspection method does not take into account the contextual factors and the success of this method lies in the experts' ability to interpret and draw meaningful conclusions [3, 4].

C. *Inquiry Based Methods*

To evaluate user interfaces and applications, the inquiry evaluation method is used to survey user behaviour and usage of the system [4].

D. Analytical Modelling

The analytical modelling method was originally applied in the field of software engineering. For instance, it has been used for automatic testing, formal description of user and task models, model-based evaluations and critical incident analysis [4].

The above-mentioned usability evaluation methods have been mostly applied in other domains but there is lack of literature in the field of ERP application. For instance, various studies have applied user testing and heuristics evaluation methods in evaluating different types of user interfaces, such as commercial web sites [5], a hotel website [6], a web-based software program [7], a universal brokerage platform [8], software user interfaces [9], 3D educational software and 3D maps [10], an office application's drawing editor [11,12], a novel information retrieval interface [13], an interactive telephone-based interface [14] and e-commerce websites [3].

The main goal of this article was to find the usability problems in ERP error messages. For this purpose, we have used Nielsen's heuristics and inquiry questionnaire method. As a sub-goal, we also try to highlights the result of these methods by total number of usability problems found, usability area and their severity level. This paper has been organised as follows: Section 2 describes the research methodology; section 3 outlines the results of usability problems; section 4 discusses the usability area, and lastly Section 5 presents the conclusions of this study.

II. Research Methodology

In order to approach this research, we have used Nielsen's heuristics and inquiry questionnaire methods. One hosiery organisation from Pakistan was selected. This organisation has been utilizing the Oracle ERP system for the last seven years. They have implemented so called Module-by-module approach. In module-by-module approach, organisation first implements one module and then integrate it into an existing system before starting another module. In order to maintain the consistency with the result, we have used the same ERP organisation for Nielsen's heuristics and inquiry questionnaire. The overall research methodology can be seen in Figure 2.

To apply the Nielsen's heuristics, we first had to collect the real world error messages of the ERP application. It was a big challenge because the organisation didn't want to share this information. In order to collect the error messages, many call and reminder emails were sent to the people working in different departments of the organisations. The author also physically visited the organisation. As a result of this process, a total of eight error messages were collected. Three error messages were eliminated because of a similar types. Five error messages were selected for the purpose of heuristics evaluation. The details of the five error messages with ten Nielsen's heuristics are shown in Appendix A. The heuristics questionnaire consisted of three parts. The first part involved demographic questions designed to collect information about the respondents name, current position and number of heuristic. The second part consisted of Nielsen's heuristics and the scale for identifying usability problems. The third part consisted of five real world error messages collected from the organisation.

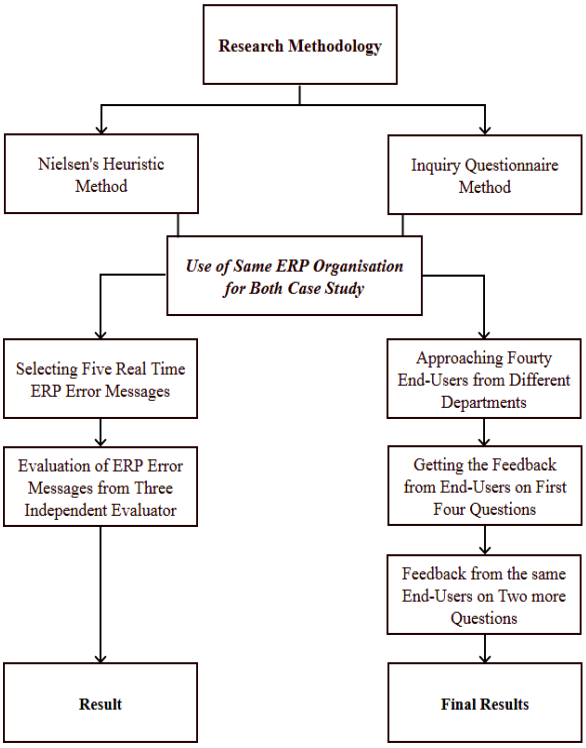

Figure 2. Research Methodology

To avoid any kind of bias, the authors of this article didn't participate in the evaluation process. Three independent evaluators from the University of Jyvaskyla (Finland), were selected. The details of the independent evaluators are shown in Table 1.

