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252

Mazhar Sadiq

Investigating the Success of ERP Systems in Pakistan

End-Users' Perspective

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Esitetään Jyväskylän yliopiston informaatioteknologian tiedekunnan suostumuksella
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ABSTRACT

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The global business environment is changing rapidly, and organisations from developing countries such as Pakistan have to re-engineer their business processes to meet the challenges of increased competition and rising customer expectations. Enterprise resource planning (ERP) systems intend to deliver many benefits, such as business automation, reduced operating costs, accurate demand forecasts, better decision-making and improved customer service. However, organisations adopting ERP systems encounter many types of problems that may lead to failures in processes, expectations and interactions. In order to address these failures, researchers have identified the critical success factors in the implementation of ERP systems, but there is a paucity of research on post-implementation success factors. Most studies on ERP systems are based on the context of Western countries, but there is a need to apply information system (IS) theories and identify the problems in developing countries such as Pakistan. By addressing the gap, this study investigates the success of ERP systems in the context of Pakistan. To approach this study, we have used different research methods. The results attempt to extend current knowledge from a different perspective. First, in Pakistani organisations, the most important factors for ERP system implementation are top management support, effective project management, clear goals and objectives, careful selection of ERP software and data accuracy. Second, Western countries views of users perspectives are problematic in the context of Pakistan. In Pakistani organisations, end-users need proper training in order to use ERP systems effectively. They also need computer literacy training before they receive software interface training. The other related problem is that most end-users do not have a training manual available to learn about existing or new tasks. Managers are unaware of the usability of ERP systems, and they believe that it is the will of end-users to use the software. Users from Pakistani organisations consider the end-users training materials to be more useful than online *H*elp. Organisations that adopt ERP should invest more in training materials for end-users and rely less on online *H*elp. The error messages generated by the software are technical and not easily understood by the end-users. Thus, software manufacturers should design error messages in a way that is more meaningful and understandable to end-users. The opening of multiple windows simultaneously is confusing for the end-users in Pakistani organisations. Software manufacturers should adopt a different strategy for tackling this problem.

Keywords: Enterprise resource planning (ERP), critical success factors, usability, context of use, computer literacy, learnability, effectiveness, efficiency, single document interface (SDI), multiple document interface (MDI), ERP application Help, end-user training material.

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It took me fair amount of time to reach this point. The road to my Ph.D. has been bumpy, especially at the beginning and the end. My full-time research process started in July 2011 and ended in 2014. Afterward, author continued on a part-time basis. From January 2015 onward, author has been learning the Finnish language full time.

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Jyväskylä, September 08, 2016
Mazhar Sadiq

FIGURES

TABLES

LIST OF INCLUDED ARTICLES

I. Sadiq, M. & Pirhonen, A. 2013. Identifying generic and local critical success factors for Enterprise Resource Planning (ERP) system implementation in Pakistan. International Conference on Information and Social Science (ISS), 335-363.

II. Sadiq, M. & Pirhonen, A. 2012. Computer literacy training is an important factor to improve usability in ERP application. IADIS International Conference Interfaces and Human Computer Interaction, 245-250.

III. Sadiq, M. & Pirhonen, A. 2014. Usability in ERP (Single and Multiple Document Interface) application environments. International Journal of Business, Humanities and Technology, 4(4), 75-80.

IV. Sadiq, M. & Pirhonen, A. 2014. Usability of ERP error messages. International Journal of Computer and Information Technology (IJCIT), 3(5), 883-893.

V. Sadiq, M. & Pirhonen, A. 2016. Finding usability problems in ERP application Help and end-user training material. Submitted to Advances in Human-Computer Interaction.

The first author did the majority of the work on each article. The first author was also responsible for collecting and analysing the empirical data from the Pakistani organisations. The second author assisted in revising the articles.

CONTENTS

1 INTRODUCTION

The global business environment is changing rapidly, and organisations from developing countries such as Pakistan have to re-engineer their business processes in order to meet the challenges of increasing competition, an expanding market and rising customer expectations. The standardised information system (IS), which enhances organisational performance through the integration of various modules and functions across an organisation into a single centralised system, is called enterprise resource planning (ERP). An ERP system is defined as "a highly unified, consolidated and reliable network of business systems, built on a single integrated platform" (Vaman, 2007). The term 'enterprise resource planning' was coined in the early 1990s (Supramaniam & Kuppusamy, 2011). Since then, a range of functionality has been added to such systems, from a basic inventory management module to business intelligence and customer relationship management (CRM). The scope of the functionality supported by ERP packages ranges from finance modules (general ledger, fixed asset, account receivable, account payable, product costing, cash management), customer and demand management modules (order management, pricing, service) and sales and operation modules (global order promising, advanced supply change planning) to supply chain management modules (purchasing, warehousing, inventory, shipping, bill of material, work in process), etc. The essential ERP technology architecture has been built upon a single database and employs a standard user interface across the entire enterprise (Al-Mashari et al., 2003). ERP systems take into account every business transaction, regardless of where the data is input; this results in up-to-date information being available to everyone in the organisation (Calisir & Calisir, 2004).

A successful ERP project is critical to increase the performance and survival of an organisation. When an ERP system is successful, it can provide significant benefits, such as business automation, a reduction of working capital, reduced operating costs, generations of more accurate demand forecasts, better decision-making and improved customer service (Shehab, 2004; Jayaraman & Tariq, 2007; Umble et al., 2003). There are many benefits of ERP systems, and

thus many organisations are willing to adopt them. The forecast for the ERP market is expected to reach 41.69bn USD by 2020 (Allied Market Research, 2015). Despite the potential benefits that an organisation could gain from a successful ERP implementation, many organisations are still facing difficult problems and are unable to achieve significant organisational improvement. Some organisations have downsized their initiatives while others have accepted minimum payoffs or given up the ERP implementation entirely (Calisir & Calisir, 2004). Problems with ERP implementation may lead to project failure. Different types of failure include poorly defined business goals (Deloitte Consulting, 2000), expectation failure (when the ERP application does not match user expectations), interaction failure (when end-users' attitudes toward the ERP application are negative), correspondence failure (when there is no match between the ERP application and the planned objectives) (Aloini et al., 2012), inadequate training (Shaul & Tauber, 2013), changes in project scope (Holland et al., 1998), lack of commitment from top management, ignoring the accuracy of the data, a delay in ERP implementation, budget overruns, a lack of user involvement and the underestimation of end-user education and training (Zhang, 2002). Many researchers have observed that usability is one of the reasons for the failure of ERP systems (Lambeck et al., 2014; Parks, 2012; Calisir & Calisir, 2004).

Usability is a critical success factor for a software product (Kaur et al., 2016; Khajouei et al., 2016; Cao et al., 2004). A poorly designed user interface can create different kinds of problems for users. First, it can frustrate and dissatisfy the users (Stone et al., 2005), causing them to become verbally and physically abusive toward the information technology (IT) in use. According to one study conducted by Compaq (1999), 'the cost to business of this increase in stress levels of employees is not only based on sick days or under-performance, but also the working time lost through waiting for IT problems to be solved. Confederation of British Industry (CBI) statistics currently evaluate this at a staggering £25,000 ($40,000) per person in lost business each year (based on one hour a day being spent sorting out IT problems)'. Others problems for users include increased heart rate, increased sweating, increased muscle tension, loss of concentration, loss of productivity, anger, lower task performance and violence towards the IT (Stone et al., 2005; Marsh & Khor, 2006). A product with low usability will make it hard for the users to achieve their goals. A user interface that is easy to learn, effective in completing tasks and pleasant to use is more likely to be acceptable to users than an interface that irritates them (Stone et al., 2005).

There are two motivations for selecting the topic of ERP. First, the current research focuses intensively on identifying the critical success factors (CSFs) that are important for successful ERP system implementation. However, the post-implementation success factors remain understudied (Calisir & Calisir, 2004; Amoako-Gyampah, 2007; Lambeck et al., 2014). Second, most studies on ERP systems are in the context of Western-based industries (Ifinedo, 2006b; Ngai et al., 2008; Vilpola, 2008; Agourram, 2009; Puvuk, 2011; Lambeck et al.,

2014), but there is a need to apply IS theories in the context of developing countries (Musa, 2006; Gallivan, 2001). By addressing this gap, this study investigates the success of ERP systems in Pakistani organisations. In order to measure the success of ERP implementations, we have evaluated the 'external user factors', such as top management support and project management. To measure the ERP post-implementation system success, we have mainly evaluated it from usability point of views.

1.1 Research objective and questions

The objective of this study was to investigate the success of ERP systems from the perspective of end-users in Pakistan. The focus lies mainly on the ERP implementation and post implementation phases. The main research question (RQ) is:

RQ: What are the success factors for ERP systems in Pakistan?

The following sub-research questions (SRQ), have been introduced in order to investigate the success factors at different stages:

SRQ 1: What are the critical success factors for ERP system implementation in Pakistan?
SRQ 2: Is it possible to improve the success of ERP systems by providing computer literacy training to end-users?
SRQ 3: Are ERP (single document interface (SDI) and multiple document interface (MDI) window) application environments the same in terms of providing usability for end-users?
SRQ 3.1: Does end-user confusion with the user interface in an ERP SDI environment affect the learnability, effectiveness and efficiency of the system?
SRQ 3.2: Does end-user confusion with the user interface in an ERP MDI environment affect the learnability, effectiveness and efficiency of the system?
SRQ 4: What kinds of usability problems exist with ERP error messages?
SRQ 5: What kinds of usability problems exist in ERP documentation (*H*elp and training materials)?
SRQ 5.1: How usable is the ERP application *H*elp?
SRQ 5.2: Are training materials available to the end-users?
SRQ 5.3: What kinds of usability problems do the end-users face without the availability of training materials?

In order to address these questions, this thesis delivers five completed research articles. Figure 1 illustrates the position of the articles according to different phases of an ERP system. Article 1 investigates the success factors in the implementation phase. Article 2 investigates the phenomenon of employee's computer literacy and its effect during the ERP implementation/post-

implementation phases. Articles 3–5 investigate the post-implementation success factors. The figure below illustrates the positioning of the SRQs and the articles in the ERP implementation/post-implementation phases.

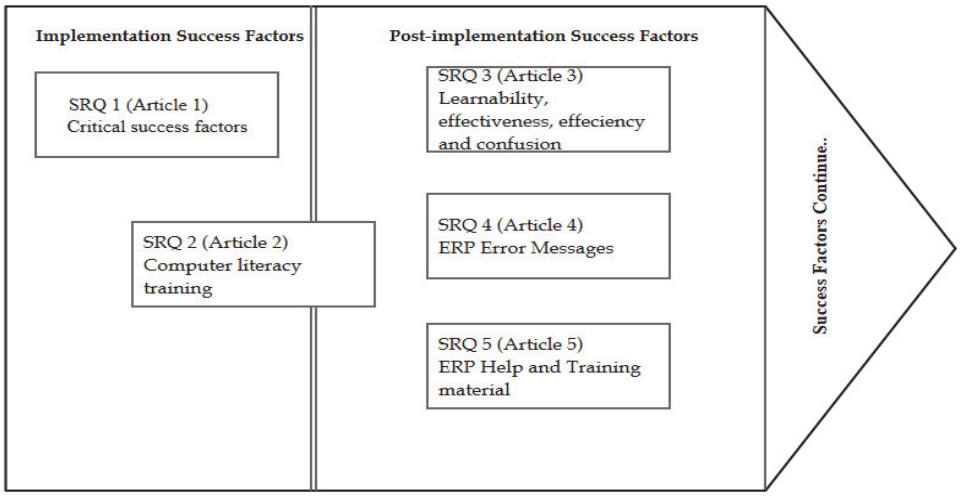

Figure 1 Investigating the success of ERP systems in Pakistan

1.2 The structure of the dissertation

This dissertation is organised as follows. Chapter 2, presents the theoretical foundation. Chapter 3, describes the research methodology, including the research methods, data collection and data analysis. Chapter 4, summarises the research results of this thesis. Chapter 5, presents a discussion of the theoretical and practical implications of the study as well as its limitations and possible future studies.

2 THEORETICAL FOUNDATION

Researchers such as Gallivan (2001) and Musa (2006) have highlighted the need to apply IS theory in the context of developing countries. This chapter reviews the relevant studies and presents the theoretical foundation of this thesis. First, the chapter discusses the research on IS success. This is followed by a discussion on related research on ERP implementation success factors in a non-Pakistani context. Finally, usability-related research on ERP post-implementation in a non-Pakistani context is presented.

2.1 IS success

Over the last decades, evaluation of the success of information technology (IT) within organisation context has received considerable attention (Ballantine et al., 1997; Barua et al., 1995; Bonner, 1995; Seddon et al., 2002). There are basically two types of research streams. The first type focuses on the measurement of users' beliefs and attitudes on behavioural intention. Theories such as the technology acceptance model (TAM) (Davis, 1989) and the unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al. 2003) have been designed accordingly. The second type of research stream focuses on the measurement of user satisfaction (sub-construct of usability). Usability (ISO 9241) and the IS continuance model (Bhattacherjee, 2001) are examples of this stream. DeLone and McLean (1992) noticed that it is unlikely that any single IS theory could evaluate all the success measures, so they advised using a combination of theories. Thus, they developed an information system success model that integrates interrelated IS theories and considers multi-dimensional success factors (DeLone & McLean, 1992).

IS success can be defined from different perspectives. The *Oxford English Dictionary* defines 'success' as 'the accomplishment of an aim or purpose'. In the IS literature, the term 'success' has been defined with respect to effectiveness (Grover et al., 1996; Markus & Tanis, 2000; Thong et al., 1994). The effectiveness

of IS can be defined 'as the extent to which an information system actually contributes to achieving organisational goals' (Thong et al., 1994). Organisations utilize ERP systems in an attempt to improve business processes. The definition of success can vary based on the perspectives of different stakeholders (users, managers, project team, vendors, consultants, ERP implementation organisation) (Larsen et al., 2009). In this dissertation, ERP system success from the end-users perspective refers to the measurement of the ERP system in terms of usability and in light of external user factors, such as top management support. Measuring success from a usability perspective requires that we ask the following questions: Was the ERP system easy to learn? What were the users attitudes towards the use of the ERP system? How well did the ERP system prevent errors or help end-users to recover from errors? What kinds of problems did the end-users encounter when interacting with the ERP system? An end-user (or simply, user) is a person who directly or indirectly interacts with the system (Alonso-Ríos et al., 2010). Direct interaction occurs when a user is performing an operational role (completing a task with the system) and a supporting role (maintenance of the system). An indirect interaction is when a user is affected by directly interacted user input. The user plays an indirect role in getting reports from the system.

2.2 Related research on ERP implementation success factors in a non-Pakistani context

ERP is a complex piece of software. Multiple factors can affect the success of an ERP system during implementation. Pinto and Selvin (1987) examined the success of ERP system implementation from the point of view of critical success factors (CSFs). Subsequently, others in the research community also extensively investigated the CSFs that are important for ERP system implementation (Bingi et al., 1999; Holland et al., 1998; Gable et al., 2003; Somers & Nelson, 2004; Vilpola & Väänänen-Vainio-Mattila, 2005; Ifinedo, 2006b; Ramayah, 2007; Ngai et al., 2008). CSFs are 'the limited number of areas in which result if they are satisfactory, will ensure successful competitive performance for the organisation. They are the few key areas where things must go right for the business to flourish' (Laosethakul & Boulton, 2007). There are different kinds of CSFs. Some of most commonly cited are top management support, project management, clear goals and objectives, careful selection of ERP software, data accuracy and integration, user involvement, end-user training on the ERP software, careful selection of an ERP implementation approach, selecting the right project team, change management, business process re-engineering (BPS), enterprise-wide communication, use of ERP consultants, use of steering committees, management of expectations, ERP vendor support and project champions (Aloini et al., 2007; Ngai et al., 2008; Shaul et al., 2010). In Western-based organisations, the most important CSFs are top management support,

project management, clear goals and objectives, careful selection of ERP software and data accuracy (Ngai et al., 2008).

2.3 Usability-related research on ERP post-implementation in a non-Pakistani context

A system is not successful if it does not satisfy the usability needs of users (Chin et al., 1988). As a sub-domain of IS, human-computer interaction (HCI) links, usability and the context of use are determinant factors for the success of IS (Norman, 1988; Barney, 1995; Dix et al., 2004). According to ISO 9241-11, usability is the 'extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use'. Context of use refers to the fact that even if an ERP system is usable in a Western organisation context, it may not be usable in organisations in developing countries. Context of use depends on the four characteristics; users, task, equipment or environmental attributes (Catherine et al., 2011; Alonso-R´ıos et al., 2010). For instance, if users have experience with a specific ERP system or a similar kind of ERP module, then the system would be more usable than if the users had no such experience. Similarly, if the users do not have any experience with the specific system, a similar kind of system or lack computer literacy, usability can be a problem. First, significant mismatches between user skillsets and the tasks can lead to anxiety and a negative attitude toward the use of the system (Smyslova & Voiskounsky, 2009). Second, this can turn system acceptance into a lengthy and difficult process. A product with good technology might still fail if the user interface is not easy to use (Caplan, 2004).

