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Adoption of ERP system: An empirical study of factors influencing the usage of ERP and its impact on end user

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KEYWORDS
Enterprise resource planning (ERP);
Technology acceptance model;
Computer self-efficacy;
Organizational support;
Compatibility;
Panoptic empowerment;
Individual performance

Abstract Complex information systems like the ERP integrate the data of all business areas within the organization. The implementation of ERP is a difficult process as it involves different types of end users. Based on literature, we proposed a conceptual framework and examined it to find the effect of some of the individual, organizational, and technological factors on the usage of ERP and its impact on the end user. The results of the analysis suggest that computer self-efficacy, organizational support, training, and compatibility have a positive influence on ERP usage which in turn has significant influence on panoptic empowerment and individual performance.

Introduction

Modern organizations are making significant investments in complex information systems such as the enterprise resource planning (ERP) systems. Despite their avowed benefits, more than two thirds of ERP system projects result in failure (Chang, Cheung, Cheng, & Yeung, 2008). A closer look at the nature of reported problems clearly suggests that the ERP implementation issues are not just technical, but encompass wider behavioural factors (Skok & Doringer, 2001). Organizations need to understand the system adoption from the user's perspective to prepare their employees to face new challenges and learn how to make good use of the technology to reap tangible benefits (Chang et al., 2008). Indian organizations have been exposed to advanced use of information technology (IT) in organizations that are made possible through joint ventures and technology transfer initiatives which in turn were facilitated by increased international trade and commerce. Indian organizations have encountered organizational and cultural problems during the adoption and implementation of new IT in general (Dasgupta, Agarawal, Ioannidis, & Gopalakrishnan, 1999). Thus, it is pertinent to understand the influence of the various factors influencing the acceptance of ERP in the Indian context. Based on the review of extant literature, we conducted this study to identify some of the factors that influence the acceptance of ERP in India and their effect on the acceptance and usage of ERP. With

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little research existing to study the impact at the individual level, this study also seeks to find the impact of usage of ERP system on the end user.

Literature review and hypotheses

ERP implementation

Enterprise resource planning systems are extensive software systems that integrate a number of business processes, such as manufacturing, supply chain, sales, finance, human resources, budgeting, and customer service activities (Weinrich & Ahmad, 2009). They result in enormous investments in software and in package customization (Doom, Milis, Poelmans, & Bloemen, 2010). The other benefits of ERP systems are its complete integration with all the business processes, reduction in the volume of data entry, upgradability of the technology, portability to other systems, adaptability, and applying best practices (Saatcioglu, 2007). However, without successful implementation of the system, the projected benefits of improved productivity and competitive advantage would not be forthcoming (Addo-Tenkorang & Helo, 2011). This requires changes not only in systems but also in processes and other social dimensions (Kwahk & Kim, 2008) and in the coordination among members of the organizations (Chang et al., 2008). The implementation of ERP systems in an organization is often accompanied by substantial changes in organizational structure and ways of working (Kallunki, Laitinen, & Silvola, 2011). Further, implementation of ERP systems in developing countries is faced with specific difficulties over and above those faced by industrialized countries (Xue, Liang, Boulton, & Snyder, 2005). This suggests that information technology and management practices need to be modified for different cultural contexts (Ananadarajan, Igbaria, & Anakwe, 2002).

While previous research has examined aspects of business process change, little research has focussed on the individual employee or studied the drivers of process adoption by employees on the factors influencing resistance, or the impacts of process change on employees of complex technology solutions like the ERP (Venkatesh, 2006). With the change in the Indian economy and consequent changes in the business environment, there is a need to understand how different factors have influenced information system (IS) deployment in Indian firms (Tarafdar & Vaidya, 2006).

Technology acceptance model

There are several theoretical models that explain user acceptance of information systems. These include the technology acceptance model (Davis, 1989), computer self-efficacy (Compeau & Higgins, 1995), task–technology fit (Goodhue and Thompson, 1995) and theory of planned behaviour (Ajzen, 1985). The technology acceptance model or TAM is a widely applied IS model to explain end user adoption of IT. It is a powerful model of user acceptance of computer technology (Igbaria, Guimaraes, & Davis, 1995). Recently, TAM has been applied to ERP systems to explain the complex implementation and adoption issues of stakeholders and end users (Amoako-Gympah and Salam, 2004).

The technology acceptance model is based on the theory of reasoned action (TRA) (Azjen & Fishbein, 1980) which proposes that an individual's behavioural intention to use a system is determined by two beliefs: perceived usefulness (PU) and perceived ease of use (PEOU) (Venkatesh & Davis, 2000). Davis (1989) defined perceived usefulness as "the degree to which a person believes that using a particular system would enhance his or her job performance". Perceived usefulness for the individual is most likely the result of improved job performance and user motivation (Robey & Farrow, 1982). Studies have reported that perceived usefulness is positively associated with system usage (Thompson, Higgins, & Howell, 1991). Perceived ease of use is defined as "the degree to which a person believes that using the system will be free of effort" (Davis, 1989). According to TAM, perceived usefulness is also influenced by perceived ease of use because, other things being equal, the easier the system is to use, the more useful it can be. People who perceive ease of use are more likely to believe in the ease and usefulness of the system (Robey & Farrow, 1982).