Table 1. Characteristics of independent Evaluators used for Nielsen's Heuristic method

Name	*Current Position*	*No. of Evaluations*
A	Postdoctoral Researcher	8-10
B	Ph.D. Student	5
C	Ph.D. Candidate	2

To get the feedback on the ERP error messages by using the inquiry questionnaire method, we selected 40 end-users from different departments of the organisation. All the end-users were full time employees working in this organisation. Of 40 end-user, 30 were male and 10 were female. The characteristics of the 40 end-users are outlined in Table 2.

Table 2. Characteristics of End-Users used for the Inquiry Questionnaire Method

Number of End-Users	*Department*	*Education*	*Experience with ERP*
10	Finance	BBA-MBA	1-5
10	Processing	BA-MA	1-4
10	Procurement	BA-MA	1-3
10	Finishing	BA-MA	1-6
Total: 40			

The inquiry questionnaire consisted of three parts. The first part involved demographic questions designed to collect the information about end-user, their education, certification, work experience and current working module. The second part involved four questions and one open ended question. The third part involved two more question. The end-users were approached twice during this process. They were approached at the beginning when there was a need to get feedback on the first four questions and one open-ended question. The questionnaire is presented in Appendix B (Questions (1-4) and one open-ended question). The end-users were approached again during the later stage when there was a need to get feedback on the last two questions (Appendix B: Question (5-6)). Question 5, and 6 were developed on the basis of the usability problems that were identified from Nielsen's heuristics method.

III. Results

This section highlights the usability problems found by Nielsen's heuristics and inquiry questionnaire methods.

A. Usability problems Identified by Nielsen's Heuristics

A total of 16 usability problems were identified by Nielsens's heuristics method. The list is as follow:

1) Several error messages windows are open simultaneously, it's confusing.

2) Too much information, it's not obvious what's the problem.

3) User does not necessarily perceive at what point the error has been made.

4) Red colour (bell-symbol) is informative, but the symbol is slightly confusing, it refers more to 'notice' than 'error'.

5) Provided information is expressed unclearly and by using system language rather than by using concepts that are familiar to the user.

6) It's not clear what is 'flex-value' (is it 'WIP_INTITY_ID' or 'VENDOR_ID' or something else?).

7) Possibility to compare error message's information to related information in the window behind is unclear.

8) It is not clear what 'ORA-01403' refers to; possibility to compare error message's information to related information in the window behind is unclear.

9) Error message is highly un-informational and there are no concepts familiar to the user.

10) The match between information in the note and information in the window behind is unclear.

11) The function of the message is unclear; what is the difference between 'note'- and 'error'-messages?

12) It's not clear whether the note refers to 'Quantity' or 'Destination type' field (in the window behind).

13) Not speaking the users' language.

14) Not helping users recognise, diagnose and recover from errors.

15) Irrelevant information.

16) Not following consistency and standards.

B. Usability problems Identified by Inquiry Questionnaire

The total number of usability problems identified by the inquiry questionnaire method was five. The feedback from 40 end-users with mean and median values is shown in Table 3. End-users were not able to give the feedback to Question 6. For one open ended question, they didn't mention any usability problem by themselves.

Table 3. Usability problems identified by Inquiry Questionnaire

	ERP Error Messages Questionnaire	***Mean***	***Median***
1	ERP application gives Error messages that are meaningful or non-technical?	2.1	2
2	ERP application gives Error messages that clearly tell me, what is the cause of problem?	1.97	2
3	ERP application gives Error messages that clearly tell me, how to fix the problem?	1.2	1
4	Whenever, I make a mistake using ERP application, I recover easily and quickly?	1.3	1
5	Simultaneously opening of several Error messages Windows are confusing in this ERP application?	2.89	3
6	Error messages generated from this ERP application follow the consistency and standard related to window operating system?	N/A	N/A

IV. Discussion

This section discusses the two methods in terms of total number of usability problems, usability area and severity level.

A. Total number of Usability Problems found

The total number of usability problems identified by Nielsen's heuristics and inquiry questionnaire method was 21. Nielsen's heuristics is more effective in identifying a large portion of problems in ERP error messages. A total of 16 usability problems were identified by Nielsen's heuristics method. On the other hand, the inquiry questionnaire method found only five usability problems and it was not effective in some cases. For instance, all the end-users were unable to reply and understand the following question:

"Q6. Error messages generated from this ERP application follow the consistency and standard related to the Windows operating system."

The reason behind this is firstly that the field of HCI is new in Pakistan. It is still hard to find bachelor or master degrees in the field of HCI at university level. The concept of HCI or usability has not been penetrated in universities as well as into the organisations level of Pakistan. Secondly, the end-user didn't get any computer literacy training related to ERP application. Third, they didn't know what kind of icons are used for error messages in the Windows operating system and the meaning of each of them. For instance, the icons used in Windows 7 and Vista are shown in Figure 3.