Only a few studies have investigated the usability problems directly related to the user interface (UI) of an ERP system (Calisir & Calisir, 2004; Topi et al., 2005; Parks, 2012; Lambeck et al., 2014). In 2004, Calisir and Calisir surveyed 51 end-users to examine the effect of usability factors on end-user satisfaction with the ERP system, finding that perceived usefulness and learnability were determinants of end-user satisfaction. Topi et al. (2005) interviewed 10 participants to identify the difficulties involved in using ERP systems. They found usability problems in the identification of and access to the correct functionality, support in transaction execution, system output limitations, terminology and overall system complexity. Scott (2008) investigated the perceived usability of ERP documentation. He evaluated 400 pages of the PeopleSoft™ ERP manual from the points of view of 289 students, concluding that 'improving documentation usability would increase training effectiveness, user satisfaction, productivity and the potential return on ERP investment, as well as decrease the pain and cost of implementation' (Scott, 2008). In 2010, Scholtz et al. used a three-part approach including a case study, interview and diary study to discover the usability problems in SAP R/3. They

discovered the following problems: difficulty in searching for information, information overload and difficulty in finding functions in the menu. Parks (2012) performed a user study on the PeopleSoft™ system. In order to measure usability, he established the criteria of task success/completion and task time when users interact with a multi-screen interface and a simplified single-screen version. Lambeck et al. (2014) used a survey method to collect data from 184 ERP users in Germany and 24 ERP users in Latvia. Their results indicated that the 'presence of multiple application window, which are opened simultaneously, is not a serious barrier for most users' (Lambeck et al., 2014).

Table 1 Related usability work on ERP system

Author(s)	Sample size	Methodology	ERP system	Usability aspects
Calisir & Calisir, 2004	51 users	Survey	Unknown	End-user satisfaction, system capability, compatibility, perceived ease of use, flexibility, user guidance, learnability, minimal memory load, perceived usefulness
Topi et al., 2005	9 users 1 non-user	Interviews	Unknown	Identification and access to information transaction execution, system output, error support, terminology, system complexity
Scott, 2008	289 (students)	Survey	PeopleSoft™	Task support, learnability, navigation, presentation
Scholtz et al., 2010	21 users (students)	Case study, interviews, diaries	SAP R/3	Navigation, information presentation, task support, learnability
Parks, 2012	38 users	User testing	PeopleSoft™	Task time, task success, possible significant effect (age)
Lambeck et al., 2014	184 (users from Germany), 24 (users from Latvia)	Survey	SAP, Microsoft, Horizon, 1C, Axapta	Support in error situations, overall system complexity, the amount and level of detail, availability of visualisations, confusion caused by simultaneously opened windows

In addition to identifying usability problems in ERP systems, some authors (Topi et al., 2005; Vilpola & Kouri, 2005) have advocated for improvements in the usability of ERP systems. Topi et al. (2005) suggested the use of collaborative theory in order to improve the usability of ERP systems. Collaborative theory has four principles: 1) commitment to joint activity, 2) mutual responsiveness, 3) commitment to mutual support and 4) meshing sub-plans (Bratman, 1992). In 2005, Vilpola and Kouri utilised a user-centred design (UCD) philosophy to design the customer-centred (C-CEI) ERP implementation

method, which helps to specify user requirements early on, before the system is selected.

2.4 Summary of the theoretical foundation

While the main focus of current research has been on identifying the CSFs important for ERP implementation, the factors related to post-implementation success remain understudied. To the author's best knowledge, there is no comprehensive theory available in the field of ERP usability from a user interface (UI) point of view. Thus, the focus of this thesis is mainly on ERP system usability.

3 RESEARCH METHODOLOGY

This chapter describes the methodological aspect of the thesis. It explains the selected research approach and methods as well as the data collection and data analysis.

3.1 Research paradigm

A scientific paradigm can be defined as 'the most fundamental set of assumptions adopted by a professional community that allows its members to share similar perceptions and engage in commonly shared practices' (Hirschheim & Klein 1989). There are three types of philosophical paradigms: positivist, interpretive and critical realism (Chen & Hirschheim, 2004; Mingers, 2004). IS research has been dominated by the positivist and interpretive research paradigms. Positivism, which developed from the domain of physical and natural science, assumes that reality is in a stable condition and does not depend on human experience (Burrell & Morgan 1979). Thus, positivists adopt quantitative methods such as field experiments, laboratory experiments and surveys. In contrast, interpretivism argues that regularities are related to socially constructed reality, highlighting human experiences, their perceptions and the participant's perspective (Orlikowski & Baroudi 1991). To overcome the limitations in positivism and interpretivism, Mingers (2004) advocated the use of critical realism in IS research. Critical realism independently accepts the existence of mechanisms and structures, which may be non-observable such as ideas and social structure (Mingers, 2004). According to Mingers (2001), the paradigms are not necessarily separate and exclusive domains; the real difference lies more in the research method than in the methodological level.

This research project focuses on identifying the factors that are important for the success of ERP systems, which leads to the following main question: What are the CSFs for ERP systems in Pakistan? The research work began with a literature review, which guided the author to understand the available

theories regarding the success/failure of ERP systems. The review led to the realisation that most of the current research focuses on issues relating to ERP implementation, while the area of post-implementation is still unexplored by the research community. The major part of this thesis adopts survey (Articles 1, 3, 5), case study (Article 2) and usability evaluation methods (Article 4). These methods are suitable for conducting this kind of research since the ERP systems (Oracle (Article 1, 2, 3, 4, 5) and SAP Article 1) have already been implemented in the organisations. Users in this research work are almost all real users, performing daily tasks within ERP systems in Pakistan. Only the three independent experts from the University of Jyväskylä were non-ERP users.

3.2 Survey research method

Survey research is one of the most widely used methods in IS research (Palvia et al., 2003). It involves a compilation of questions that are implemented in either a computer- or paper-based environment. Surveys have been a primary source of data collection since the early days of science (Ozok, 2008). There are basically two types of surveys: opinion surveys and evaluation surveys (Ozok, 2008). The purpose of an opinion survey is to collect general information regarding a system, product or environment for the purpose of meeting the users' expectations, preferences and requirements. It is not specific to any product or environment and could include questions such as 'Is the use of a computer to perform daily tasks a good thing?' or 'Are you satisfied with the information available on the system?' (Ozok, 2008)? On the other hand, evaluation surveys collect information related to a specific system, product or environment. They include questions such as 'Was navigation of the ERP system difficult?', 'Was it easy to learn the ERP system?' or 'Was your experience with the ERP system satisfying?' The aim of an evaluation survey is to evaluate interfaces, environments and procedures from the user's perspective (Ozok, 2008). The third type of survey is a demographic survey, which is used to collect information about user demographics (Ozok, 2008).

3.2.1 Survey on ERP system implementation in Pakistan

Article 1, 'Identifying generic and local critical success factors for enterprise resource planning system implementation in Pakistan', used two types of survey methods: demographic and evaluation. The questionnaire consisted of three parts. The first part included demographic questions designed to collect information about the respondents, their current positions, their work experience with the Oracle ERP system and with other ERP systems, the number of ERP implementation projects in which they participated and their roles as well as the name of the implementation organisation. The second part consisted of 18 factors, with a brief introduction. The third part consisted of an evaluation survey. The following 18 factors were evaluated for the 25

respondents working in the 8 Pakistani organisations: top management support, business process re-engineering (BPR), project management, use of steering committee, change management, clear goals and objectives, enterprise-wide communication, project champion, selecting the right team, careful selection of ERP software, ERP vendor support, management of expectations, use of ERP consultants, data accuracy, user involvement, selecting the right ERP implementation approach, end-user training on ERP software and computer literacy training for illiterate end-users. To survey the degree of agreement, a ten-point Likert-type scale was used, ranging from '1- important' to '10- very important'. In seven organisations, the survey was implemented in a paper-and-pencil form, while in the other it was implemented using email.

3.2.2 Survey on ERP post-implementation in Pakistan

Article 3, 'Usability in ERP (single and multiple document interface) application environments', used demographic and evaluation surveys. The questionnaire consisted of four parts. The first part included demographic questions designed to collect information about the respondents, their organisation, age, gender, type of ERP system used and their experience with the ERP system. The respondents' demographic information is shown in Table 2. The second part consisted of items measuring confusion with the ERP system. The third part consisted of items measuring three usability attributes: learnability, effectiveness and efficiency. A seven-point Likert-type scale was used to collect feedback from the 110 respondents. The measurement scale ranged from 1 (strongly disagree) to 7 (strongly agree).

Table 2 Respondents' demographic information for evaluating the ERP SDI/MDI application environment

UI Methodology	Oracle ERP system	Industry Type	Respondents	Experience
SDI	CC & B	Distribution	55	0–6
MDI	Financial, Purchasing, Inventory	Manufacturing	55	0–6

To evaluate the ERP system, 110 respondents participated in this study. The respondents were full-time employees working in two types of industries in Pakistan. They were divided into two groups based on the user interface adoption methodology. The first group, which consisted of 55 respondents, was working on single document interface (SDI) applications such as Oracle Utilities' Customer care and Billing (CC&B). This application utilises a browser base user interface (BUI), which is comprised of a combination of HTML andJavaScript (Oracle, 2010). The second group consisted of another 55 respondents who were working on multiple document interface (MDI) applications such as Oracle's Finance, Inventory and Order management (Oracle, 2009). Out of 110

respondents, 20 were utilising both types of applications.

Article 5, 'Finding usability problems in the ERP Application Help and End-user training material', used demographic and evaluation surveys. The questionnaire was utilized to collect information from 80 respondents. It consisted of four parts. The first part involved demographic questions designed to collect information about the respondents, their organisation type, department, age, gender, ERP system and experience with the ERP system. The respondents' demographic information is shown in Table 3.

Table 3 Respondents demographic information for evaluating online Help and end-user training materials

ERP System	Respondents	Industry type	Department	Experience	Education
ORACLE	20	Oil and Gas	Financial	0 – 6	MBA, B. Com
	20		Order Management	0 – 6	B. A, B. Com, MBA
	15	Manufacturing	Purchasing	0 – 6	B. A, B. Com, MBA
	25		Inventory	0 – 6	F. A, B. A, B. Com, MBA
Total	**80**				

The second part involved two questions to obtain the respondents' feedback on the ERP applications' Help and end-user training materials. This part used a four-point Likert-type scale (1=not at all to 4=very usable). The third part involved one question about the respondents' feedback on the availability of end-user training materials. This part also used a four-point Likert-type scale (1=not at all to 4=all of it). The fourth part involved one open-ended question about usability problems when end-user training materials were not available. The main purpose of the open-ended question was to identify usability problems by giving a degree of freedom to the respondents. The data were collected between June and September 2013. Of 80 respondents, 20 were female and 60 were male. The survey was implemented in a paper-and-pencil form.

3.3 Case study methodology

Article 2, 'Computer literacy is an important factor to improve usability in ERP application', used a case study methodology. A case study is defined as an 'empirical inquiry that investigates a contemporary phenomenon within a real-life context: when the boundaries between phenomenon and context are not clearly evident, and in which multiple sources of evidence are used' (Yin, 1994). For conducting the case study, we selected three organisations from Pakistan. All these organisations had been using an ERP system for one and a half years. ERP implementation can be divided into three categories: comprehensive,

middle of the road and vanilla (Parr & Shanks, 2000). Organisations A and B are in the middle of the road category, whereas Organisation C is in the vanilla category. Details of these three organisations are shown in Table 4.

Table 4 ERP organisations' details

Organisations	*Organisation A*	*Organisation B*	*Organisation C*
Industry type	Oil & Gas	Manufacturing	Manufacturing
Category	Middle of the Road	Middle of the Road	Vanilla
Approach	All Module	Module-by-Module	All Modules
Implementation	Consultant	Project Manager	Consultant
ERP Application	Utility & Billing V2.2	EBS Suite R12	EBS Suite11.5.10

To acquire the employees' computer literacy data, we conducted preliminary interviews with six key users, who were working in the IT departments. The purpose of the interviews was to understand the users' backgrounds and the type of training they received at the time of ERP implementation. These key users were involved with the project implementation in the organisations. As a result of the interviews, we learned that organisations B and C did not provide computer training to end-users. They only offered ERP software-related training to users when they were ready to 'go live'. Different methods such as an employee resource planning sheet, telephone inquiry and an employee personal education record were used to collect information regarding the employees' computer literacy.

3.4 Heuristics and inquiry questionnaire methods

Article 4, 'Usability of ERP error messages' used heuristics and inquiry questionnaire methods. Heuristic evaluation is a usability inspection method (Nielsen, 1994) in which experts evaluate the interface and its elements against the established design rules. For the purpose of evaluation, we selected five real-time error messages from one Pakistani organisation. Three independent experts from the University of Jyväskylä, Finland evaluated the error messages. Details regarding the independent experts are listed in Table 5.

Table 5 Details of independent experts from the University of Jyväskylä, Finland

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

The inquiry questionnaire method is used to survey the user behaviour in a system (Bernhaupt et al., 2008). To evaluate error messages, we selected 40 end-users from two Pakistani organisations. Four closed-ended and one open-end questionnaire were used to collect the feedback.

3.5 Data analysis

In this thesis, we have used a mixed-methods approach to analyse the data. Different types of data analysis techniques can be utilised on quantitative and quantitative data, including descriptive statistical analysis, content analysis, correlation analysis, development of predictive models and hypothesis testing. For our research purposes, we have mainly used descriptive statistics analysis, which is a technique that is easily understandable by the different stakeholders. The psychometric properties of the instrument were evaluated using Cronbach's alpha, which measures internal consistency.

3.6 Summary of research methodologies

This dissertation used four types of research methods: surveys, case study, heuristics and inquiry questionnaire. Articles 1, 3 and 5 used the survey research methodology, while the case study method has been used to an extent in all the papers. Article 2 specifically used the case study methodology. Finally, Article 4 used heuristics and an inquiry questionnaire.

4 SUMMARY OF ARTICLES

This section summarises the key purposes and findings of the five attached articles. Article 1 investigates the CSFs important for ERP implementation in Pakistan. Article 2 examines the success of ERP systems by providing computer literacy training. Articles 3–5 investigate ERP post-implementation success factors.

4.1 Success factors of ERP system implementation in Pakistan

Article 1: Sadiq, M. & Pirhonen, A. 2013. Identifying generic and local critical success factors for Enterprise resource planning (ERP) system implementation in Pakistan. International conference on Information and Social science (ISS), 335-363.

SRQ 1: What are the CSFs for ERP system implementation in Pakistan?

The main purpose of this article was to identify the generic and local CSFs perceived to be important for ERP system implementation in Pakistan. Generic factors are those that have been mentioned in the existing Western organisational literature. Among the available generic factors in the literature, the article of Ngai (2008) forms the basis of our research work. There are more than 60 critical factors, including sub-factors. In order to identify the most relevant factors according to Pakistani organisations, we selected 4 project managers from the manufacturing industry. As a result of our primary empirical work, 17 CSFs were identified: top management support, BPR, project management, use of steering committee, change management, clear goals and objectives, enterprise-wide communication, project champion, selecting the right team, careful selection of ERP software, ERP vendor support, management of expectations, use of ERP consultants, data accuracy, user involvement, selecting the right ERP implementation approach and end-user training on ERP

software. Based on previous research work (Sadiq & Pirhonen, 2012), the local factor 'computer literacy training to illiterate end-users' was added to the 17 identified factors. Then, 25 respondents from 8 organisations evaluated these 18 factors using a ten-point Likert-type rating scale. The results of this study are shown in Figure 2, arranged from most to least important.

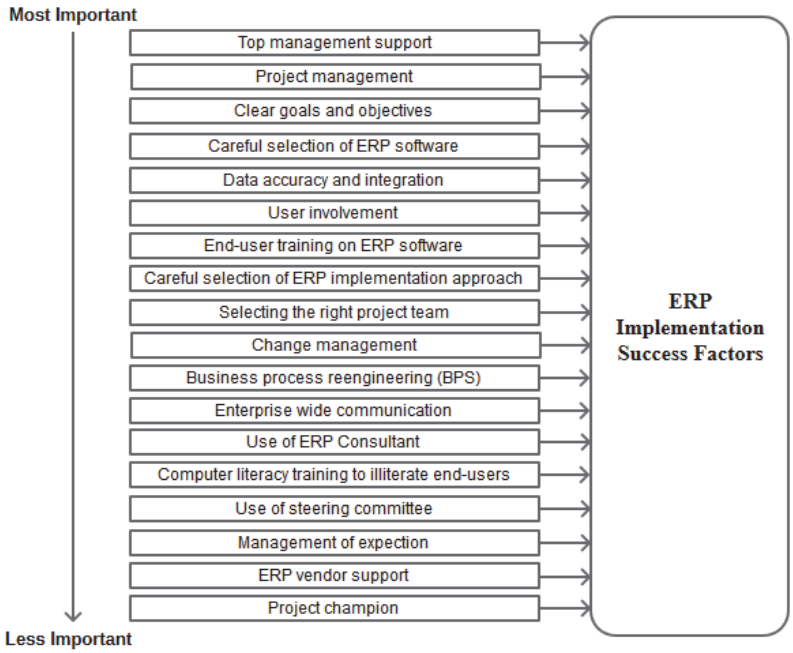

Figure 2 CSFs of ERP system implementation in Pakistan

The five most important factors according to Pakistani organisations are top management support, project management, clear goals and objectives, careful selection of ERP software and data accuracy and integration. The local factor computer literacy training to illiterate end-users is more important than factors such as steering committee, management of expectations, ERP vendor support and project champion.