According to Davis et al. (1989) usefulness was more strongly linked to usage than ease of use. In associative cultures, typically found among Africans, Asians and Arabs, perceptions and behaviour are often diffuse i.e., they utilize associations among events that may not have a logical basis (Micheal, 1997). In view of this, Anandarajan et al. (2002) reasoned that individuals in associative cultures might not connect perceptions of perceived usefulness with usage behaviour and hypothesised that perceived usefulness was not expected to influence usage, amplifying the role of perceived ease of use as an influence on both usage and perceived usefulness. But contrary to this finding, perceived usefulness was significantly related to usage (Fusilier & Durlabhji, 2005). In the Indian context, the adoption of ERP needs to be further examined.

Role of external and contextual variables on the use of ERP

The technology acceptance model predicts that external variables are expected to influence technology acceptance behaviour indirectly by affecting beliefs, attitudes, or intentions (Szajna, 1996). Orlikowski (1993) demonstrated that adopting and using specific IT is not solely dependent on the characteristics of the IT but is also dependent on other external aspects such as organizational or social context, and individual characteristics and attitudes. Based on the fundamentals of human computer interactions and socio-technical systems theory (Land & Hirschheim, 1983), Brown (2002) in his study used technological and individual user characteristics as determinants of perceived usefulness and perceived ease of use. Chang et al., (2008), in their study considered technology, organization, and user as important actors and predicted that factors relating to individual and organization will together contribute to the adoption decision of the ERP users. In studies employing TAM, the variables were considered as independent variables that would influence the usage of ERP. The variables

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in the present study have been categorized as individual, organizational, and technological characteristics. The following are the external variables considered in this study.

Individual characteristics

Some individual characteristics of information system users have been empirically shown to be associated with different levels of information system usage (Szajna, 1993). These are discussed below.

Computer self-efficacy

Self-efficacy is a measure of a user's confidence in his/her ability to use a technology (Taylor & Todd, 1995). It is the people's judgements of their capabilities to organise and execute courses of action required to attain designated types of performances (Bandura, 1986). In the context of using computers and IT, computer self -efficacy, therefore, is defined as a judgement of one's capability to use a computer, and is an important antecedent of perceived usefulness (Compeau & Higgins, 1995). Computer self-efficacy was found to play an important role in explaining usage intention through perceived usefulness (Agarwal & Karahanna, 2000). Venkatesh and Davis (1996) modelled and empirically tested the determinants of perceived ease of use and found that an individual's computer self-efficacy is a strong determinant of perceived ease of use and behavioural intention.

Organizational characteristics

Organizational support

In organizations which use a technical system, organizational support affects behavioural intention to use the system (Fishbein & Ajzen, 1975). Organizational support was categorised by Lim et al. into technology support and management support (Lee, Kim, Rhee, & Trimi, 2006). Ralph (1991) defined technical support as people assisting the users of computer hardware and software products, which can include hotlines, online support service, machine-readable support knowledge bases, faxes, automated telephone voice response systems, remote control software, and other facilities. Top management support is defined as the willingness of top management to provide the necessary resources and authority or power for project success (Slevin & Pinto, 1987). In an ERP system environment, if the organization provides sufficient support to employees for their task, employees are more likely to enjoy their work and improve their performance through usage of the new system (Lee, Lee, Olson, & Chung, 2010). The implementation of an ERP system brings far reaching changes in an organization and its processes. Hence, top management must realize that communication is essential to ensure that employees understand and accept the changes brought about by ERP (Balsmeier & Nagar, 2002). Thus organization support is crucial for successful adoption of ERP. The implementation of systems often requires substantial changes to organizational structure, employees' roles and jobs, reward systems, control and coordination mechanisms, and work processes. Therefore, top management support in the form of commitment and communication related to system implementation is critical for the legitimacy of the implementation process and employee morale following the implementation (Venkatesh & Bala, 2008).

Lee et al. (2010) found that organizational support was positively associated with the factors of TAM. While organizational support has been found to be crucial for successful adoption of a new system, little work has been done on the effect of internal technical support on technology acceptance (Lee et al., 2006).