Figure 3. Standard Error, Warning, Information and Question Mark Icons [15]

The meaning of each icon is as follows [15]:
Standard Error Icon (Left most from Figure 3): The user interface (UI) is presenting an error or problem that has occurred.
Warning Icon: The UI is presenting a condition that might cause a problem in the future.
Information Icon: The UI is presenting useful information.
Question Mark Icon: The UI indicates a help entry point.

Now, let us look at the icon that was shown in the ERP error message window.

Figure 4. Icon Used in the ERP Error Message Window [16]

This icon is totally different from the Windows operating system and didn't follow any platform standard. In Nielsen's heuristics method, the independent evaluators successfully identified this usability problem.

B. Usability problems area and Severity level

Nielsen's heuristics evaluation method is more effective in identifying a large usability area, as compared to the inquiry questionnaire method. The problems found in different usability areas by the heuristics method include 'visibility of system status', 'match between system and the real world', 'user control and freedom', 'consistency and standards', 'error prevention', 'recognition rather than recall', 'aesthetic and minimalist design' and 'help users recognise, diagnose and recover from errors'. Within these areas, the evaluators were also able to identify unique usability problem, for instance "several error messages windows are open simultaneously, it's confusing". Table 5, presents the usability problem areas (with their severity level).

Table 5. Comparison of the Two Methods According to Usability Area and Severity level

Usability Area	Problems	NH	IQ
Visibility of System Status	Multiple Error messages Window is confusing	**1**	**3**
Consistency and Standards	Problems with Standard Icon	**2**	**N/A**
Match between System and Real World	Technical or Non-meaningful	**2**	**2**
Help Users Recognise, Diagnose and Recover from Errors	Cause of Error?	**2**	**2**
	How to Fix the Error?	**2**	**1**
	Recover from Error?	**2**	**1**

If we compare the above results, then there are some interesting points to note. First, from the evaluators' point of view, the opening of multiple error windows is a minor problem. However, it is a major problem from the end-users' point of view and this usability issue caused a lot of confusion for them. Second, the end-users are also more interested in knowing the cause of the problems rather than how to fix and recover from the errors.

V. CONCLUSION

Since the launching of the concept of usability, it has become more or less obvious requirement of interactive technology. More recently, subjective perception of the value of technology has largely superseded the traditional usability approach. The concept of user experience appears the currently dominant way to conceptualise user's perspective. The shift from quite objectively measured usability qualities to subjective issues reflects the change of information technology; in the past, industrial applications were in focus, stressing efficiency, error rates and other quantifiable characteristics. At the moment, in a contrary, much of the information technology deals with consumer products, which are important to be enjoyable and easy to adopt to guarantee commercial success. However, even if ICT-based consumer products seem to dominate the public image of digital technology, the need to produce effective and robust industrial applications has not diminished. We argue and demonstrate in the current study, that usability issues are as topical and essential in industry as ever.

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Appendix A

Heuristic Evaluation of ERP Error Messages

1	Name:
2	Current Position:
3	Number of Heuristic work done:

The purpose of this study work is to evaluate ERP error messages by using Nielsen's Heuristics. These real time error messages have been collected from one of the Hosiery Organisation of Pakistan. The findings of this study will help us to understand the usability problems and their severity level in ERP error message. All responses given will be treated with confidence. The result will be used for research purpose only and no attempt will be made to identify any individual in any publication. Please read 5 Error messages and do Severity rank (0 to 3) in your opinion.

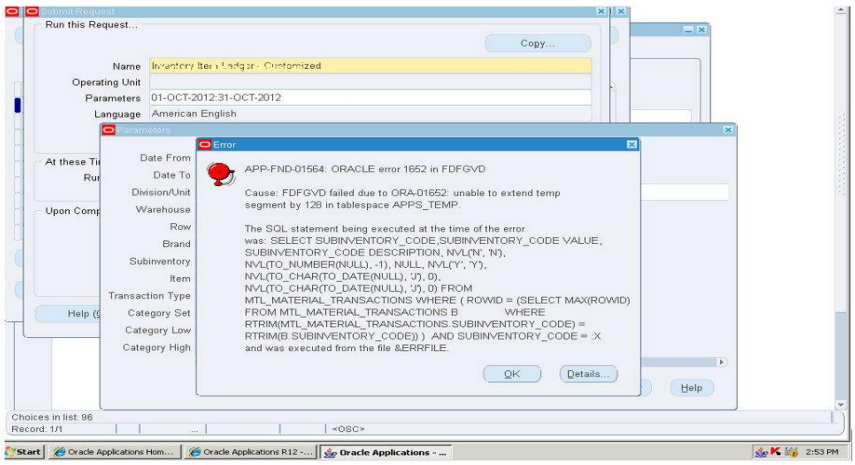
Thank you!