4.2 Success factors of ERP implementation / post-implementation in Pakistan

Article 2: Sadiq, M. & Pirhonen, A. 2012. Computer literacy is an important factor to improve usability in ERP application. IADIS International Conference and Human Computer Interaction, 245-250.

SRQ 2: Is it possible to improve the success of ERP systems by providing computer literacy training to end-users?

This article highlights three issues. First, the basic requirements for using an ERP system are discussed, giving an example of a move order requisition. Second, the issue of end-user computer literacy in Pakistan is underlined. Since there is no organisational end-user computer literacy data available in Pakistan, the author collected and analysed data from 702 employees across 3 organisations, as shown in Figure 3. Third, the effect of providing computer literacy training for end-users before giving them ERP interface-related training was investigated.

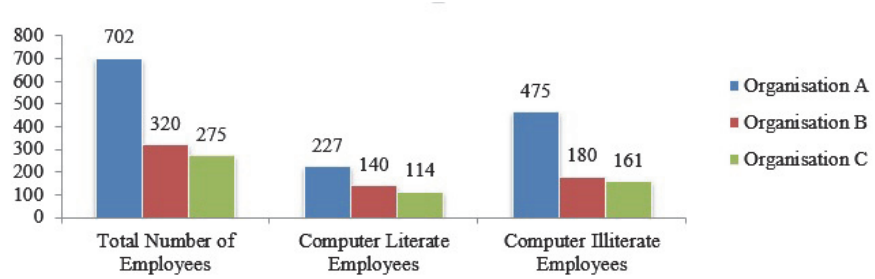

Figure 3 Employee computer literacy data from 3 organisations

The empirical results show that, in Organisation A, only 227 employees were computer literate. In Organisation B, 140 employees were computer literate, and in Organisation C only 114 were computer literate. The results also indicate that the employees who received computer literacy training before receiving ERP software interface-related training were more motivated and committed to learning the ERP system.

4.3 Success factors of ERP post-implementation in Pakistan

Article 3: Sadiq, M. & Pirhonen, A. 2014. Usability in ERP (single and multiple document interface) application environments. International Journal of Business, Humanities and Technology, 4(4), 75-80.

SRQ 3: Are ERP (single and multiple document windows) application environments the same in terms of providing usability to end-users?
3.1: Does end-user confusion with the user interfaces in an ERP SDI environment affect the learnability, effectiveness and efficiency of the system?
3.2: Does end-user confusion with the user interfaces in an ERP MDI environment affect the learnability, effectiveness and efficiency of the system?

The main purpose of this article was to identify the usability issues such as learnability, effectiveness and efficiency in ERP SDI and ERP MDI window environments. To approach this research, we employed a survey methodology. The 110 respondents were full-time employees working in two organisations that had implemented ERP systems. Out of 110 respondents, 20 were using both types of applications. We divided the respondents into two groups. The first group, which consisted of 55 respondents, were using SDI applications such as Oracle CC&B, while the second group consisted of another 55 respondents using MDI applications such as Oracle's finance, inventory and order management. In order to collect the feedback from the 110 respondents, a seven-point Likert-type scale was used.

The results of this study indicate that SDI is better than MDI for providing end-user usability in the context of Pakistan organisations. In SDI applications, end-user confusion with the ERP system directly affected learnability but not effectiveness and efficiency. In the case of MDI application environments, end-user confusion directly affected learnability, effectiveness and efficiency.

Article 4: Sadiq, M. & Pirhonen, A. 2014. Usability of ERP error messages. International Journal of Computer and Information Technology (IJCIT), 3(5), 883-893.

SRQ 4: What kind of usability problems exist with ERP error messages?

The main purpose of this article was to highlight the usability problems with ERP error message windows. In order to approach this research, we have used inquiry questionnaire and Nielsen's heuristics methods. One hosiery organisation from Pakistan was selected. This organisation has been using the Oracle ERP system for the last seven years. To apply the inquiry questionnaire methods, we selected 40 end-users from the organisation. All these end-users were full-time employees working in the organisation. Out of 40 end-users, 30 were male and 10 were female. To apply Nielsen's heuristics, we collected real-time errors messages from the different departments of the organisation. Three independent evaluators from the university of Jyvaskyla (Finland) evaluated five selected error messages. An error message generated by the ERP software can be seen in Figure 4.

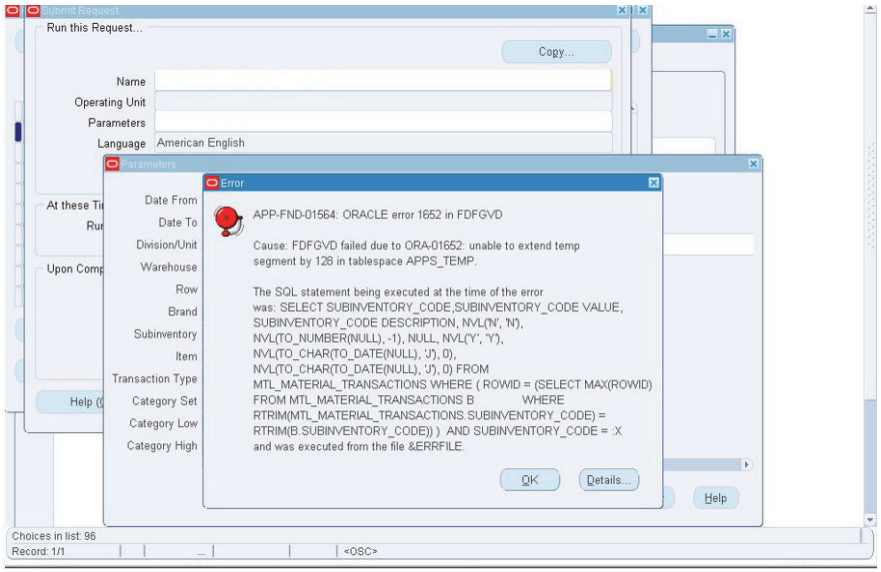

Figure 4 ERP error message

A total of 21 usability problems were identified using Nielsen's heuristics and the inquiry questionnaire. The heuristic evaluation method is more effective in identifying large usability problems compared to the inquiry questionnaire method. The following usability problems were identified by Nielsens's heuristics method:
1) Several error message windows are open simultaneously, which is confusing.
2) The red colour (bell-symbol) is informative, but the symbol is slightly confusing; it refers more to 'notice' than 'error'.
3) The error message is highly un-informational, and there are no concepts familiar to the user.
4) Not speaking the users' language.
5) Not helping users recognise, diagnose and recover from errors.

Article 5: Sadiq, M. & Pirhonen, A. 2016. Finding usability problems in ERP application Help and end-user training material. Submitted to Advances in Human-Computer Interaction.

SRQ 5: What kinds of usability problems exist in ERP application *H*elp and training materials?

5.1: How usable is the ERP application *H*elp?
5.2: How usable are the end-user training materials?
5.3: Are training materials available to end-users?
5.4: What kinds of usability problems do the end-users face without the availability of training materials?

The main purpose of this article was to highlight the usability problems in the ERP application Help and end-user training materials. In order to approach this study, the survey methodology was employed. Two organisations from Pakistan were selected. Organisation A is from the oil & gas sector while organisation B is from the manufacturing industry. The 80 respondents for this research were full-time employees working in these organisations. Of the 80 respondents, 20 were female and 60 were male. The main instrument for collecting data was the questionnaire. The results of this article indicate that 56% of the respondents did not consider the Oracle ERP online Help to be usable. Out of 80, only 35 respondents considered it usable on some level; three considered it mostly usable while only two considered it fully usable. Further analysis revealed that the respondents with less than two years experience considered the online Help less usable, compared to those having more experience (2–6 years). According to the results from research question 5.2, all the respondents considered the end-user training materials usable. The results from research question 5.3 indicate that out of 80 respondents, 45 did not have any training materials, 16 had some level of materials, 14 respondents had most of the needed materials and 5 respondents had complete materials. The results from research questions 5.4 highlight many problems. First, end-users are dependent on their senior colleagues. Second, without training materials, it is difficult to learn existing and especially new tasks.

5 DISCUSSION

This is the last section of the dissertation. First, it answers the main research question. Then, it contrasts the Western industry view with that of Pakistan. This is followed by the theoretical and practical implications. Finally the limitations and future studies are discussed.

5.1 Summary of the main research question

The main research question is:

RQ: What are the success factors for ERP systems in Pakistan?

Based on the above discussion, we summarised the findings: the five most important factors for ERP system implementation are top management support, project management, clear goals and objectives, careful selection of ERP software and data accuracy and integration. The local contextual factor 'computer literacy training to illiterate end-users' is also more important than other factors such as steering committee, management of expectations, ERP vendor support and project champion. Furthermore, the importance of providing computer literacy training before giving ERP software interface training to illiterate end-users should be recognised in the context of Pakistani organisations. Ignoring this factor could have many consequences. First, it would not only affect the software interface training itself but also the time to learn to use ERP system would be increased after the 'go live'. Second, if there is a significant mismatch between employee skillsets and the tasks that are to be performed, this can lead to negative attitudes on the part of the employees toward the use of the software (Smyslova, 2009).

In the ERP post-implementation phase, different usability factors are important to the success of the software. First, the ERP SDI window environment is better and less confusing than the ERP MDI window. Using SDI, end-users take less time to learn to use the ERP system, and they are able to

complete the tasks in an effective and efficient manner. Based on the empirical data, we can say that the SDI strategy is more successful than MDI in Pakistani organisations. Different success factors for ERP implementation/post-implementation can be seen in Figure 5.

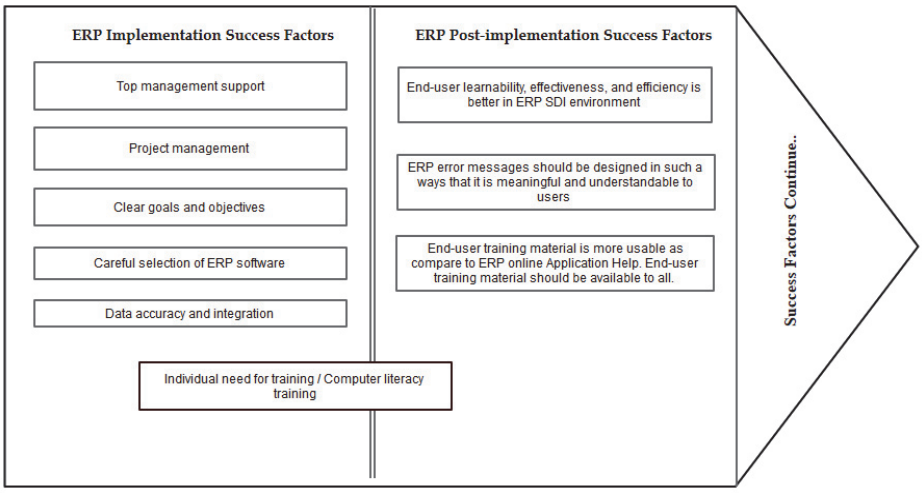

Figure 5 ERP system success in Pakistan

Second, the error messages generated by the ERP system are misleading, technical and intended for the system developer. They do not speak the users' language nor help them to recognise, diagnose or recover from errors. Effective communication between the end-user and the ERP system is important for the success of the system, so software manufacturers should design the error messages in a way that they are more meaningful and understandable to the end-users. Third, the users from Pakistani organisations consider the functional documents/training materials to be more useful than the online *H*elp. Training is an important factor for ERP system success, and the effectiveness of training depends on the usability of the documentation. Thus, organisations that adopt ERP adopting should invest more on end-user training materials and rely less on online *H*elp. They also need to ensure that all users have access to training documents.

5.2 'Western view' vs 'Pakistani View'

Much of the available literature on ERP systems is from the context of Western organisations, where the focus lies mainly on finding the CSFs for ERP implementation. According to Western organisations, the most important CSFs are top management support, ERP team and composition, project management and change management (Ngai, 2008). In Pakistani organisations, the important

factors are top management support, project management, clear goals and objectives, careful selection of ERP software and data accuracy. Only two factors, top management support and change management, are common important factors; the rest are different. 'Steering committee' is an important factor in Western organisations, but it is less important in Pakistani organisations.

The users' perspective view in Western organisations is problematic in the context of Pakistani organisations. Theories such as TAM (Davis, 1989), UTAUT (Venkatesh et al. 2003) and usability (ISO 9241-11) are well known and have been applied in the context of Western organisations. From a user perspective, Pakistani organisations are still far behind. In Article 1, we shared two managers' beliefs about end-user usability, who said that 'it's not the matter of usability, but it's the matter of their (employees) will to use ERP application'. In Article 2, the issue of computer literacy issue was mentioned with respect to the employee data that were collected from three organisations. Even though 40% of the employees were computer illiterate, the need for individual training is still being overlooked. Of the three organisations, only one provided computer literacy training to its employees before giving them ERP software-related training. In advanced Western organisations, this is not as much of an issue as it is in Pakistan. Furthermore, functional documents/end-user training materials were not available to most of the end-users. This issue has been mentioned in Article 5. Usability issues are discussed from the point of view of ERP SDI and MDI environments in Article 4. There is no literature available discussing the SDI and MDI strategies in the context of Western organisations. For end-users in Pakistani organisations, multiple open windows is a big problem, whereas in Western organisation this is not a significant problem for most users (Lambeck et al., 2014). In Western organisations, the survey method is dominant. In this study, we utilised different methods including surveys, case studies, heuristics and inquiry-based methods.

5.3 Theoretical implications

This study extended the scope of ERP systems knowledge in developing countries such as Pakistan. From a theoretical point of view, the key results attempt to contribute to IS system success evaluation. In Article 1, we contributed to existing knowledge by mentioning one local contextual factor, computer literacy training for illiterate end-users. Furthermore, the results show that the five most important success factors, according to Pakistani organisations, are top management support, project management, clear goals and objectives, careful selection of ERP software and data accuracy.

In Article 2, we highlighted the user characteristics issue from the users' point of view. According to ISO 9241-11 (1998), usability depends on the context of use, which entails the users, tasks, equipment and environment. This means that an ERP system that is usable in a developed country may not be usable in a

developing country, which may be characterised by different users, tasks, equipment or environmental attributes. The current literature focuses on user characteristics (experience, etc.) from two perspectives (Alonso-Ríos et al., 2010): the user experience with respect to a specific system or a similar kind of system. However, if an organisation has been using a manual system (e.g. pen-and-paper based) but is now in the process of implementing a computer-based system (e.g. an ERP system) user experience with a specific or similar system is not enough. There is also a need to consider other experience such as computer literacy experience. Article 2 highlights the user characteristics issue in the context of usability.

Article 3 contributes to the knowledge by addressing the usability issues that are directly related to user interface (UI) such as SDI and MDI. There are two methods for organising the graphic user interface window: SDI and MDI. The findings of this study contribute to the extant knowledge by showing that in the context of Pakistani organisations, the ERP SDI application environment is more usable (learnability, effectiveness and efficiency) and less confusing than the MDI environment.

Article 4 contributes by evaluating ERP system error messages. We have used Nielsen's heuristics and inquiry questionnaire methods to identify the problems in error message windows. Nielsen's heuristics is more effective than the inquiry questionnaire for identifying a large proportion of the problems in ERP error messages. Sixteen usability problems were identified by Nielsen's heuristic method, whereas the inquiry questionnaire method found five usability problems.

Article 5 contributes to the knowledge by highlighting the usability problems in the ERP application *H*elp and end-user training material.

5.4 Practical implications

The results of this study have practical implications for different stakeholders, including ERP vendors, ERP implementers/service providers and organisations adopting ERP.

Article 1 reveals that the five most important ERP implementation factors are top management support, project management, clear goals and objectives, careful selection of ERP software and data accuracy. Pakistani organisations that are adopting ERP should thus focus more on these factors. In addition, they should consider providing computer literacy training for employees before giving them ERP software interface-related training. Finally, managers must understand that usability is an important factor for the success of an ERP system. If it is not usable, a system cannot be successful.

In Article 2, the basic requirements for using an ERP system are discussed. An ERP system is a complex piece of software. Therefore, to promote the effective and efficient use of an ERP system, the ERP vendor should establish some criteria to use ERP system such as computer literacy and background

education. This is relevant in the case of developing countries such as Pakistan. Moreover, organisations adopting ERP should provide training according to the needs of individual users.

In Article 3, we learned that the ERP MDI environment is confusing to end-users. Hence, the ERP adoption/service provider organisation should provide intensive training to users when implementing MDI-related modules, such as Oracle Finance, Purchasing and Inventory.