Training

Education and training refers to the process of providing management and employees with the logic and overall concepts of the ERP system (Yusuf, Gunasekaran, & Abthorpe, 2004). Enterprise resource planning systems are extremely complex and demand rigorous training; therefore, training is an important factor for successful implementation (Bingi, Sharma, & Godla, 1999). Lack of training has been one of the important reasons for failure of ERP systems (Somers & Nelson, 2001). Training and education will reduce employees' anxiety and stress about the use of the ERP system and provide better understanding about the benefits of the system for their tasks (Lee et al., 2010). Training and education influence user beliefs toward the systems, and training programmes increase the users' confidence in their ability to use them (Gist, 1987). Training also provides managers with a mechanism to disseminate useful and pertinent information about the ERP system and how it fits in with the existing and proposed system (Amoako-gyampah & Salam, 2004).

Technological characteristics

Technological complexity

Enterprise resource planning systems, similar to other management information systems, are often perceived as very complex and difficult to implement (Xue et al., 2005). Aiman-smith and Green (2002) defined technological complexity as the extent to which a new technology is more complicated for its user than the previous technology used for the same or similar work, and represents an increase in the number of things the user must do at once. The complex nature of ERP systems limits the amount of knowledge that users can absorb before actual usage (Yi & Davis, 2003). Higher complexity results in higher mental workload and stress (Sokol, 1994). The complexity of the ERP system could negatively affect user's attitudes towards using the system (Basoglu, Daim, & Kerimoglu, 2007; Chang et al., 2008).

Technological compatibility

Common problems in adopting ERP systems are widely recognized to be rooted in the poor fit between ERP systems and business process (Chen, Road, & Chen, 2009). In ERP implementation, systems are developed to support business processes such as manufacturing, purchasing, or distribution, and so ERP implementation and business process should be closely connected (Tsai, Chen, Hwang, & Hsu, 2010). Elbertsen and Reekum (2008) indicated that in business process, the ERP system is significantly explained by competitive pressure and systems compatibility. Rogers (1983) defined compatibility as the degree to which an

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innovation is perceived as being consistent with existing values, needs, and past experiences of potential adopters. Karahanna, Agarwal, and Angst (2006) brought forward four dimensions reflecting the definition of compatibility: compatibility with existing work practices, compatibility with preferred work style, compatibility with prior experience, and compatibility with existing values. In this paper, technological compatibility is considered as one of the technological characteristics that affects the usage of ERP. It refers to the compatibility of ERP with the existing system in the organization. In technological compatibility, the knowledge gained from past and present experiences with technology are considered (Ortega, Martinez and Hoyos, 2008).

According to Soh, Kien, and Tay-Yap (2000) procedural and data compatibility are crucial to the acceptance of the system by the employee. Enterprise resource planning packages are only compatible with the databases and operation systems of some companies, and procedural and data compatibility are crucial to the acceptance of the system by the employees (Zhang, Lee, Huang, Zhang, & Huang, 2005). Technology incompatibility will thus negatively affect system productivity, efficiency, employees' satisfaction, commitment, and motivation (Erensal & Albayrak, 2008). Greater compatibility of the technology innovation with the existing technical systems, operating practices, and the value and belief systems of the adopting unit has been cited to be favourable to its adoption and diffusion (Cooper & Zmud, 1990; Ramamurthy & Premkumar, 1995).

Impact of ERP usage

System usage is considered as a dependent variable in many empirical studies. According to Sun, Bhattacherjee, and Ma (2009) current IT usage models do not venture into the outcomes of usage. But without studying outcomes, it cannot be known if IT investments are successful or not (Sun et al., 2009). According to Ein-Dor and Segev (1978), usage is highly correlated with other criteria such as profitability, application to problems in organization, quality of decision making, performance, and satisfaction, and that an individual will use a system intensively only if it meets some of these criteria. Users tend to use the system if it improves their task performance or decision quality, otherwise they may avoid using a system unless its usage is made mandatory (Bokhari, 2005). Since the adoption of an ERP system requires extensive efforts, both for the technological and business aspects of the implementation, neither IT practitioners nor researchers have developed a deterministic method to evaluate the related impacts (Al-Mashari, 2002).

The impacts and the outcomes of the usage of ERP, therefore, should be investigated from different perspectives especially with a view to study how the human factor influences success and how users can improve ERP's performance significantly (Botta-Genoulaz, Millet, & Grabot, 2005). Hence, in addition to understanding the factors which influence technology acceptance, it is also important to examine the impact of accepting or rejecting a technology from an individual or social system perspective (Rogers, 1995). Little research has addressed the link between user acceptance and individual and organizational outcomes, and there has been no systematic investigation of the impact of technology on employee job characteristics (Venkatesh, Morris, Davis, & Davis, 2003). The following are some of the variables which are considered in this study.

Panoptic empowerment

The ERP system has not only increased the ability of organizations to gather more information in greater detail and in real time, but has also brought about more widespread dispersal of information throughout the organization. This expanded access to information not only gives the employees the added flexibility, but also allows them to make decisions which used to be formally referred upwards or to other departments due to lack of information (Sia, Tang, Soh, & Boh, 2002). The central concept of empowerment is the delegation of power to staff/employees in order to make and implement their own decisions (Psoinas, Kern, & Smithson, 2000).