Nielsen's 10 Point Usability Heuristics for User Interface Design		
1	**Visibility of system status**	The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.
2	**Match between system and the real world**	The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.
3	**User control and freedom**	Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.
4	**Consistency and standards**	Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.
5	**Error prevention**	Even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action.
6	**Recognition rather than recall**	Minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.
7	**Flexibility and Efficiency of use**	Accelerators- unseen by the novice user- may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.
8	**Aesthetic and Minimalist design**	Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.
9	**Help users recognize, diagnose, and recover from errors**	Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.
10	**Help and Documentation**	Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.

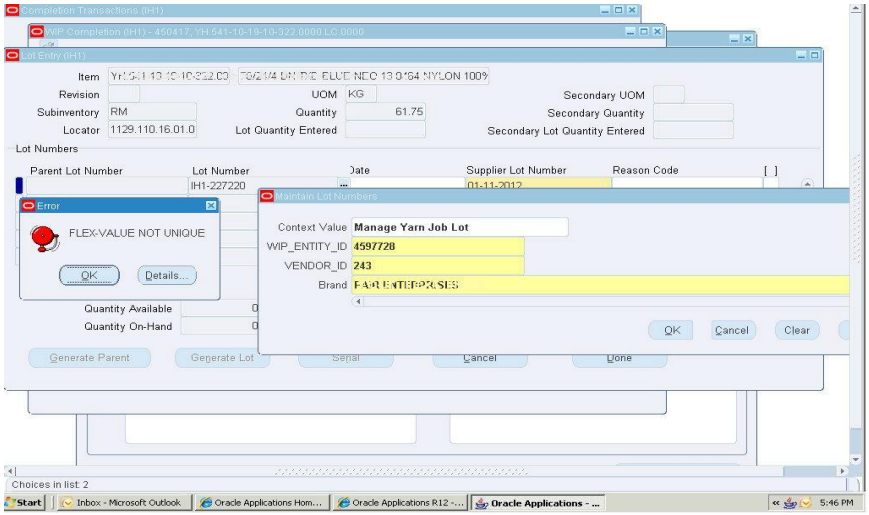
Scale for Identifying Usability problems

Severity Rank	***Definition***
0	I don't agree that this is a usability problem at all
1	Cosmetic problem only: need not be fixed unless extra time is available on project
2	Major usability problem: important to fix, so should be given high priority
3	Usability catastrophe: imperative to fix this before product can be released

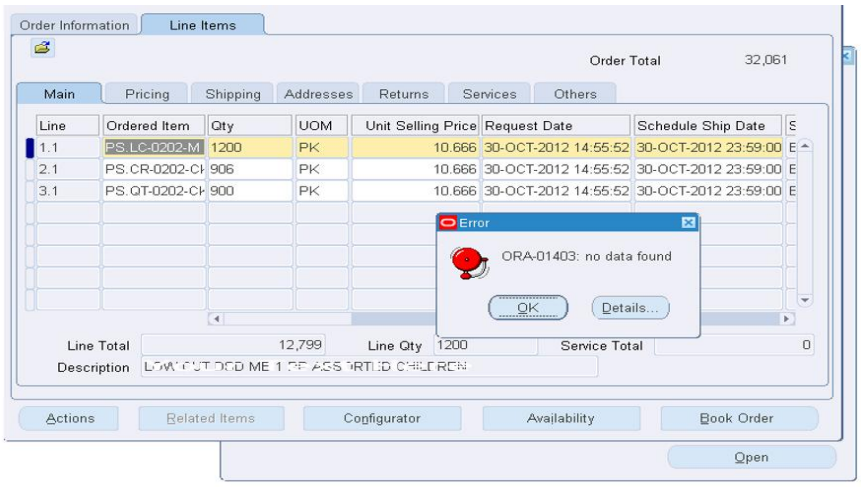
Error Message 1:



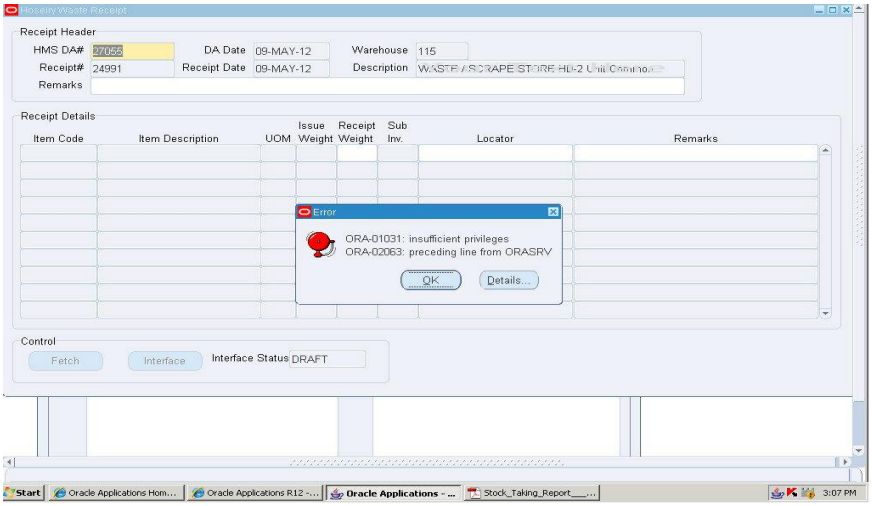
Error Message 2:



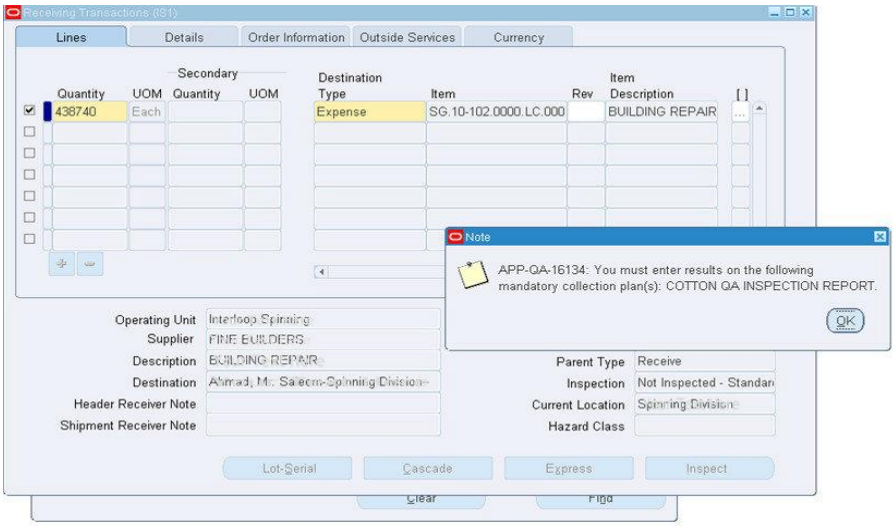
Error Message 3:



Error Message 4:



Error Message 5:



Appendix B

ERP Error Messages Evaluation

1	Name:
2	Education:
3	Certification Related to ERP Applications, If any:
4	Work Experience with ORACLE ERP Application:
5	Current Working Modules:

This questionnaire (which starts on the following page), gives you an opportunity to tell us your reactions to the Oracle ERP application you used. Your response will help us to understand what aspects of ERP Errors Messages you are particularly concerned about and the aspects that satisfy you. To a great degree as possible, think about all the ERP Error Messages that you have received when interacting with the Oracle ERP application.

All responses given will be treated with confidence. The result will be used for research purpose only and no attempt will be made to identify any individual or Organisation in any publication.

Please read each statement and indicate how strongly you agree or disagree with the statement by selecting a number on the scale (1-3). 1 is for strongly dis-agree and 3 is for strongly agree. Please select Zero (0) if you think this is not an issue.

Thank you!

	ERP Error Messages Related Questionnaire	***0***	***1***	***2***	***3***
1.	ERP application gives Error messages that are meaningful or non-technical?	☐	☐	☐	☐
2.	ERP application gives Error messages that clearly tell me, what is the cause of problem?	☐	☐	☐	☐
3.	ERP application gives Error messages that clearly tell me, how to fix the problem?	☐	☐	☐	☐
4.	Whenever, I make a mistake using ERP application, I recover easily and quickly?	☐	☐	☐	☐

	Please mention any other Issues which is left in above Questionnaire?
1.	
2.	

	ERP Error Messages Related Questionnaire Continue...	***0***	***1***	***2***	***3***
5	Simultaneously opening of several Error messages Windows are confusing in this ERP application?	☐	☐	☐	☐
6.	Error messages generated from this ERP application follow the consistency and standard related to window operating system?	☐	☐	☐	☐