In Article 4, we discovered that the error messages generated by the software are misleading and technical (code). Therefore, ERP vendors should design the error messages in such a way that they are meaningful and understandable to users. The messages should also inform users about the cause of the problem and how to fix it. Second, the information should be relevant to specific error messages. Third, the symbol and its colour in the error message should be consistent with the standards of the operating system.

In Article 5, we learned that software online *H*elp is not as usable as a functional document or user manual. ERP vendors should thus design the standard online *H*elp in such a way that it includes not only text but also a screenshot for each step. Further, the *H*elp should be specific to an organisational unit and specific to end-users' job responsibilities. Since functional documents/training materials are more usable for end-users, organisations adopting ERP should ensure that training materials are available to everyone working with the ERP system.

5.5 Limitations

This thesis provides many interesting findings. However, it has several limitations that need to be acknowledged.

First, the user satisfaction factor could not be evaluated. This is an important factor for judging the overall success of ERP systems in Pakistan. Second, the concept of usability was explained to the users at the time of data collection, but there is a chance that some of the users misunderstood the concept. It was not possible to completely explain the usability concept to all the users.

Third, the sample sizes used in Articles 2 are relatively small. Obtaining results that are generalisable would require a larger sample size from more organisations.

Fourth, in Article 1, there is bias due to the organisational sector of the respondents. Most of the respondents have ERP implementation experience from the manufacturing sector, so there is a need to validate these CSFs from other sectors, such as banking.

Fifth, the ERP systems that were evaluated in this study are mostly provided by Oracle. There is a need to evaluate other ERP systems such as SAP.

5.6 Future research topics

The study touches on many novel topics, but there is a need to replicate various aspects in other developing countries. It is difficult to validate the findings on the basis of a single study in Pakistan.

We suggest some directions for future research. First, there is a need to investigate end-user satisfaction with the ERP system in developing countries. Second, there is a need to investigate the relationship between usability characteristics such as learnability, effectiveness and efficiency and end-user satisfaction in SDI and MDI windows.

YHTEENVETO (FINNISH SUMMARY)

Maailmanlaajuinen liiketoimintaympäristö muuttuu nopeasti. Kehittyvissä maissa, kuten Pakistanissa, organisaatioiden tulee muuttaa toimintatapojaan vastatakseen kiristyvän kilpailun ja asiakkaiden kovenevien vaatimusten haasteeseen.

Standardoitua tietojärjestelmää, joka parantaa organisaation suorituskykyä integroimalla eri toimintoja, kutsutaan toiminnanohjausjärjestelmäksi (ERP, Enterprise Resource Planning). Toiminnanohjausjärjestelmillä pyritään useisiin hyötyihin, kuten liiketoiminnan automatisointiin, alentuneisiin käyttökuluihin, tarkoihin kysyntäennusteisiin, parempaan päätöksentekoon ja parantuneeseen asiakaspalveluun.

Toiminnanohjausjärjestelmiä käyttöön ottavat organisaatiot kohtaavat monia ongelmia, jotka saattavat johtaa projektien epäonnistumiseen. Epäonnistumisia on kahta päätyyppiä: täydellisiä ja osittaisia. Täydellisessä epäonnistumisessa projekti keskeytyy ja organisaatio kärsii merkittäviä pitkän aikavälin taloudellisia menetyksiä; merkittävä osa liiketoiminnasta menetetään. Osittainen epäonnistuminen voi merkitä prosessin epäonnistumista, epäonnistumista odotuksiin vastaamisessa, ongelmat vuorovaikutuksessa (jolloin loppukäyttäjien asenne toiminnanohjausjärjestelmään on negatiivinen), johdon sitoutumisen puutetta, talousarvion ylitystä tai loppukäyttäjien kouluttamisen puutetta.

Epäonnistumisten välttämiseksi monet tutkijat ovat määritelleet kriittiset menestystekijät (critical success factors, CSF) toiminnanohjausjärjestelmien käyttöönotossa. Käyttöönoton jälkeiseen vaiheeseen liittyviä menestystekijoitä on tutkittu paljon vähemmän. Kriittiset menestystekijät ovat ne kaikkein keskeisimmät osa-alueet, joilla onnistuminen takaa kilpailukykyisen suorituksen yksilön, osaston tai koko organisaation näkökulmasta.

Suurin osa toiminnanohjausjärjestelmien tutkimusta on tehty läntisissä teollisuusmaissa. Kehittyvissä talouksissa, kuten Pakistanissa, olisi suuri tarve soveltaa tietojärjestelmäteorioita ja tunnistaa niiden avulla tuotannon ongelmakohtia. Tässä tutkimuksessa pyritäänkin täyttämään havaittua tarvetta tutkimalla toiminnanohjausjärjestelmiä pakistanilaisessa kontekstissa. Tutkimuksessa on käytetty kyselyitä, tapaustutkimuksia ja heuristiikkoja.

Tutkimuksen tulokset laajentavat ymmärtämystä ja tarjoavat vaihtoehtoisen näkökulman tutkimuskohteeseen. Ensinnäkin pakistanilaisissa organisaatioissa tärkeimmät toiminnanohjausjärjestelmän käyttöönoton tekijät ovat johdon tuki, selkeät tavoitteet ja päämäärät, huolellisuus ohjelmiston valinnassa ja datan oikeellisuus. Toisekseen, länsimainen näkökulma ei ole riittävä pakistanilaisessa kontekstissa. Pakistanilaisissa organisaatioissa käyttäjät tarvitsevat kunnollisen koulutuksen voidakseen käyttää toiminnanohjausjärjestelmiä tehokkaasti. Lisäksi he tarvitsevat tietokoneen käyttötaitojen koulutusta ennen varsinaista perehdytystä toiminnanohjausjärjestelmän käyttöön. Tähän liittyvä ongelma on myös riittävän ohjeistusmateriaalin puute tehtävien suorittamiseen.

Tutkimuksen mukaan työnjohto ei ole riittävästi tiedostanut käytettävyyden merkitystä tietojärjestelmien käytössä vaan näkevät käytön ongelmat lähinnä motivaatio- ja koulutuskysymyksinä. Lisäksi huomattiin, että käyttäjät pitävät

koulutusmateriaalia hyödyllisempänä tapana oppia käyttöä kuin sovellukseen liitettyjä Help-osioita. Johtopäätöksenä suositellaankin, että resursseja suunnattaisiin Help-osioita enemmän varsinaiseen koulutusmateriaaliin.

Virheilmoitukset olivat tutkimuskohteessa luonteeltaan hyvin teknisiä ja käyttäjät kokivat ne vaikeaselkoisina. Virheilmoitusten selkeyteen tulisikin kiinnittää nykyistä enemmän huomiota. Hämmennystä aiheutti myös monien päällekkäisten ikkunoiden käyttö käyttöliittymässä. Tutkimuksessa suositellaankin toisenlaisen suunnitteluperiaatteen käyttöä tutkitun kaltaisessa kontekstissa.

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ORIGINAL PAPERS

I

IDENTIFYING GENERIC AND LOCAL CRITICAL SUCCESS FACTORS FOR ENTERPRISE RESOURCE PLANNING (ERP) SYSTEM IMPLEMENTATION IN PAKISTAN

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IDENTIFYING GENERIC AND LOCAL CRITICAL SUCCESS FACTORS FOR ENTERPRISE RESOURCE PLANNING (ERP) SYSTEM IMPLEMENTATION IN PAKISTAN

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ABSTRACT

The main purpose of this article is to empirically identify and evaluate generic and local critical success factors (CSFs) important for enterprise resource planning (ERP) system implementation in Pakistan. To conduct this research, we have used a three-tiered approach. In the first tier, generic critical success factors mentioned in exiting literature are reviewed. In the second tier, based on primary empirical work, we have identified 17 critical success factors from the aforementioned generic factors. In the third tier, we have added a local factor of "Computer literacy training to illiterate end user" to these 17 generic factor and have conducted secondary empirical work. A 10 point Likert rating scale was used to collect degree of agreement from 25 project participants. As a major finding, the five most important factors, according to Pakistani organisations, were top management support, project management, clear goals and objectives, careful selection of ERP software, and data accuracy. However, the local factor "computer literacy training to illiterate end users" was also critical and was more important compared to factors such as steering committee, management of expectation, ERP vendor support, and project champion. The least important factors were project champion, use of steering committee, and ERP vendor support.Keyword: Enterprise resource planning (ERP), Critical success factor, Usability

1. INTRODUCTION

The global business environment is changing rapidly, and organisations from developing countries such as Pakistan have to re-engineer their business processes in order to face the challenge of increasing competition, an expanding market, and rising customer expectations. The innovation tool that is enhancing organisational performance through the integration of various modules and functions across an organisation into a single centralised system is called Enterprise Resource Planning (ERP). The term "Enterprise Resource Planning" was initiated in the early 1990s (Supramaniam, 2011). Since then, the range of functionality has been added from a basic inventory management module to business intelligence and customer relationship management (CRM). The scope of functions supported by an ERP package could range from Finance Modules (general ledger, fixed asset, account receivable, account payable, product costing, cash management), Customer and Demand management modules

(order management, pricing, service), Sales and operation modules (global order promising, advanced supply change planning) to supply chain management modules (purchasing, warehousing, inventory, shipping, bill of material, work in process), etc. A successful ERP project implementation is critical in order to increase performance and survival of organisations. Potential benefits for organisations are automation of business process, reduction of working capital, reduced operating costs, generations of more accurate demand forecasts, better decision making, and improved customer services (Shehab, 2004; Jayaraman, 2007; Umble, 2003).

Despite the benefits an organisation could gain from successful ERP implementation, many ERP implementation problems can be found in the literature. These problems potentially lead to ERP project failure. There are two types of failure: complete and partial (Vidyaranya, 2005). In complete failure, the project stops and the organisations suffers significantly in terms of long term financial damage; they lose a major portion of their business. An example of complete failure is FoxMeyer, a drug distributor that went bankrupt and had filed a $500 million lawsuit against ERP vendors (Bingi, 1999). In partial failure, the organisation must adjust when facing interruption to daily operation (Vidyaranya, 2005). Partial failure include categories further into processing, expectation, interaction, and correspondence. These are (Aloini, 2007):

(1) Process failure: When an ERP project is not completed within the time and budget.

(2) Expectation failure: When the ERP system does not match user expectations.

(3) Interaction failure: When end-users attitudes toward ERP application are negative.

(4) Correspondence failure: When there is no match between ERP systems and the planned objectives.

Some problems related to partial failure are a lack of commitment from top management, ignoring of data accuracy, a delay in ERP implementation, budget over run, lack of user involvement, underestimation of end user education & training, and poor project management (Zhang, 2002).

In order to avoid complete or partial failure in ERP implementation projects, a number of studies have attempted to identify factors important for successful implementation in different countries. Critical success factors (CSFs) have been defined as "the limited number of areas in which satisfactory results will ensure successful competitive performance for the individual, department, or organisation" (Ngai, 2008). ERP systems can be seen predominantly in

developed countries, but over the last few years these have started to take shape in developing countries as well. There is a growing body of literature on ERP applications in Malaysia and China (Supramaniam, 2011), but there is still a lack of studies on ERP implementation in Pakistan. Currently, an increasing number of organisations in Pakistan have started implementing ERP application, so there is a need to understand the factors that are important for ERP implementation in this context.

The purposes of this research is to 1) empirically identify and evaluate the generic CSFs of ERP implementation, 2) empirically evaluate local factors of "Computer literacy training to illiterate end-user", and 3) comparing local factor with generic factors. This paper has been organised as follows: Section 2 describes usability problems mentioned in the literature as well as some observations from empirical work; Section 3 describes the research methodology; Section 4 describes critical success factors and the hypothesis, and Section 5 includes the results and discussion. The last section, Section 6, describes the conclusions and limitations.

2. USABILITY PROBLEMS IN ERP APPLICATION

According to ISO 9241-11, usability is defined as the "extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use". The concept of usability has received much attention in the consumer market. Many consumer product oriented companies use usability as a marketing argument. However, this concept has not been sufficiently entered in industrial application environments such as ERP. ERP is a complex piece of software, and its interlinked business processes capabilities pose more usability problems. Some of the problems that have been mentioned in literature are (Shehab, 2004):

a) Time to learn to use an ERP application is too long
b) Lack of user-friendliness for occasional users
c) System input is not always logical
d) Report terminology can be difficult to understand
e) Lack of ability to cut and paste
f) Online help incapability
g) The accounting rules are difficult to understand

Another problem related to usability of ERP software is the low level of computer literacy (Sadiq, 2012). In Pakistani manufacturing organisational environments, there are more than 40% computer illiterate end-users, as can be seen in the following Fig 1.

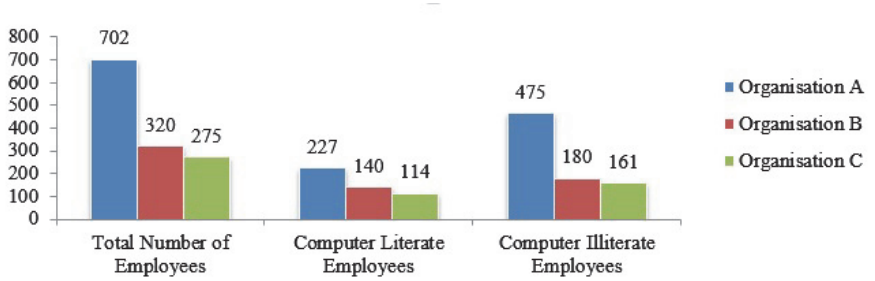

Fig 1. Computer literacy among end-users in 3 Pakistani organisations

From Organisation A, B and C, if we calculate the percentage of illiterate employees then it is approximately 67%, 56% and 58%. Computer illiterate end-users or employees affect the usability of ERP application from two perspectives. First, it would affect during the ERP implementation phase, when we give software related training to end-users (Suhonen, 2009). Secondly, after implementation or the 'go live' phase when end-users start using actual applications, it takes too much time to learn to use this application (Sadiq, 2012). This situation indicates that the employer should give computer literacy training to illiterate end-users before giving them software interface-related training.

An additional problem that has been observed during this empirical work in Pakistan is that IT management lacks knowledge and concepts related to usability. We had to tell them what usability is and how computer illiterate employees affect the usability of ERP application. Here, we would like to mention two IT managers who share their views regarding employee computer illiteracy and usability:

"It's not the matter of usability, but it's the matter of their (employees) will to use ERP application"

If we analyse and try to find out reasons behind this view, it turns out these managers are indirect users; their user-names exist in ERP application but one cannot find the history of their last use of ERP application.

3. RESEARCH METHODOLOGY

The starting point for this research was clarification of critical success as well as sub factors important for ERP implementation. In order to do this, we have completed a literature review on generic factors that have been discussed regardless of developed and developing countries. Among available literature, the article of Nagi (Ngai, 2008) forms the basis for our primary empirical work. The entire research methodology can be seen in Fig 2.

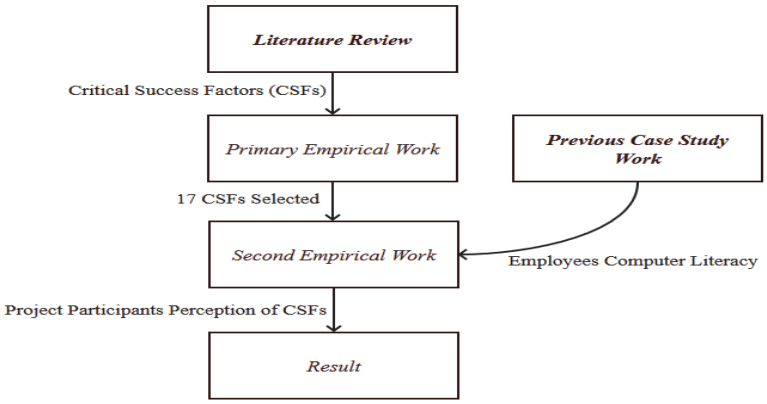

Fig 2: Research Methodology

In primary empirical work, we selected 4 project managers from two manufacturing organisations. The main purpose of primary empirical work was to identify those critical success factors perceived important in context of Pakistan. Seventeen critical success factors were identified as a result of this process. Those factors were: Top management support, business process re-engineering (BPR), project management, use of steering committee, change management, clear goals and objectives, enterprise wide communication, project champion, selecting the right team, careful selection of ERP software, ERP vendor support, management of expectations, use of ERP consultants, data accuracy, user involvement, selecting the right ERP implementation approach, and end-user training on ERP software". The factor "Computer literacy training to illiterate end-users" has been added based on our previous study (Sadiq, 2012).

Before conducting the second empirical work, a questionnaire, comprised of 4 sections, was developed (see Appendix A). The first section concerned respondents' previous project experience. The second section was a type of research agreement mentioning that this information would be kept confidential and anonymous. The third section of this questionnaire included a brief introduction to the eighteen critical success factors. The main purpose in providing this brief introduction was to reach a common understanding of the content of factors. The last section of this questionnaire was related to the eighteen CSFs and includes a 10 point Likert Scale. To survey the degree of agreement, this scale ranged from '1- important to 10- very important'. For this empirical work, we selected 25 respondents from 8 organisations. The criterion used to select these people was that they should have worked in at least one ERP implementation project. Most of data collected from these organisations are based on

paper questionnaires completed by physically visiting individuals. Only from one organisation was it sent and collected by email.