The panopticon is an early nineteenth century design for prisons developed by Bentham. The principal effect of the panopticon is to induce in the prisoners a state of conscious and permanent visibility that assures the automatic functioning of power, and they begin to act as if they are being observed because they cannot tell when or whether they are being observed (Foucault, 1979). An ERP similarly employs a gaze because it records all user actions, which can be observed in real-time and also stored for later observation. Thus, with no extra effort ERP surveillance is essentially continuous (Sia et al., 2002). The greater visibility of information provided by the common shared database not only empowers workers to do their work more efficiently and effectively but also makes them more visible to others in the organization, who can then easily exercise process and outcome control (Elmes, Strong, & Volkoff, 2005). This is referred to as panoptic empowerment which combines the concept of empowerment and multidirectional visibility. There is simultaneous increase in control and empowerment occurring through the mediating effects of formation visibility (Elmes et al., 2005). This contrasts with Sia et al.'s (2002) study where there was greater emergence of greater panoptic control without corresponding increase in empowerment though the technology was capable of both. Hence more research is required to generalize the findings to other organizations.

Individual performance

With the rapid growth in use of computing, academicians and practitioners have recognized that IT success can be measured by its impact on an individual's work (Law & Ngai, 2007). Organizations that spend millions of dollars on IT are primarily concerned about how their investment will influence organizational and individual performance. The impact of IT on work at the individual level is a direct consequence of system use, which in turn is a major factor in determining organizational impact (Torkzadeh & Doll, 1999). The way individuals use information systems accounts for the differences in performance impact in

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case of complex technologies. Organizational users cannot realize significant productivity or performance gains if they do not use IT adequately and appropriately (Sun et al., 2009). Users would adopt an ERP system if they perceived ERP would assist them to attain desired performance outcomes (Amoako-gyampah & Salam, 2004). Goodhue and Thompson (1995) argued that IT was more likely to be used in organizational settings and would have a positive impact on individual performance if the capabilities of the IT matched the tasks that the user had to perform. Some of these studies that have used individual performance in their study have stated positive relationships between IS and performance (Venkatesh, 2000) while a few other studies have stated that there is no relationship between the performance of the individual and the usage of IS (Millman & Hartwick, 1987) which needs further examination.

Research model and hypotheses

The review of literature shows that although there has been research on ERP, there has been little research to find the impact of the acceptance of ERP on the employees. Many of the existing research projects on ERP adoption are primarily undertaken in developed countries and very few in developing countries like India. Though previous research has considered external variables in the research, there was no clear pattern with respect to the choice of the external variables considered (Legris, Ingham, & Collerette, 2003). (The external variables used in this study were chosen from previous research.) Based on this research gap, we propose the following research model (Figure 1) to study the effects of individual, organizational, and technological factors affecting the usage of ERP and its impacts on employee attitude and behaviour.

The acceptance of ERP is influenced by various external variables. In this study we have categorised the external variables as individual, organizational, and technological characteristics, and we hypothesise the following:

H1a: Computer self-efficacy will have a positive effect on the perceived usefulness of ERP system.
H1b: Computer self-efficacy will have a positive effect on perceived ease of use of ERP system.
H2a: Organizational support will have a positive effect on perceived usefulness of ERP system.
H2b: Organizational support will have a positive effect on perceived ease of use of ERP system.
H3a: Training will have a positive effect on perceived usefulness of ERP system.
H3b: Training will have a positive effect on perceived ease of use of ERP system.
H4a: Complexity will have a negative effect on perceived usefulness of ERP system.
H4b: Complexity will have a negative effect on perceived ease of use of ERP system.
H5a: Compatibility will have a positive effect on perceived usefulness of ERP system.
H5b: Compatibility will have a positive effect on perceived ease of use of ERP system.

The relationships between the TAM variables are replicated in our model in the context of ERP system.

Hypothesis H6: There is a positive relationship between the perceived usefulness of ERP system and the intention to use the ERP system.
Hypothesis H7: There is a positive relationship between the perceived ease of use and intention to use the ERP system.