4. CRITICAL SUCCESS FACTORS AND HYPOTHESIS

The ERP system is an extremely complex and expensive piece of software. The implementation requires extensive planning. Without proper planning there is a severe risk that the system can damage the business because of potential implementation problems (Umble, 2003). It is therefore important to study factors critical for successful ERP implementation. The eighteen critical success factors and their hypothesis are discussed in this section.

4.1 Top Management Support

Top management support was the most important and frequently cited factor in literature (Ramayah, 2007; Ngai, 2008). ERP is highly interlinked business processes software that span across many organisational boundaries. Their implementation not only affect the different interest group but also many stakeholders like senior executives from different departments. In this situation when there is a political conflict between departments, the top management should play a role to resolve conflict between different stakeholders and provide clarity to any doubts (Ngai, 2008). To implement an ERP system smoothly, an organisation requires necessary resources like peoples, funds and equipment. An ERP implementation could be seriously handicapped if these resources are not available (Ramayah, 2007). Top management support in ERP implementation has two main aspects, providing leadership and providing the necessary resources to continue project (Jafari, 2006).

Fig 3: Top management support

Ho *(Null Hypothesis): Top management support is not a critical success factor if mean value is ≤ 7*

Ha *(Alternative Hypothesis): Top management support is a critical success factor if mean value is >7*

4.2 Business Process Re-Engineering (BPS)

Business process re-engineering (BPR) has been defined as "the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and speed" (Hammer, 2001). Implementing ERP in organisation requires re-engineering of existing business processes to the best of standard business ERP application processes (Bingi, 1999). Different dimension related to business processes re-engineering are organisation willingness to re-engineering, organisation readiness for change and, organisation capability of re-engineering (Zhang, 2002).

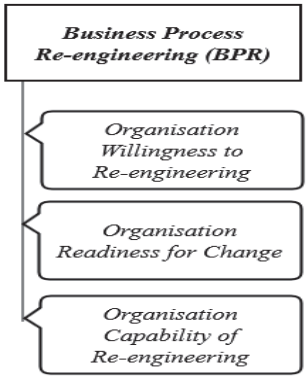

Fig 4: Business process re-engineering (BPR)

Ho *(Null Hypothesis): BPR is not a critical success factor if mean value is ≤ 7*

Ha *(Alternative Hypothesis): BPR is a critical success factor if mean value is >7*

4.3 Project Management

Project management has an important role to play in modern industrial system like ERP. ERP system is consist of extremely complex activities covering the combination of hardware, software and organisation business processes, that is why its implementation should have adopted an effective project management strategy to avoid schedule and budget overrun (Zhang, 2002). The three major activities related to project management are: a formal implementation plan, a realistic time frame, and having periodic project status meetings. In ERP implementation plan, the project manager defines project activities, and assignment of personnel to those activities (Zhang, 2002). Without having a realistic time frame, an organsiation will have to face many problems, like pressure to rush through activities in a haphazard manner, loss of people patience, low morale and resistance (Zhang, 2002). Having project status meeting with each team member is important to check the progress of ERP implementation. Project management related activities can be seen in Fig 5.

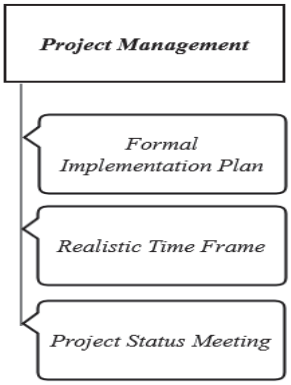

Fig 5: Project management

Ho *(Null Hypothesis): Project management is not a critical success factor if mean value is ≤ 7*

Ha *(Alternative Hypothesis): Project management is a critical success factor if mean value is >7*

4.4 Use of Steering Committee

A steering committee within a project management is a group of "Superusers" consist of senior management from different corporation function, project management representative and representative from end user to show effective means of appropriate involvement in ERP project. During the implementation phase steering committee is usually involves in monitoring the project team decision and management of outside consultants (Somers, 2001).

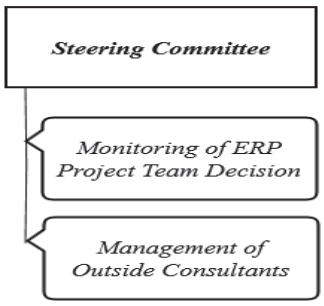

Fig 6: Steering committee

Ho *(Null Hypothesis):* Steering Committee is not a critical success factor if mean value is ≤ 7

Ha *(Alternative Hypothesis):* Steering committee is a critical success factor if mean value is >7

4.5 Change Management

Many organisations take ERP implementation as simply installing the IT tool. Their understanding of ERP implementation is from technology point of view, and they undermine the challenge from the way the organisations operates (Umble, 2003). Problems with this view are multiple, one of the most significant being is the changes in processes and ways of working are neglected in change management and end-user training (Umble, 2003; Ramayah, 2007).

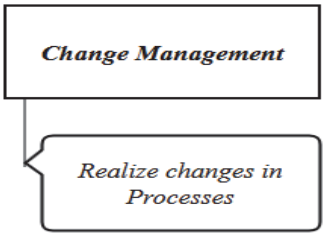

Fig 7: Change management

Ho *(Null Hypothesis):* Change management is not a critical success factor if mean value is ≤ 7

Ha *(Alternative Hypothesis):* Change management is a critical success factor if mean value is >7

4.6 Clear Goals and Objectives

Clear goals and objectives are critical for successful ERP implementation. Before going to start any other activity, the ERP project goals should be defined first. The organisation should have a clear business need for implementing a new ERP systems. The "triple constraint" to clear goals and objectives are scope goal, time goal and cost goals (Somers, 2003).

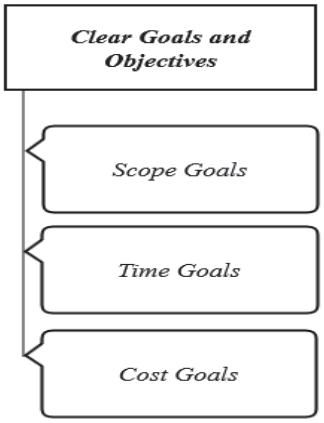

Fig 8: Clear goals and objectives

Ho *(Null Hypothesis):* Clear goals and objectives is not a critical success factor if mean value is ≤ 7

Ha *(Alternative Hypothesis):* Clear goals and objectives is a critical success factor if mean value is >7

4.7 Enterprise Wide Communication

There are two type of communication during ERP implementation, one is inwards to the ERP project team and other is outwards to whole organisation (Jafari, 2006).

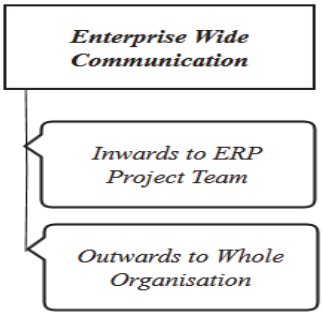

Fig 9: Enterprise wide communication

Ho *(Null Hypothesis):* Communication is not critical success factor if mean value is ≤ 7

Ha *(Alternative Hypothesis):* Communication is a critical success factor if mean value is >7

4.8 Project Champion

A project champion is a person who performs the crucial functions of transformational leadership, facilitation and marketing the project to the users. The appropriate person for performing project champion role is the Chief Information Officer (CIO) or Chief Executive Officer in charge of Information Technology (IT) (Ramayah, 2007). The different functions of project champion can be seen in Fig 10.

Fig 10: Project champion

Ho *(Null Hypothesis):* Project champion is not critical success factor if mean value is ≤ 7

Ha *(Alternative Hypothesis):* Project champion is a critical success factor if mean value is >7

4.9 Selecting the Right Team

Selecting the right project team, which is not only technologically competent but also understand the company and its business requirements is important throughout the ERP implementation (Ngai, 2008).

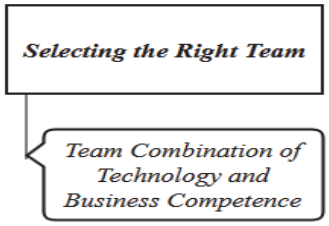

Fig 11: Selecting the right team

Ho *(Null Hypothesis):* Selecting the right team is not critical success factor if mean value is ≤ 7

Ha *(Alternative Hypothesis):* Selecting the right team is a critical success factor if mean value is >7

4.10 ERP Software Selection

It is important to select the right software package that best matches with existing company business processes. This will ensure minimal modification and increase the chances of successful implementation (Somers, 2003).

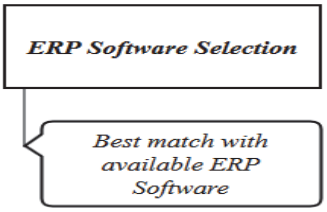

Fig 12: ERP software selection

Ho *(Null Hypothesis):* Selecting the right ERP software package is not a critical success factor if mean value is ≤ 7

Ha *(Alternative Hypothesis):* Selecting the right ERP software package is a critical factor if mean value is >7

4.11 ERP Vendor Support

ERP system is a lifetime commitment from software vendor. There will always be new modules and updating of versions to achieve better alignment between business and system (Ramayah, 2007). Different dimensions related to ERP vendor support are service response time, qualified consultants and vendor participation in ERP implementation (Zhang, 2005).

Fig 13: ERP vendor support

Ho *(Null Hypothesis):* ERP vendor support is not a critical success factor if mean value is ≤ 7

Ha *(Alternative Hypothesis):* ERP vendor support is a critical success factor if mean value is >7

4.12 Management of Expectation

It is the ability of an ERP system to meet specific stakeholder group expectations, starting from development of business case to training people (Akkermans, 2002; Somers, 2004).

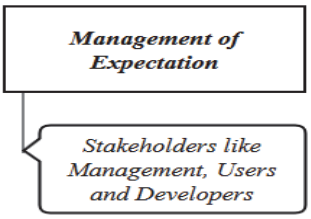

Fig 14: Management of expectation

Ho *(Null Hypothesis):* Management of expectation is not a critical success factor if mean value is ≤ 7

Ha *(Alternative Hypothesis):* Management of expectation is a critical factor if mean value is >7

4.13 Use of ERP Consultant

Use of consultant to implement ERP application is common practice in most of the organisations. Consultants experience in specific industries, comprehensive knowledge about certain modules, and their technical and interpersonal skill are important for successful implementation (Somers, 2003; Bingi, 1999).

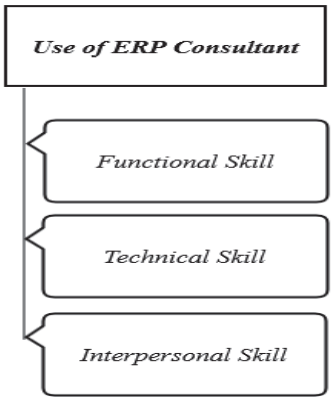

Fig 15: Use of ERP consultant

Ho *(Null Hypothesis):* Use of ERP consultant is not a critical success factor if mean value is ≤ 7

Ha *(Alternative Hypothesis):* Use of ERP consultant is a critical factor if mean value is >7

4.14 Data Accuracy

ERP modules are integrated with one another, inaccurate data input to one module will affect the functionality of other modules. So data accuracy is very important for an ERP system to function properly (Umble, 2003).

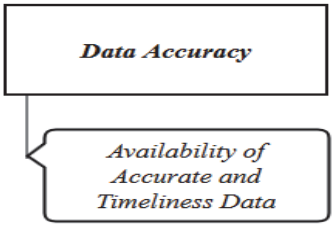

Fig 16: Data accuracy

Ho *(Null Hypothesis):* Data accuracy is not a critical success factor if mean value is ≤ 7

Ha *(Alternative Hypothesis):* Data accuracy is a critical success factor if mean value is >7

4.15 User Involvement

If user will see the ERP application late in the training phase then their motivation towards the use of new ERP system could also suffer (Vilpola, 2005). There are two areas of user involvement in ERP implementation: user involvement at definition of organisation needs, and user participation during the ERP implementation (Zhang, 2002).

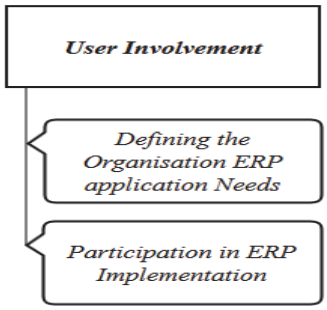

Fig 17: User involvement

Ho *(Null Hypothesis):* User Involvement is not a critical success factor if mean value is ≤ 7

Ha *(Alternative Hypothesis):* User involvement is a critical success factor if mean value is >7

4.16 ERP Implementation Approach

Selecting the right ERP implementation approach that best suit to specific organisation requirement, is important for successful implementation. There are several implementation approaches but are variant of big bang, phased, parallel, process line and hybrid (Leon, 2009).

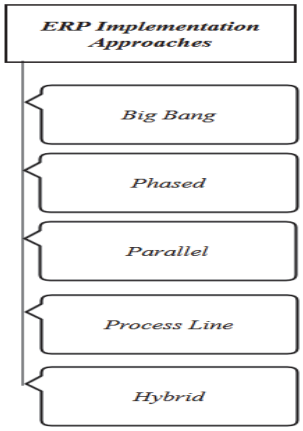

Fig 18: ERP implementation approaches

Ho *(Null Hypothesis):* Selecting the right ERP implementation approach is not a critical success factor if mean value is ≤ 7

Ha *(Alternative Hypothesis):* Selecting the right ERP implementation approach is a critical success factor if mean value is >7

4.17 End-user Training on ERP Software

In organisation setting, almost everyone has to use new ERP system. Without giving the proper training to end user there is chance that about 30 percent to 40 percent of front line worker will note be able to handle the demand of the new ERP application (Bingi, 1999). Different dimension related to software training are: training on software features and functional training (Zhang, 2002).

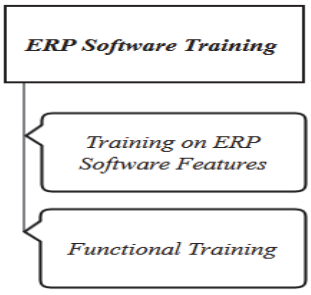

Fig 19: ERP software training

Ho *(Null Hypothesis):* ERP software training is not a critical success factor if mean value is ≤ 7

Ha *(Alternative Hypothesis):* ERP software training is a critical success factor if mean value is >7

4.18 Computer Literacy Training to Illiterate End-Users

ERP is a complex piece of software unlike 'WordPad' or 'Excel', which users can learn and start using quickly (Sadiq, 2012; Bingi, 1999). Within the context of the ERP application, much emphasis has been placed on ERP functional or software interface related training (Xue, 2005; Amoako-Gyampah, 2004), which is usually provided near the time of the 'go live'. However, the importance of recognising and providing computer literacy training to illiterate end-users prior to providing interface-related training is still not adequately stressed in most of ERP implementation projects in Pakistan (Sadiq, 2012) or abroad (Suhonen, 2009). Ignoring computer literacy training to illiterate end-users has many consequences. First of all, individual basic requirements for computer skills to effectively use ERP software has been completely overlooked (Sadiq, 2012). Secondly, if there is significant mismatch between employee skillset and the task, this can lead to anxiety and a negative attitude toward the use of applications (Smyslova, 2009).Third, in Pakistan, where there are approximately more than 40% illiterate key end- users, it will not only affect software interface-related training but also time taken to learn to use ERP application, which will increase after the 'go live' phase (Sadiq, 2012).

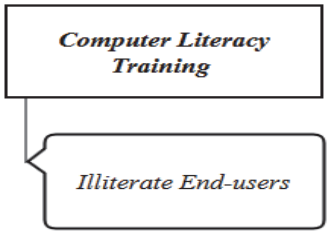

Fig 20: Computer Literacy training to illiterate End-users

Ho *(Null Hypothesis):* Computer literacy training to illiterate end-users is not a critical success factor if mean value is ≤ 7

Ha *(Alternative Hypothesis):* Computer literacy training to illiterate end-users is a critical success factor if mean value is >7

5. RESULT AND DISCUSSION

In this study, we have collected data from 8 organisations and 25 valuable project participants. The minimum criteria in selecting a participant was that he/she work on at least one ERP implementation project. For ERP implementation, there are normally two types of peoples involved, one from the client's side and the other from the consultant

side organisation. The people from the consultant side organisation are responsible for the implementation of the ERP system in client organisation. The details of the 25 participants are presented in the following Table 1. Same sector (manufacturing) organisations are gathered into one group.