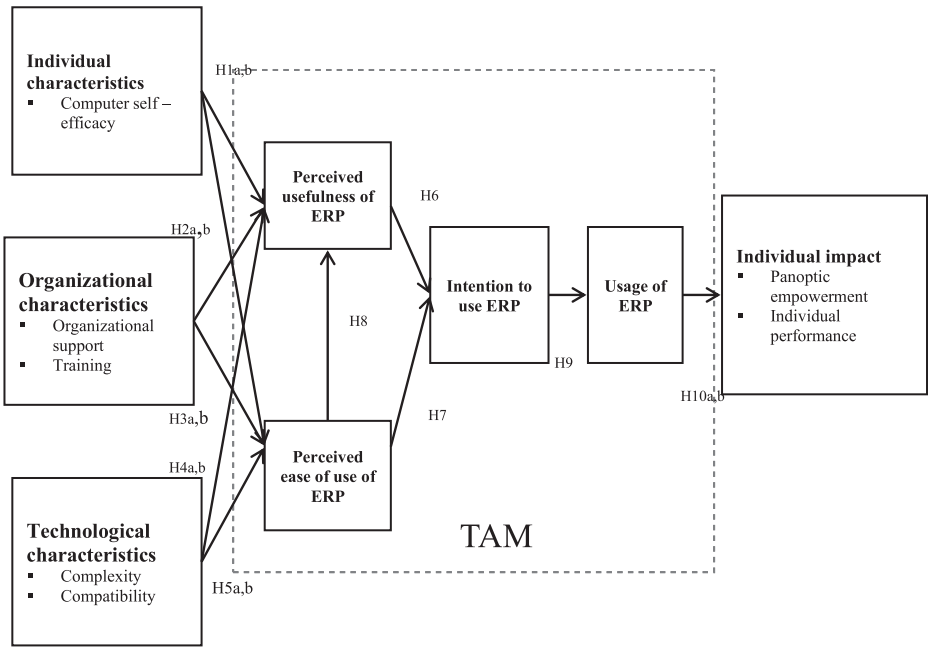

Figure 1 Proposed research framework.

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Hypothesis H8: There is a positive relationship between perceived ease of use of ERP system and perceived usefulness of ERP system.
HypothesisH9: There is a positive relationship between the intention to use and usage of ERP.

Literature suggests that the acceptance and usage of ERP will have an outcome at the individual level; however little research has empirically examined this link. Hence panoptic empowerment and individual performance have been considered as the outcome variables measured at the individual level. The following are the hypotheses to be tested:

Hypothesis H10a: There is a positive relationship between the usage of ERP and panoptic empowerment.
Hypothesis H10b: There is a positive relationship between the usage of ERP and individual performance.

Research methodology

Sample and procedure

To test the proposed model and hypotheses, a survey questionnaire was developed. The research targets were end users of ERP systems in select Indian organizations. The main study was carried out in organizations that had implemented ERP system within a time frame of less than five years. In order to obtain accurate subjects for the study and also owing to other constraints in getting data related to IS in an organization, the data was collected through purposive sampling. The list of organizations that had implemented ERP was obtained from the client list of SAP, Oracle, and Ramco systems. Organizations that had implemented ERP earlier than five years ago were excluded from the study. The questionnaires were administered in person to some organizations or sent through post. Some others were approached through online questionnaires after seeking permission from the respective organizations. The responses were obtained only from employees who used ERP for their regular work. A total of 181 responses were obtained from end users of ERP, out of which 154 responses were usable. The respondents were asked to indicate their age, gender, type of industry, educational qualification and experience. Information was also sought on the modules that the ERP users used. Out of the 154 sample respondents that were obtained, most of the respondents (43.5%) were in the age group of 26–35. About 69.5 percent of the respondents were male. The sample respondents were from banking, manufacturing, automobile and IT/ITeS sectors. The demographic profiles of the respondents are provided in Table 1.

Table 1 Demographic details of the respondents.

Demographic characteristics	Frequency	Percentage
Age		
<25	25	16.2
26–35	67	43.5
36–45	28	18.2
>45	34	22.1
Gender		
Male	107	69.5
Female	47	30.5
Experience		
between 2 and 5 yrs	40	26.0
between 5 and 10 yrs	48	31.2
more than 10 yrs	66	42.9
Type of industry		
Manufacturing	42	27.3
Automobile	39	25.3
Banking and Finance	24	15.6
IT/ITES	37	24.0
Others	12	7.8
Education		
Graduate	66	42.9
Post graduate	84	54.5
Doctorate	3	1.9
Others	1	0.6

Measures

Computer self-efficacy was measured using the 10 items developed by Compeau and Higgins (1995). Seven items to measure organizational support were adopted from Igbaria (1990) and Thompson et al. (1991). Training was measured using five items which were adapted from Amoako-gyampah and Salam (2004). Technology complexity was measured using four items from Thompson et al. (1991). Compatibility was measured using four items from Premkumar and Ramamurthy (1995). Technology acceptance model scales of perceived usefulness and perceived ease of use were measured using four items adapted from Davis (1989) and Davis et al. (1989). Intention to use was measured using two items from Azjen and Fishbein (1980). To measure panoptic empowerment, 15 items of Sia et al. (2002) were used, and for individual performance, two items of Goodhue and Thompson (1995) were used. The operationalization of each measure is provided in Appendix A.

Analysis and results

The data was analysed using the partial least squares (PLS), a multivariate path analysis statistical technique developed by Herman Wold (1982). Partial least squares involves two stages: (a) assessment of the measurement model, including the reliability and discriminant validity of the measures, and (b) assessment of the structural model.