Table 1: Total number of Respondents

Organisations Sector	ERP Vendor	Respondents	Experience	No of Projects	Organisation Type
Chemical	SAP	A	4 Years	1	Client Side
		B	4 Years	1	Client Side
		C	5 Years	1	Client Side
Manufacturing	ORACLE	D	2 Years	1	Client Side
		E	7 Years	2	Client Side
		F	6 Years	2	Client Side
		G	3 Years	2	Consultant Side
		S	3 Years	1	Client Side
		T	4 Years	3	Consultant Side
		H	2 Years	2	Consultant Side
		I	4 Years	2	Client Side
		J	6 Years	4	Consultant Side
		K	10 Years	6	Client Side
		L	3 Years	1	Client Side
		M	5 Years	2	Client Side
		N	6 Years	2	Client Side
		O	8 Years	10	Consultant Side
Distribution	ORACLE	P	3Years	1	Client Side
		Q	6 Years	2	Client Side
		R	10 Years	3	Client Side
Communications	ORACLE	U	5 Years	5	Consultant Side
		V	5 Years	7	Consultant Side
		W	6 Years	6	Consultant Side
		X	7 Years	3	Client Side
		Y	7 Years	3	Client Side
		Number of Respondent: **25**			
		Total Number of ERP Implementation Projects: **73**			

5.1 Holistic Perception and Hypothesis Testing

We have performed three types of analysis on critical success factors (CSFs). The first analysis is from a holistic point of view, in which all results from 25 respondents are presented. The other two analyses are from the client side and consultant side participant which have been discussed in sections 5.2 and 5.3. Table 2 shows the holistic analysis of each of the critical success factors (CSFs) from their level of importance in mean value. The top five critical success factors are top management support, project management, clear goals and objectives, careful selection of ERP software, and data accuracy. Interestingly, the local factor of computer literacy training to illiterate end-users is more important than some generic factors such as use of a

steering committee, management of expectations, ERP vendor support, and project champion.

Table 2: Holistic analysis of CSFS with their degree of Importance

	Critical Success Factors (CSFs)	Mean	Alpha	Ho (Null Hypothesis <7) Ha (Alternative Hypothesis ≥ 7)
1	Top Management Support	9.31	.826	**Reject null Hypothesis** Top management support is critical to ERP Implementation
2	Project Management	9.27	.819	**Reject null Hypothesis** Project management is critical to ERP Implementation
3	Clear Goals and Objectives	9.04	.805	**Reject null Hypothesis** Clear goals and objectives are critical to ERP Implementation
4	Careful selection of ERP software	8.90	.805	**Reject null Hypothesis** Careful selection of ERP software is critical to ERP Implementation
5	Data accuracy and Integration	8.72	.796	**Reject null Hypothesis** Data accuracy and integration is critical to ERP Implementation
6	Users Involvement	8.72	.803	**Reject null Hypothesis** User involvement is critical to ERP Implementation
7	End-user Training on ERP Software	8.59	.802	**Reject null Hypothesis** End-user Training on ERP software is critical to ERP Implementation
8	Careful Selection of ERP Implementation approach	8.59	.809	**Reject null Hypothesis** Careful selection of ERP Implementation approach is critical to ERP Implementation
9	Selecting the right Project team	8.50	.797	**Reject null Hypothesis** Selecting the right project team is critical to ERP Implementation
10	Change Management	8.40	.809	**Reject null Hypothesis** Change management is critical to ERP Implementation
11	Business Process Re-engineering (BPS)	8.31	.823	**Reject null Hypothesis** Business process Re-engineering is critical to ERP Implementation
12	Enterprise wide communication	8.18	.820	**Reject null Hypothesis** Enterprise wide communication is critical to ERP Implementation
13	Use of ERP consultant	8.09	.805	**Reject null Hypothesis** Use of ERP consultant is critical to ERP Implementation
14	Computer literacy training to illiterate end-users	8	.817	**Reject null Hypothesis** Computer literacy training to illiterate end-users is critical to ERP Implementation
15	Use of Steering Committee	7.77	.832	**Reject null Hypothesis** Use of steering committee is critical to ERP Implementation
16	Management of	7.63		**Reject null Hypothesis**

	Expectation		.802	Management of expectation is critical to ERP Implementation
17	ERP Vendor support	7.40	.813	**Reject null Hypothesis** ERP vendor support is critical to ERP Implementation
18	Project Champion	7.36	.799	**Reject null Hypothesis** Project champion is critical to ERP Implementation

The other two analyses we have performed on this holistically perspective is from a reliability and hypothesis point of view. Reliability coefficients, the cronchbach's alpha, is used to check internal consistency. From the above table, the minimum and maximum values of alpha are between .796 and .832 which shows high internal consistency. The last test we performed on holistic perception of these critical success factors (CSFs) is related to the hypothesis. The mean values range from 7.36 to 9.31, above our test value of 7. The results provide strong support that all factors, including the local factor of providing computer literacy training to illiterate end-users, are important for ERP implementation in organisational settings in Pakistan.

5.2 Project Participant Experience from Client Side Organisations

For further analysis, we divided the respondents into two groups. One group has background experience from the client's side, while the other is from the consultant side organisations. The visibility of these two group can be seen from the above table, Table 1. In this section we would like to discuss the results from those respondents who have background experience from client side organisations. The total number of respondents for this analysis was 17, with 34 as the number of implementation projects among them. The top five critical success factors are top management support, clear goals and objectives, project management, care selection of ERP software, and business processes re-engineering. The local factor is at number 13 and is more important than some generic factors, such as use of steering committee, use of ERP consultants, project champions, ERP vendor support and management of expectation.

Table 3: Client Respondents analysis of CSFS

Respondents Experience from Client Side Organisations		**Mean**	**SD**
1	Top Management Support	9.43	0.96
2	Clear Goals and Objectives	9.18	1.27
3	Project management	9.06	1.18
4	Careful selection of ERP software	8.93	1.52
5	Business Process Re-engineering (BPS)	8.75	1.12

6	Change Management	8.63	1.40
7	Data accuracy and Integration	8.62	1.66
8	Selecting the Right Project team	8.56	1.41
9	Careful Selection of ERP Implementation approach	8.50	1.21
10	Enterprise wide communication	8.47	1.54
11	Users Involvement	8.43	1.75
12	End-user Training on ERP Software	8.31	1.92
13	Computer literacy training to illiterate end-users	8.12	1.74
14	Use of Steering Committee	7.87	2.24
15	Use of ERP consultant	7.75	1.98
16	Project Champion	7.58	1.63
17	ERP Vendor support	7.56	2.44
18	Management of Expectation	7.53	1.45

5.3 Project Participants Experience from Consultant side Organisations

The total number of respondent for this analysis was 8, with the number of projects among them 39. According to this analysis, the top five critical success factors are project management, user involvement, end-user training on ERP software, use of ERP consultant, and data accuracy and integration. The local factor is more important compared to the five generic factors, as can be seen from Table 3.

Table 4: Consultant analysis of CSFs with their degree of Importance

Respondents Experience from Consultant Side Organisations		Mean	SD
1	Project management	9.83	0.40
2	Users Involvement	9.50	0.83
3	End-user Training on ERP Software	9.33	0.81
4	Use of ERP consultant	9.11	0.89
5	Data accuracy and Integration	9.8	1.54
6	Top Management Support	9.2	1.67
7	Careful selection of ERP software	8.89	1.62
8	Careful Selection of ERP Implementation approach	8.83	1.60
9	Clear Goals and Objectives	8.66	1.50
10	Selecting the right Project team	8.33	1.63
11	Management of Expectation	7.83	1.83
12	Change Management	7.83	2.04
13	Computer literacy training to illiterate end-users	7.66	2.42

14	Use of Steering Committee	7.59	2.07
15	Enterprise wide communication	7.50	3.98
16	Business Process Re-engineering (BPS)	7.16	1.72
17	ERP Vendor support	7	3.40
18	Project Champion	6.83	2.13

Comparison between two Respondent Groups

Comparing results from two respondent groups shows several differences, as can be seen in Fig 21. The first major difference is in the factor of business process re-engineering (BPR). This factor is at number 5 and number 16; it is more important according to respondents with background experience in client side organisations. The second difference is in the factors of project management and top management support. The respondent with background experience from the consultant side give more weight to project management, while the other group gives more importance to top management support. The final difference is in the factor of use of ERP consultants. This factor is more important according to respondents with experience from consultant side organisations.

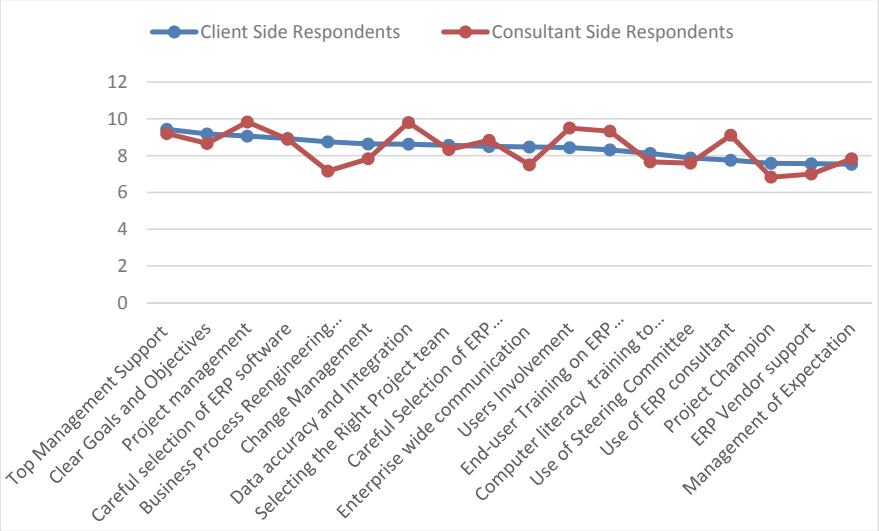

Fig 21: Comparison of Client side and Consultant side respondents

6. CONCLUSION AND LIMITATION

Usability has been a topic of interest in many developed countries for at least two decades. However, this concept has yet to receive attention in an industrial context of developing countries such as Pakistan. Computer illiterate employees affect the usability of ERP application during and after its implementation. This issue is expected

to stay constant for another five to eight years, especially in the manufacturing sector of Pakistan. In this sector, the average employee does not have a basic computer literacy before he or she uses ERP application. Therefore, it is important to provide computer literacy training to illiterate employees prior to providing them with software interface training. The factor of giving computer literacy training to illiterate end-users is related to partial failure when the expected productivity of employees cannot be reached. The purpose of critical success factors (CSFs) is to avoid complete or partial failure and to focus instead on factors that are important for successful implementation. The major findings of this research are threefold. From a holistic perspective (25 project participants) analysis point of view, the five most import factors are top management support, project management, clear goals and objectives, careful selection of ERP software, and data accuracy. However, local factor "computer literacy training to illiterate end users" is critical and in some ways more important than some generic factors, such as steering committee, management of expectations, ERP vendor support, and project champions. Further analysis shows that individuals with background experience from client side organisations give more importance to top management support, clear goals and objectives, project management, careful selection of ERP software, and business process re-engineering (BPS). In contrast, participants with previous experience from consultant side organisations give more weight to factors such as project management, user involvement, end-user training on ERP software, use of ERP consultants, data accuracy, and integration. The least important factors among these three analyses were project champions, use of steering committee, and ERP vendor support.

6.1 Limitation

There are several limitations in this study. First, the sample size of 25 (from 8 organisations) is relatively small. Obtaining more valuable results would require a larger sample size from many more organisations. Secondly, bias lies in the organisational sector of respondents. Most of the respondents have ERP implementation experience from the manufacturing sector, so there is a need to validate these critical success factors (CSFs) from other sectors, such as banking, etc.

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Evaluating Critical Success Factors for ERP Implementation

1	Name:
2	Current Position:
3	Work Experience with Oracle ERP System:
4	Work Experience with other ERP System:
5	No of ERP Implementation Project work done & Roles:
6	Name of Implementation Organisations:

The purpose of this study is to evaluate eighteen (18), Critical Success Factors (CSFs) in ERP implementation processes. Factors (CSFs) from 1 to 17 are based on existing literature while Factor 18 has been added after analyzing the Pakistan organisational environment. The findings of this study will help us to understand the most important CSFs for the successful implementation. You are requested to think about all the roles that you have performed during ERP Implementation.

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 18 CSFs (which start on the following page) and do rank (**1: Important** to **10: Very Important**) in your opinion.

Thank you!

Brief Introduction to Critical Success Factors (CSFs)	
Top Management Support	Top management support in ERP implementation has two main aspects: (1) providing leadership; and (2) providing the necessary resources like funds to continue project.
Business Process Re-engineering (BPS)	Different dimensions related to BPR are: (1) Companies willingness to re-engineering; (2) Companies readiness for change; (3) Companies capability of reengineering.
Project management	The three major parts of project management are: (1) having a formal implementation plan, (2) a realistic time frame, and (3) having periodic project status meetings.
Use of Steering Committee	A steering committee within a project management is a group of "Superusers" consist of senior management from different corporation function, project management representative and representative from end user to show effective means of appropriate involvement in ERP project. During the implementation phase steering committee is usually involves in monitoring the project team decision and management of outside consultants.
Change Management	Many organisations view ERP implementation simply installing IT tool. Problems with this view are multiple, one of the most significant being is the changes in processes and ways of working are neglected in change management and end-user training.
Clear Goals and Objectives	Clear goals and objectives are essential to guide an ongoing organisational effort for ERP implementation. The "triple constraint" of project management specifies three often competing and interrelated goals that need to be met: scope, time, and cost goals.
Enterprise wide communication	There are two type of communication during ERP implementation process: (1) inwards the project team, and (2) outwards to the whole organisation.
Project Champion	A project champion is a person who performs the crucial functions of transformational leadership, facilitation, and marketing the project to the users. The appropriate person for performing project champion role is the Chief Information Officer (CIO) or Chief Executive Officer in charge of Information Technology (IT).
Selecting the Right team	Selecting the right team member, which is not only technologically competent but also understand the company and its business requirements is important throughout the ERP implementation.
Careful selection of ERP software	Choosing the right ERP package that best matches the organisational information needs and processes is critical to ensure minimal

	modification and successful implementation.
ERP Vendor support	Three dimensions to ERP vendor support are: (1) service response time; (2) qualified consultants with knowledge and ability in both enterprises business processes and information technology including vendors ERP systems; and (3) participation of vendor in ERP implementation.
Management of Expectation	It is the ability of an ERP system to meet specific stakeholder group expectations.
Use of ERP Consultant	Consultants experience in specific industries, comprehensive knowledge about certain modules, and may be better able to determine which suite will work best for a given company is important for successful ERP implementation.
Data Accuracy and Integration	ERP modules are integrated to one and other, inaccurate data input into one module will affect the functionality of other modules.
Users Involvement	There are two areas for user involvement when the company decides to implement an ERP system: (1) user involvement at definition of organisation needs, and (2) user participation the implementation of ERP systems.
Careful Selection of Implementation approach	There are several Implementation approaches but most of them are variants of the five basic types: a) Big Bang b) Phased c) Parallel d) Process Line e) Hybrid
End-User Training on ERP Software	Training is another crucial critical success factor in ERP implementation. Everyone who will use ERP systems needs to be trained on a new ERP application in order to use it to continue day to day operations. Two dimension related to software training are: 1) training on software features, 2) functional training.
Computer literacy Training to Illiterate End-User	ERP application is complex piece of software. It is not like a 'WordPad' that a user can learn quickly. Ignoring computer literacy training to illiterate end-users has many consequences. First of all, individual basic requirements for computer skills to effectively use ERP software has been completely overlooked. Secondly, if there is significant mismatch between employee skillset and the task, this can lead to anxiety and a negative attitude toward the use of applications. Third, in Pakistan, where there are approximately more than 40% illiterate key end-users, it will not only affect software interface-related training but also time taken to learn to use ERP application, which will increase after the 'go live' phase.

Critical Success Factors (CSFs)			1	2	3	4	5	6	7	8	9	10	
1	Top Management Support	Important	□	□	□	□	□	□	□	□	□	□	Very Important
2	Business Process Re-engineering (BPR)	Important	□	□	□	□	□	□	□	□	□	□	Very Important
3	Project Management	Important	□	□	□	□	□	□	□	□	□	□	Very Important
4	Use of Steering Committee	Important	□	□	□	□	□	□	□	□	□	□	Very Important
5	Change Management	Important	□	□	□	□	□	□	□	□	□	□	Very Important
6	Clear Goals and Objectives	Important	□	□	□	□	□	□	□	□	□	□	Very Important
7	Enterprise wide Communication	Important	□	□	□	□	□	□	□	□	□	□	Very Important
8	Project Champion	Important	□	□	□	□	□	□	□	□	□	□	Very Important
9	Selecting the Right Team	Important	□	□	□	□	□	□	□	□	□	□	Very Important
10	Careful selection of ERP Software	Important	□	□	□	□	□	□	□	□	□	□	Very Important
11	ERP Vendor Support	Important	□	□	□	□	□	□	□	□	□	□	Very Important
12	Management of Expectation	Important	□	□	□	□	□	□	□	□	□	□	Very Important
13	Use of ERP Consultant	Important	□	□	□	□	□	□	□	□	□	□	Very Important
14	Data accuracy and Integration	Important	□	□	□	□	□	□	□	□	□	□	Very Important
15	Users Involvement	Important	□	□	□	□	□	□	□	□	□	□	Very Important
16	Selecting the right ERP Implementation approach	Important	□	□	□	□	□	□	□	□	□	□	Very Important
17	ERP Software Training	Important	□	□	□	□	□	□	□	□	□	□	Very Important
18	Computer Literacy Training to illiterate End-user	Important	□	□	□	□	□	□	□	□	□	□	Very Important

II

COMPUTER LITERACY IS AN IMPORTANT FACTOR TO IMPROVE USABILITY IN ERP APPLICATION

by

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COMPUTER LITERACY TRAINING IS AN IMPORTANT FACTOR TO IMPROVE USABILITY IN ERP APPLICATION

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ABSTRACT

Over the last decade, the subject of usability has received a great deal of attention. One of the reasons for this increased attention is that technology use has shifted away from experts towards ordinary individuals. The expectation for the ordinary individual to have more ease of use and to learn the product has increased. Usability, as a package, not only refers to one's ability to use hardware, software, menus, icons, and online help, but can also be affected if the user lacks computer literacy. Recently, researchers have begun investigating the usability issues of commercial off-the-shelf (COTS) software applications, such as enterprise resource planning (ERP) systems. Within the context of the ERP application, much emphasis has been placed on software interface-related training, which is usually provided nearer the time of the 'go live' activity. But the importance of recognising and providing computer literacy training to employees is still not stressed enough in most ERP implementation projects. In this study, we used employee data from three case organisations to examine computer literacy. After analysing the sample organisations departmental data, we discovered that approximately 56% to 66% of employees lacked basic computer skill. Out of the three organisations, only one provided computer literacy training to its employees at the time of ERP implementation. Further analysis shows that the company that provided computer literacy training to its employees experienced positive attitudes towards the use of the product. This resulted in a decrease in learning time. In conclusion, we would like to highlight computer literacy training as an important factor that should be provided before software interface-related training.

KEYWORDS

Usability, Enterprise Resource Planning, Context of use, Computer literacy training.

1. INTRODUCTION

Usability is not a last-minute activity in the design and development phases of a product; organisations should be proactive when considering usability. Usability activity should be used to think ahead before user requirements are established. According to ISO 9241 standards, '*Usability is the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use*'. The usability of a product is not only affected by the applications features or functions, but it can also be affected by the context characterised by different users (Alonso-Ríos et al., 2010). The context of use analysis is defined as the analysis of users and their characteristics (input device skill, qualifications, language skills, etc.), the tasks they carry, and the environment where they are using the product (Martin, 2001). Recently, researchers have begun investigating the usability of commercial off-the-shelf (COTS) software such as ERP applications. However, examining the usability of commercial off-the-shelf ERP applications is a challenging task that demands further exploration. The purpose of implementing an ERP application, such as SAP or ORACLE, is to improve the organisation's performance (Aloini et al., 2009). Organisations have various motivations for ERP implementation. These motivations can be categorised using technical, operational, or business and strategic dimensions (Parr & Shanks, 2000; Shehab et al., 2004). In the technical dimension, the main reason for implementing ERP is to have a common IT platform for the integration of cross-function business processes. The operational or business dimension includes process improvement, data visibility, operating cost reduction, and reducing inventory. The strategic dimensions include multi-site standardisation and improved decision making, as well as an increased need for efficiency, integration, and business restructuring.

Despite the numerous motivations and reasons for adopting an ERP application, the actual implementation requires careful planning and may cost millions of dollars. It also has shortcomings because of tight integration of modules and data (Shehab et al., 2004). Some of shortcomings include functionality (project tracking and report deficiencies, cash-flow and planning deficiencies), technological (integration between the ERP system and non-ERP systems, deficiencies in data interfaces), and usability (report terminology that's difficult to understand, lack of online help, and the challenge to learning) (Bhatti & Jayaraman, 2008; Charles, 2004). The expectation of users that ERP software will be easy to learn and use has motivated ERP software vendors to improve the usability of ERP application. But still, the time it takes to learn to use an ERP software application is too long. Depending on the user's skill and system knowledge, it can last from a few months to more than eight months. Like the ERP software interface user's skill, the issue of computer literacy of the end user is still unknown in most of the literature. In the literature, much emphasis has been placed on software interface training, which is usually provided nearer the time of the 'go live' activity (Umble et al., 2003). But the importance of recognising and providing computer literacy training to the end user before the software interface-related training is not stressed enough in ERP implementation projects. Computer literacy is also required for all levels of IT-related work in society (Pawlowski et al., 2008).

This paper is structured as follows. In section 2, we discuss the basic requirement to use an ERP application. Section 3 discusses three case studies, comparisons of employee computer literacy, and the impact of providing computer literacy training to employees. In conclusion, we highlight the issue of computer literacy and recommend providing basic computer literacy training to employees before giving them software interface-related training.

2. BASIC REQUIREMENT TO USE AN ERP APPLICATION

Commercial off-the-shelf applications, like ERP, are complex pieces of software. The average implementation time that is needed for an ERP product is anywhere from six months to several years. The implementation costs approximately USD1 million (Aloini et al., 2009). An ERP application is not like an Excel application that a user can install quickly and learn easily. The ERP application changes the way people do business (Aloini et al., 2009). It also changes the way end users work. The integration environment of business processes causes the end user to enter more information into the user interface as compared to normal software. This requires not only an understanding of the business process but, in order to use the ERP application effectively and efficiently, end users are also required to have computer literacy. Normally ERP users have to perform several transactions in order to complete one business process (Topi et al., 2005). To elaborate on this point, let's examine Figure 1, which is an example of a task for generating a move order requisition.

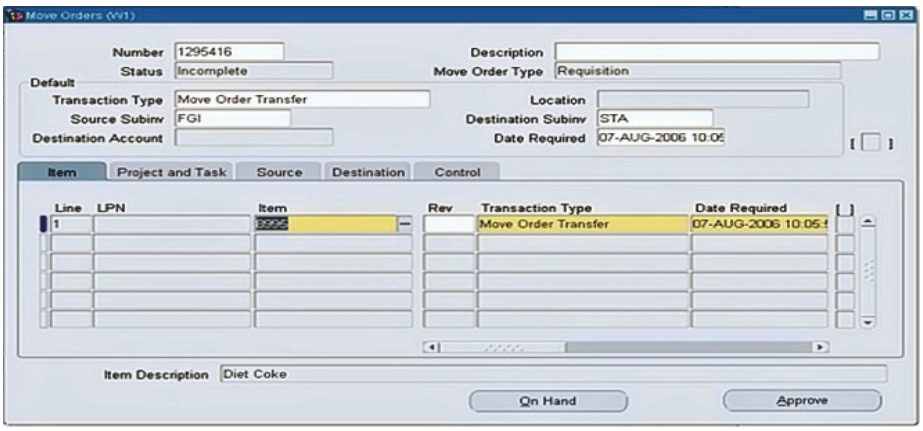

Figure 1. Generating a move order requisition (Tyra, 2006)

A move order requisition is a basic task that end users of an ERP application perform on a daily basis. It is used to request the movement of material from one store to another. Only authorised users who have the assigned responsibility of making move order requisitions will be able to enter the information in the

move order window. First, the user needs to navigate to the 'Move Order' window. As can be seen in Figure 1, users can enter the information into two levels: header and line. The header level information begins by giving the move order number. The user can enter this manually or by pressing tab; the system will then generate an automatic number for the move order. Users can provide the reason for the item in the optional 'Description' field. The 'Status' field displays the information as 'Incomplete'. The move order status is incomplete until it has been approved by an employee with a higher designation in the department. At the header level, the default section includes fields related to transaction type, location, etc., which can be used to override information at the line level. Users can select two transaction types: 'Move Order Transfer' or 'Move Order Issue'. A transfer means that there has been a request for movement of material from one locator to another. A locator is defined as the physical area for storing an item. A move order 'issue' transaction type is used to request the material from the store. Before requesting the material, users can check the item availability in the stores by using the 'On Hand' button. The requested item code information can be entered at the line level tab 'Item'. Users can select the required item code from a list of values either by mouse click or by using shortcut keys. Depending on the size of the organisation, the user may have to enter numerous daily transactions. So here, the role of shortcut keys is important for entering the item code information in the move order window. Compared to using a mouse, shortcut keys make tasks easier to perform. For the list of values to show, users can use Ctrl + L. In order to use the shortcut key efficiently, users should know how to use the keyboard. This detailed discussion highlights the basic requirements to use an ERP application. (Tyra, 2006)

3. RESEARCH METHODOLOGY

To approach this study, we have used case study research methodology. We selected three organisations from Pakistan to assist us in examining usability. All of these organisations have been using ERP software for one and half years. ERP implementation can be divided into three categories: comprehensive, middle of the road, and vanilla (Parr & Shanks, 2000). These categories are based on five characteristics: physical scope, business process re-engineering scope, technical scope, module implementation strategy, and resource allocation. In terms of physical scope, the characteristics of an ERP implementation might involve a single site, multiple sites within a country, or multiple sites in different countries. Implementation organisations can align themselves with the ERP business process or be independent of it (Parr & Shanks, 2000). In the technical scope, the organisation decides how much modification it needs for ERP application. The implementation category of Organisations A and B can be defined as Middle of the Road, whereas Organisation C, as Vanilla, as shown in the following table 1.

Table 1. ERP Organisation case study work

Organisations	*Organisation A*	*Organisation B*	*Organisation C*
Industry type	Oil & Gas	Manufacturing	Manufacturing
Category	Middle of the Road	Middle of the Road	Vanilla
Approach	All Module	Module-by-Module	All Modules
Implementation	Consultant	Project Manager	Consultant
ERP Application	Utility & Billing V2.2	EBS Suite R12	EBS Suite11.5.10

There are two main types of ERP implementation approach, module-by-module or all-module approach. Organisations A and C use the all-module implementation approach, while Organisation B uses the module-by-module approach. In the module-by-module approach, the organisation should first implement one module and then integrate it into an existing system before starting with another module. In the all-module approach, all of the modules are first implemented simultaneously and are connected later to an existing system (Parr & Shanks, 2000). For the ERP implementation approach, Organisations A and C hired external consultants, while in Organisation B the project managers, who were expert, had the responsibility for implementation.

3.1 Employee Computer Literacy Data Collection and Analysis

To acquire the organisational employee computer literacy and education data, we conducted interviews with six key users who work in the IT department of those three case organisations. The key users were involved in providing the training to end users during the time of implementation. Organisations B and C did not try to give this their attention, and considered fetching the employee computer literacy data during

their ERP software implementation processes. Post-implementation computer literacy data analysis from Organisations B and C is mainly based on employees' educational backgrounds, telephone inquiry, and personal interaction of the key users with end users during the software interface user training. Only Organisation A attempted to obtain and prepare proper computer literacy data from their employees during the time of ERP implementation. In fact, obtaining computer literacy data was one of the columns on their resource planning sheet. In Organisation A, the department head or section head was responsible for obtaining and providing information regarding general computer literacy to the IT department. Sample employee departmental literacy data from different departments in Organisations A, B, and C can be seen in the following Figure 2.

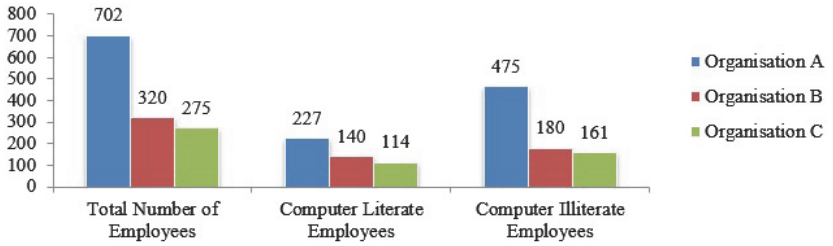

Figure 2. Column chart for employee information

From Organisation A, only 227 out of 702 employees were computer literate, while 475 were illiterate. If we convert this into a percentage, then approximately 66% of employees from Organisation A were computer illiterate during the time of ERP implementation. Likewise, approximately 56% of employees from Organisation B and 58% of employees were computer illiterate during the time of ERP implementation. As a total, about 62% of the sample employees from all three organisations were computer illiterate. This is a very alarming figure, and requires a proper analysis of employee computer literacy at the beginning of ERP implementation phases.

3.2 Impact of Providing Computer Literacy Training to Employees

After analysing the employee computer literacy data, Organisation A arranged a two-week literacy training program for those end users who needed it. To the best of our understanding, the issue of providing IT training to employees in Organisation A was not only recognised by the organisation's management, but there is a possibility that this issue was brought up by the external consultant. To see the impact of providing IT literacy training to employees, we asked one specific pending transaction-related question of six individuals, two from each organisation. These individuals work as application developers and system administrators for the ERP application.

Table 2. Pending transaction questionnaire from end user point of view

Question 1.	**For how long after the 'go live' phase activity did you observe the pending transaction issue, regardless of any other technical issues?**
Organisation A Users	Approximately 4 Months
Organisation B Users	Approximately 8 Months
Organisation C Users	Approximately 7 Months

As can be seen from Table 2, the time to learn to use an ERP application for Organisation A was three to four months less when compared to the other two organisations. This is because employees who received computer literacy training were more motivated and committed to learn the application, as compared to users from the other organisations who received software interface training closer to the 'go

live' activity. Organisations can improve usability by giving their employees IT literacy training before giving software interface-related training.

4. CONCLUSION

Usability, as a package, not only refers to one's ability to use hardware, software, menus, icons, and online help, but it can also be affected if the user is lacking in computer literacy. Nowadays it has become the standard to change legacy systems with ERP software applications. ERP systems are complex pieces of software, and average time to implement the ERP product can be anywhere from six months to several years. The complexity of software is not only due to implementation, but also from a usability point of view. The time to learn to use an ERP application is too long. The integration environment of business processes causes end users to enter more information in the user interface as compared to normal software. This requires not only understanding the business process but, in order to use the ERP application effectively and efficiently, end users are also required to have computer literacy. But the importance of recognising and providing computer literacy training to employees before software interface training is still not stressed enough in most ERP implementation projects. In this research work, we tried to highlight the issue of employees' computer literacy from the point of view of Asian countries such as Pakistan. In conclusion, we have found that computer literacy training is an important factor in increasing usability, and organisations should consider it during the initial stages of ERP implementation.

As a future work, we would like to develop a resource planning sheet that may be useful for obtaining employee computer literacy data.

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III

USABILITY IN ERP (SINGLE AND MULTIPLE DOCUMENT INTERFACE) APPLICATION ENVIRONMENTS

by

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Usability in ERP (Single and Multiple Document Interface) Application Environments

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Abstract

The usability of complex information systems, like enterprise resource planning (ERP), is the next frontier, as the trend becomes more and more adopted in the industrial working environment. In complex information systems, the traditional usability criteria of learnability, effectiveness and efficiency have never lost their importance, even though the focus of research appears to have shifted for the consumer product. This study based on 110 responses attempt to highlight the usability issues in ERP single document interface (SDI) and multiple document interface (MDI) application environments. It also investigates the effect of negative user experience, such as 'confusion', on learnability, effectiveness and efficiency. The results indicate that the SDI is better for providing end-user usability in ERP. The results suggested that in SDI application environments, end-user confusion with the ERP system directly affected learnability but not effectiveness and efficiency. In MDI application environments, the results suggested that end-user confusion with the ERP system directly affected learnability, effectiveness and efficiency.

Keywords: Usability; Enterprise Resource Planning; Single Document Interface (SDI) Window; Multiple Document Interface (MDI) Window; Learnability; Effectiveness; Efficiency

1. *Introduction*

The history of the concept of usability arises from industrial settings and Taylorian ideals to reconcile industrial machinery with its human operator (e.g., Card et. al, 1983), that is, the whole, consisting of machines and humans, should work effectively. Usability was introduced as a means to understand the relationship between human beings and technical devices. However, when the focus of human-computer studies gradually shifted to consumer products, the role of usability changed. In industrial settings, usability was considered a means for accurate, effective performance; in the area of consumer products, that kind of criterion has value only if the consumer prioritises it. The most important aspect was not measurable efficiency but the overall experience of using the application. In marketing consumer products, the primary aim is to make the consumer consume, not to perform a given task effectively.

In practice, this has led to the seeking of entertainment rather than satisfaction of some fundamental human needs.

Even if there has been a great deal of progress in the usability of consumer products during the last few years, usability is only valued in that context if it makes people consume more. Therefore, more subjective criteria, such as user experience (UX), have gained popularity among human-computer researchers, along with the expansion of computational consumer products. UX can be describe as the "overall experience and satisfaction a user has when using a product or system" (Lumsden, 2008).

In complex information systems, subjective and possibly biased qualities like UX may play an important role. At least it is difficult to see what harm would be caused if a user of an industrial application like enterprise resource planning (ERP) finds the usage satisfying, enjoyable, fun, entertaining and motivating. It is also interesting to see whether an undesirable user experience,

such as 'confusion' with the user interfaces (SDI or MDI), would also affect typical usability attributes such as learnability, effectiveness and efficiency. There are mainly two types of methods for organising the graphic user interface window: single document interface (SDI) and multiple document interface (MDI).