Measurement model

The strength of the measurement model can be demonstrated through measures of convergent and discriminant validity (Hair, Anderson, Tatham, & Black, 1998).

Convergent validity

Convergent validity was assessed by three criteria.

1. The standardized path loadings, which are indicators of the degree of association between the underlying latent factor and each item, and should be greater than

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0.7 and statistically significant (Gefen, Straub, & Boudreau, 2000).
2. The composite reliability (CR) must be larger than 0.7 (Hair et al., 1998).
3. The average variance extracted (AVE) for each factor should exceed 0.5 (Fornell & Larcker, 1981).

The majority of the loadings were significant except for one item of computer self-efficacy (CSE1) and two items of panoptic empowerment (PE1 and PE2) which were less than 0.4. The AVE values of the constructs computer self-efficacy and panoptic empowerment, were less than the recommended threshold of 0.5. Hence the items CSE1, PE1, PE2 were removed as they did not satisfy the criterion. The CR values ranged from 0.8566 to 0.9561; all were above the recommended level of 0.7 for a reliable construct. The PLS algorithm was run again to improve the CR and AVE of the constructs. An increase in CR was observed for the constructs whose items were excluded and the AVE values were above 0.5 for the constructs. The AVE values were between 0.5004 and 0.8625. Thus the convergent validity was established. Additionally, the Cronbach's alpha also reflected a very high reliability for all of the constructs with alpha values over 0.7. The results of convergent validity are shown in Table 2.

Discriminant validity

Discriminant validity indicates that "a construct should share more variance with its measures than it shares with other constructs in a given model" (Hulland, 1999). To establish discriminant validity, the square root of a construct's AVE must be larger than the inter-construct correlations (Fornell & Larcker, 1981). Table 3 shows the results of discriminant validity. The diagonal elements represent the square root of the average variance extracted. All constructs showed more variance with their indicators than with other constructs. The square root of AVE exceeds the correlation between other constructs. These results imply satisfactory discriminant validity. After testing the measurement model with all the parameters mentioned above, the model can be confirmed reliable and valid.

Multicollinearity is said to exist among the independent variables if these independent variables are related to or dependent upon each other (Bowerman, O'Connel, & Hand, 2001). Multicollinearity was assessed among the external

Table 2 Results of convergent validity.

Construct items	AVE	Composite reliability	Cronbach's alpha
Computer self-efficacy (CSE)	0.500	0.900	0.875
Compatibility (COMP)	0.714	0.909	0.867
Complexity (CX)	0.601	0.857	0.782
Individual performance (IP)	0.863	0.926	0.842
Intention to use (IU)	0.852	0.920	0.827
Organizational support (OS)	0.628	0.922	0.901
Training (TR)	0.799	0.952	0.936
Panoptic empowerment (PE)	0.500	0.927	0.916
Perceived ease of use (PEOU)	0.672	0.891	0.836
Perceived usefulness (PU)	0.845	0.956	0.939
Usage (USG)	0.818	0.900	0.777

Table 3 Results of discriminant validity.

Construct	COMP	CSE	CX	IP	IU	JS	OS	PE	PEOU	PU	TR	USG	AVE
COMP	**0.845**												0.714
CSE	0.349	**0.707**											0.500
CX	−0.193	−0.140	**0.775**										0.601
IP	0.417	0.296	−0.232	**0.929**									0.863
IU	0.507	0.399	−0.281	0.463	**0.923**								0.852
OS	0.458	0.475	−0.383	0.465	0.502	0.275	**0.792**						0.628
PE	0.473	0.376	−0.262	0.651	0.484	0.612	0.488	**0.707**					0.500
PEOU	0.492	0.561	−0.381	0.496	0.661	0.358	0.662	0.601	**0.820**				0.672
PU	0.522	0.555	−0.375	0.566	0.721	0.473	0.696	0.585	0.763	**0.919**			0.845
TR	0.467	0.353	−0.349	0.499	0.571	0.259	0.688	0.492	0.733	0.686	**0.893**		0.799
USG	0.386	0.195	−0.205	0.446	0.453	0.281	0.393	0.310	0.456	0.456	0.451	**0.904**	0.818

Notes. COMP —Compatibility, CSE — Computer Self-Efficacy, CX — Complexity, IP — Individual Performance, IU — Intention to Use, OS — Organizational Support, PE — Panoptic Empowerment, PEOU — Perceived Ease of Use, PU — Perceived Usefulness, TR — Training, USG — Usage.

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variables which were categorized as individual, organizational, and technological characteristics. Correlation coefficient above 0.80 would suggest a problem of multicollinearity (Hair et al., 1998). The correlation matrix of the independent variables given below in Table 4 does not indicate multicollinearity concerns. Additionally the variance inflation factor (VIF) was assessed to check multicollinearity. The collinearity diagnostics given in Table 5 shows that VIF for the independent variables were less than 3 and the tolerance level was above 0.4 which further suggests that multicollinearity does not exist among the independent variables.