In SDI, the graphical user interfaces are organised in such a way that each individual window is handled separately by the manager of the operating system's window (Wikipedia, 2014). In MDI, the information can be presented simultaneously in adjacent windows, and the system often allows child windows to be embedded in other windows (Galitz, 2007). For example, to process the order, you could collect the customer name and account number in one window and the inventory details in a second or third window (Galitz, 2007). The goal of this article is to highlight usability issues in ERP SDI and MDI application environments. This study also investigated the effects of negative user experience, such as 'confusion', on learnability, effectiveness and efficiency. The next section discusses the research methodology that is based on the survey of 110 end-users from two organisations. This is followed by the results, comparison and the conclusion.

2. *Research Methodology*

To approach this research, we used survey methodology. Two organisations from the Pakistan were contacted for collecting primary data from the end-users. The main instrument for collecting the data questionnaire comprising the following three questions:

1. Is ERP (single and multiple document window) application environment same for providing end-users usability?
2. Does end-user confusion with the user interfaces in an ERP SDI environment affect learnability, effectiveness and efficiency?
3. Does end-user confusion with the user interfaces in an ERP MDI environment affect learnability, effectiveness and efficiency?

The Overall Research Methodology can be seen in Figure 1.

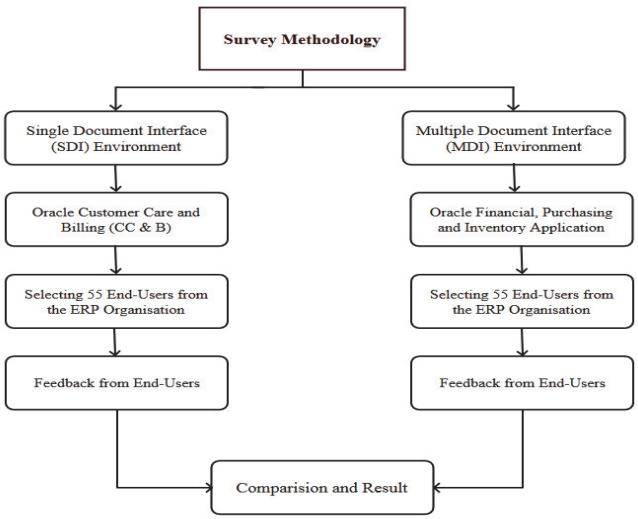

Figure 1: Research Methodology

2.1 End-User Detail

The 110 respondents for this research were full-time employees working in two organisations that implement ERP system. We divided the respondents into two groups. This division is based on user interface adoption methodology. The first group, which consisted of 55 respondents, were working on SDI applications like Oracle Utilities' customer care and billing (CC&B).This

application utilises the browser base user interface (BUI), which is the combination of HTML and JavaScript (Oracle, 2010). The second group consisted of another 55 respondents who were working on MDI applications like Oracle's finance, inventory and order management. These three types of applications utilise form base user interfaces to present information. Most of the forms have several windows associated with them (Oracle, 2009). Out of 110 respondents, 20 were having the experience with both type of applications. The details of the respondents are shown in Table 1.

Table 1: End-user Detail

UI Methodology	Oracle ERP system	Industry Type	Respondents	Experience
SDI	CC & B	Distribution	55	0–6
MDI	Financial, Purchasing, Inventory	Manufacturing	55	0–6

2.2 Questionnaire Items

The questionnaire consisted of four parts. The first part involved demographic questions designed to collect information about the respondents, their organisation, age, gender, type of ERP system used and their experience with the ERP system. The second part consisted of items measuring confusion with the ERP system. The third part consisted of items measuring three usability attributes: learnability, effectiveness and efficiency. A seven-point Likert-type scale was used to collect feedback from the 110 respondents. The measurement scale starts at 1 (strongly disagree) and goes to 7 (strongly agree). The entire instrument is shown in Appendix A.

3. *Research Results*

This section presents the results of research questions 2 and 3. The results of research question 1are discussed in section 4. For the seven items of the scale, descriptive statistics were investigated using mean, standard deviation, skewness and kurtosis. The psychometric properties of the instrument were evaluated using Cronbach's alpha, which measures internal consistency.

3.1 Results from the SDI Application Environment

A total of 55 responses were obtained from the end-users who were working on the Oracle Utilities' CC&B application. The results are shown in Table 2. The mean value for learnability is 2.7, and the standard deviation is .58. The overall mean value for effectiveness is 5.9, and the standard deviation .74; for efficiency, it is 5.5 and .49; for confusion, it is 2.9 and .52. Some values for skewness and kurtosis are positive and others are in negative, but the overall data achieved in this process are in the normal distribution range. The normal values range is between -1 and 1 (Joo et. al., 2011). All of the alpha values are above .5, which is acceptable for this kind of research.

Table 2: Results from the SDI application environment

Attributes	Item	Mean	Standard Deviation	Skewnss	Kurtosis	Cronbach's alpha
Learnability	Lrn1	2.7	.58	-1.0	.37	.59
Effectiveness	Eft1	5.9	.74	-1.0	.96	.68
	Eft2					
Efficiency	Efy1	5.5	.49	.85	-.89	.72
	Efy2					
	Efy3					
Confusion	Cnf1	2.9	.52	.35	-.25	.54

3.11 End-User Confusion and its Effect on Usability Attributes

To determine the answers to research question 2, a correlation analysis was performed. The results are shown in Figure 2. Positive correlations are shown with a plus (+) green sign, while negative correlations are shown with a minus (–) red sign. The results show that in the SDI application environment, end-user confusion with the ERP system directly affected learnability with the system. This is negatively correlated with effectiveness (-.13) and efficiency (-.11). These results are interesting and provide further research opportunities for ERP SDI application environment.

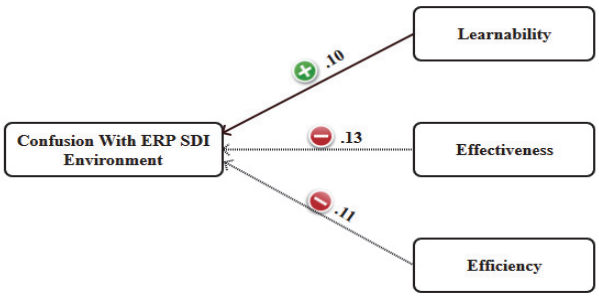

Figure 2. Confusion with the ERP SDI Environment

3.2 Results from the MDI Application Environment

A total of 55 responses were obtained from the end-users who were working on the Oracle financials, purchasing and inventory modules. The results are shown in Table 3. The overall mean value for learnability is 1.4, and the standard deviation .69; for effectiveness it is 5.7 and .7; for efficiency it is 2.0 and .44; for confusion it is 5.5 and .7. All the skewness, kurtosis and alpha values are in the required range.

Table 3: Results from the MDI Application Environment

Attributes	Item	Mean	Standard Deviation	Skewness	Kurtosis	Cronbach's alpha
Learnability	Lrn1	1.4	.69	.43	-0.9	.62
Effectiveness	Eft1	5.7	.7	1.0	.23	.54
	Eft2					
Efficiency	Efy1	2.0	.44	.32	-0.8	.67
	Efy2					
	Efy3					
Confusion	Cnf1	5.5	.7	.83	.17	.59

3.3 End-Users Confusion and its Effect on Usability Attributes

Figure 3 shows the results of the correlation analysis. The results are different than those shown in the SDI application environment. In the MDI application environment, end-user confusion with the ERP system directly affected learnability, effectiveness and efficiency with the ERP system. The positively correlated values are .22 for learnability, .15 for effectiveness and .31 for efficiency.

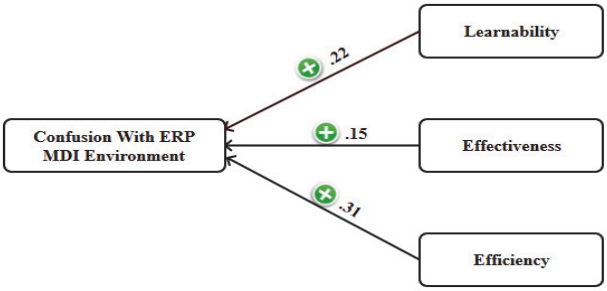

Figure 3: Confusion with the ERP MDI Environment

4. *Usability Issues in ERP SDI and MDI Application Environment*

The overall usability results from the ERP SDI and MDI application environments are shown in the end-user interaction model in Figure 4. The results are based on four attributes: learnability, effectiveness, efficiency and confusion. The end-user has the goal of completing his or her tasks using an ERP application. He or she interacts with the ERP application, which, in this study, is Oracle's customer care and billing, financial, purchasing and inventory modules.

The assumed usability goals of the ERP are that end-users should not have to spend a great deal of time learning to use the ERP system, they should be able to complete their tasks in effective and efficient ways, and they should not be confused when using the ERP system. If we compare the overall results then, the SDI is better in term of usability as compared to MDI. In case of learnability, the mean value is 2.7 for SDI and 1.4 for MDI, and the difference between the two values is 1.3. For effectiveness, the mean value is 5.9 for SDI and 5.7 for MDI, and the difference between the two values is .2; for efficiency, it is 5.5 and 2.0, and the difference is 3.5; for confusion, it is 2.9 and 5.5, and the difference is 2.6.

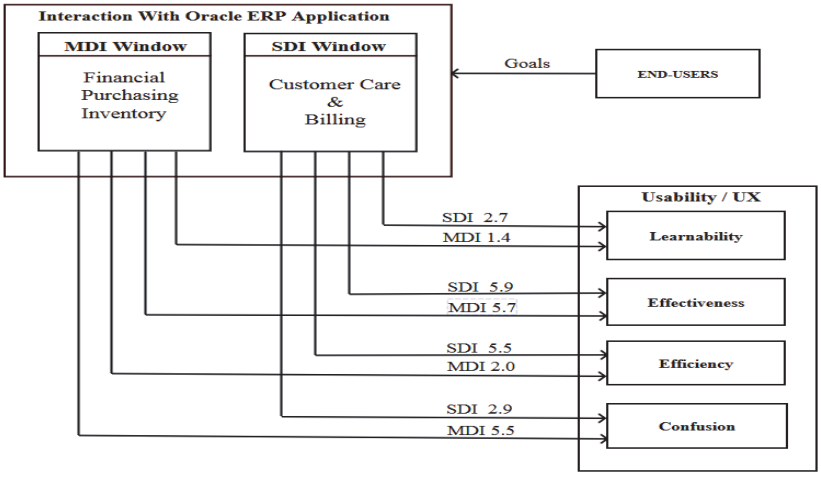

Figure 4: End-User Interaction Model

5. *Conclusion*

This research examined usability issues in ERP SDI and MDI application environments. A conceptual model presenting the usability attributes of learnability, effectiveness, efficiency and confusion was developed. The most noticeable aspects of this model are the differences in the values for confusion and efficiency with the ERP. The overall result show that for end-users, a

SDI window was better for providing usability in the ERP system. Another noticeable aspect of the results was that in the SDI application environment, end-user confusion with the ERP system only affected learnability and not effectiveness and efficiency. However, in the MDI application environment, end-user confusion with the ERP system directly affected learnability, effectiveness and efficiency with the system.

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Appendix A. Questionnaire Items

Part I: Demography Questions

What is your age?
What is your gender?
What type of ERP system are you using?
What is your work experience with the ERP system?

Part II: Confusion with the ERP User Interface

Scale:
1= Strongly disagree, 2 = Somewhat disagree, 3 = Disagree, 4 = Neutral, 5 = Agree,
6 = Somewhat agree, 7 = Strongly agree

Question Item:
Cnf1: The user interface of this ERP application is confusing.

Part III: Learn ability, Effectiveness and Efficiency

Scale:
1= Strongly disagree, 2 = Somewhat disagree, 3 = Disagree, 4 = Neutral, 5 = Agree,
6 = Somewhat agree, 7 = Strongly agree

Learn ability

Question Item:

Lrn1: It is easy to learn how to use this ERP application.

Effectiveness

Question Items:

Efy1: It is easy to find the required information by giving different search criteria.
Efy2: This ERP application effectively helps me complete my job task.

Efficiency

Question Items:

Eft1: The ERP application requires one simple step to go from the main menu to a higher level window.
Eft2: The ERP application requires only one simple step to return back to the main menu.
Eft3: The ERP application requires minimal steps for submitting and viewing the reports output.

IV

USABILITY OF ERP ERROR MESSAGES

by

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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.

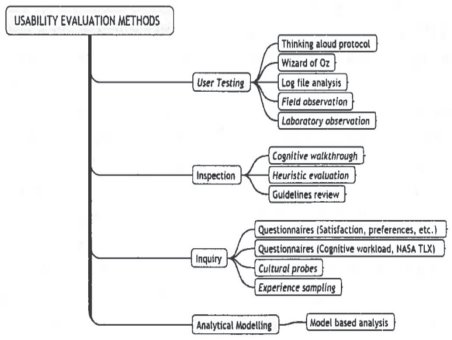

Figure 1. Usability evaluation method [4]

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.

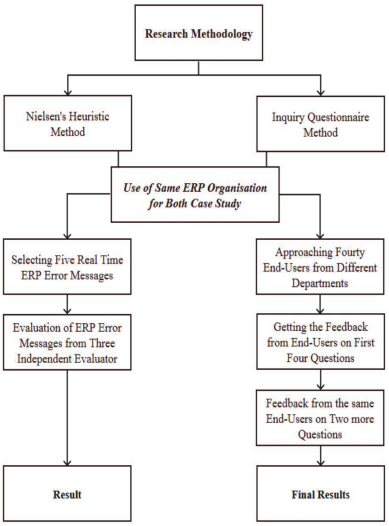

Figure 2. Research Methodology

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.

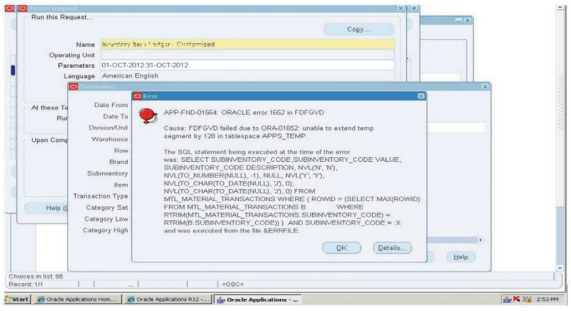
Thank you!

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.

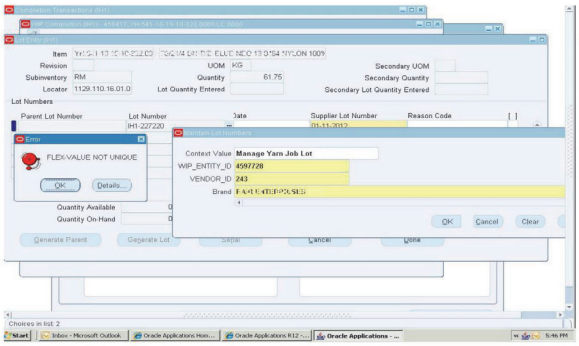
Scale for Identifying Usability problems

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

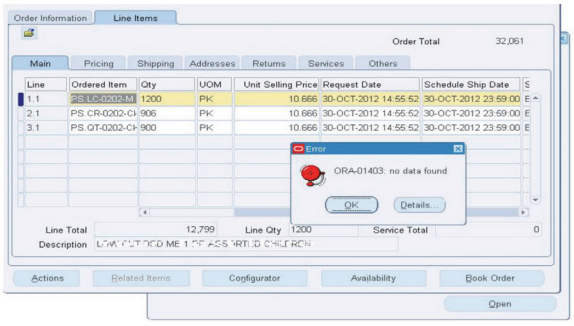
Error Message 1:



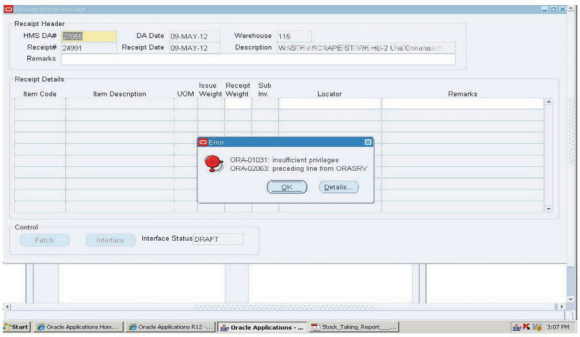
Error Message 2:



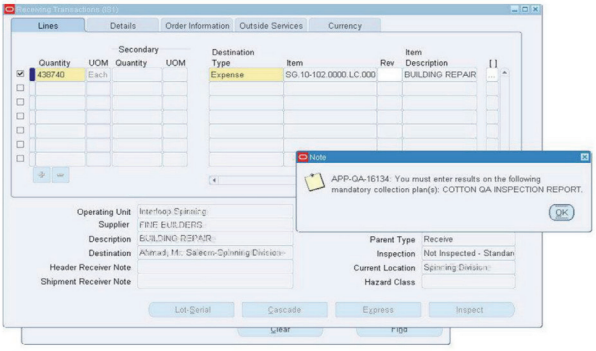
Error Message 3:



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?	☐	☐	☐	☐

V

FINDING USABILITY PROBLEMS IN ERP APPLICATION HELP AND END-USER TRAINING MATERIAL

by

Sadiq, M. & Pirhonen, A. 2016

Submitted to Advances in Human-Computer Interaction.