Table 5 Collinearity statistics.

Collinearity statistics		
Construct	Tolerance	VIF
Organizational support (OS)	0.443	2.257
Training (TR)	0.488	2.050
Complexity (CX)	0.837	1.194
Compatibility (COMP)	0.741	1.350
Computer self efficacy (CSE)	0.762	1.313

Structural model

The structural model was examined to test the hypotheses. The R^2, which is generated for each regression equation, indicates the explanatory power or variance explained of the latent endogenous variable. Paths are interpreted as standardised beta weights in a regression analysis. As recommended (Chin, 1998), bootstrapping (with 500 subsamples) was performed to test the statistical significance of each path coefficient using t-tests. The hypotheses tests were conducted by examining the signs (positive or negative) and assessing the statistical significance of t-values for the corresponding path estimates.

The PLS path analysis results showed that computer self-efficacy was significantly related to perceived usefulness ($\beta = 0.200$, $p < 0.001$) and perceived ease use ($\beta = 0.297$, $p < 0.001$) supporting hypotheses H1a and H1b. Organizational support was significantly related to both perceived usefulness ($\beta = 0.201$, $p < 0.001$) and perceived ease of use ($\beta = 0.112$, $p < 0.05$) supporting hypotheses H3a and H3b. Consistent with hypotheses H4a and H4b training was significantly related to perceived usefulness ($\beta = 0.202$, $p < 0.001$) and perceived ease of use ($\beta = 0.474$, $p < 0.001$). Under technological characteristics, complexity had a negative significant effect on perceived usefulness ($\beta = -0.066$, $p < 0.05$) and perceived ease of use ($\beta = -0.103$, $p < 0.001$) supporting hypotheses H5a and H5b respectively and compatibility had a positive significant effect on perceived usefulness ($\beta = 0.105$, $p < 0.001$) and perceived ease of use ($\beta = 0.0801$, $p < 0.05$) supporting hypotheses H6a and H6b (Table 6).

The TAM variables such as perceived usefulness ($\beta = 0.518$, $p < 0.001$) and perceived ease of use ($\beta = 0.266$, $p < 0.001$) were significantly related to intention to use thereby supporting hypotheses H7 and H8 respectively. Further perceived ease of use was also significantly related to perceived usefulness ($\beta = 0.329$, $p < 0.001$) supporting hypothesis H9. Supporting hypothesis H10, intention to use was positively and significantly related to usage of ERP ($\beta = 0.453$, $p < 0.001$). Supporting hypothesis H11a, the usage of ERP was significant and positively related to panoptic empowerment ($\beta = 0.302$, $p < 0.001$). Finally, the usage of ERP was significantly related to individual performance ($\beta = 0.446$, $p < 0.001$) supporting hypothesis H11b.

The external variables could explain 68.5 percent variance in perceived usefulness ($R^2 = 0.685$) and 67.2 percent variance in perceived ease of use ($R^2 = 0.672$). Perceived usefulness and perceived ease of use together could explain 54.9 percent of the variance in intention to use ERP system. The intention to use explained 20.5 percent of variance of usage. The usage of ERP explained 9.6 percent and 19.9 percent of variance of panoptic empowerment and individual performance respectively.

Discussion

The results of this research support most of the proposed relationships in the structural model. Most were consistent with the previous study results. The relationship between the external variables such as computer self-efficacy, organizational support, training, and compatibility and the TAM variables were found to be significant and positively related. Computer self-efficacy was significantly and positively related to perceived usefulness and perceived ease of use. Computer self-efficacy was the major determinant of perceived ease of use which confirms the study by Venkatesh and Davis (2000). Under organizational characteristics, both organizational support and training had a significant positive effect on perceived usefulness and perceived ease of use. These results are consistent with previous research (Lee et al., 2010; Ngai et al., 2007). Organizational support was more strongly related to perceived usefulness than perceived ease of use while

Table 4 Correlation matrix between independent variables.

Construct	Computer Self-Efficacy (CSE)	Organizational support (OS)	Training (TR)	Complexity (CX)	Compatibility (COMP)
Computer self-efficacy (CSE)	1				
Organizational support (OS)	0.475	1			
Training (TR)	0.353	0.688	1		
Complexity (CX)	−0.14	−0.383	−0.349	1	
Compatibility (COMP)	0.349	0.458	0.467	−0.193	1

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Table 6 Results of structural model.

Relationship	Path coefficient	T statistics	Hypothesis	Support yes/No
CSE → PU	0.2008	6.2642	H1a	Yes
CSE → PEOU	0.2975	9.3027	H1b	Yes
OS → PU	0.2010	4.6687	H2a	Yes
OS → PEOU	0.1122	1.9745	H2b	Yes
TR → PU	0.2025	4.1088	H3a	Yes
TR → PEOU	0.4741	9.7530	H3b	Yes
CX → PU	−0.0666	2.0546	H5a	Yes
CX → PEOU	−0.1032	3.5107	H5b	Yes
COMP → PU	0.1052	2.9955	H4a	Yes
COMP → PEOU	0.0801	2.2836	H4b	Yes
PU → IU	0.5331	10.2476	H6	Yes
PEOU → IU	0.2517	4.2078	H7	Yes
PEOU → PU	0.2810	4.8811	H8	Yes
IU → USG	0.4506	8.1163	H9	Yes
USG → IP	0.4457	11.0173	H10a	Yes
USG → PE	0.2847	6.7433	H10b	Yes

Notes. COMP — Compatibility, CSE — Computer Self-Efficacy, CX — Complexity, IP — Individual Performance, IU — Intention to Use, OS — Organizational Support, PE — Panoptic Empowerment, PEOU — Perceived Ease of Use, PU — Perceived Usefulness, TR — Training, USG — Usage.

training on the other hand was more strongly related to perceived ease of use when compared to perceived usefulness. This denotes that organization support will encourage users to use ERP and realize the benefits that can be achieved with the use of ERP, and training will help users to interact with the ERP system and remove any negative perceptions and develop favourable attitude with regard to the use of the ERP system.

Among the technological characteristics, complexity had a negative effect on perceived usefulness and perceived ease of use, supporting the hypotheses. Enterprise resource planning is a complex information system and the complexity of ERP could negatively affect the user's attitude towards using the system (Igbaria et al., 1995). Compatibility had a positive significant effect on perceived usefulness and perceived ease of use. This means, if the implementation of ERP is compatible with the existing technical systems and operating practices, it will lead to a favourable attitude towards the acceptance of ERP by the end users.

The relationships between the TAM variables were replicated in this study in the context of ERP. Perceived usefulness and perceived ease of use significantly affect intention to use and in turn the usage of the ERP system. In this study perceived usefulness was more strongly related to intention to use compared to perceived ease of use. This is consistent with the findings of Davis (1989).

Models considering usage as an end have been criticized by researchers (Sun et al., 2009). In this study, it was found that the usage of ERP had significant impact on the end users' panoptic empowerment. The results show that due to the visibility of information provided by the ERP there is increase of both control and empowerment through the usage of ERP. The usage of ERP also had a positive significant impact on individual performance.

Implications and conclusion

Enterprise resource planning systems are different from other innovations of IT because of the socio-technical challenges due to the complexity involved in the implementation process and the different types of end users. This research has implications for managers as well as organizations. The findings of this study provide insights for managers to efficiently manage the adoption of the ERP system across the organization. Organizations should understand and identify factors in terms of individual, organizational, and technological characteristics when a complex information system such as ERP is implemented in the organization. Technology acceptance models have been criticized for considering usage as an end in itself. The present study tries to identify the impact of usage on the individual's panoptic empowerment and individual performance. Managers should have the goal of not just making use of the system but to make employees satisfied with using the system, to improve their performance, and also to empower them to make decisions. Further research can be done through a longitudinal approach for the study. This will help to understand how the factors vary at different stages in the implementation process of ERP.

This study has a few limitations. The model required estimation of many variables and this requires a large sample size. But the sample size of the present study was small. The present study was a cross-sectional survey from respondents. The influence of some factors on the intention of using information technology might vary at different stages in the implementation process. Further research should use a larger sample and take a longitudinal approach. Future research can also explore the interrelationships between individual, organizational and technological variables and their effect on the usage of ERP.

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Appendix A
Measures and operationalizations.

Construct	Items	Question items
Computer self-efficacy (CSE)		I could complete the job using ERP,
	CSE1	if there was no one around to tell me what to do as I go
	CSE2	if I had never used a package like it before
	CSE3	if I had only the software manuals for reference
	CSE4	if I had seen someone else using it before trying it myself
	CSE5	if I could call someone for help if I got stuck
	CSE6	if someone else had helped me get started
	CSE7	if I had a lot of time to complete the job for which the software was provided
	CSE8	if I had just the built-in help facility for assistance
	CSE9	if someone showed me how to do it first
	CSE10	if I had used similar packages before this one to do the same job
Organizational support (OS)		Technical support
	OS1	I know where to turn to when I need any assistance with our ERP system
	OS2	In my company we get good technical support for our ERP system
	OS3	We have extensive support to help with problems related to our ERP system
		Top management support
	OS4	Management is aware of the benefits that can be achieved with the use of ERP system
	OS5	Management always supports and encourages the use of ERP for job-related work
	OS6	Management provides most of the necessary help and resources to enable people to use ERP
	OS7	Management is really keen to see that people are happy with using ERP
Training (TR)	TR1	The kind of training on ERP system provided to me was complete
	TR2	My level of understanding was substantially improved after going through the training programme
	TR3	The training gave me confidence in the ERP system
	TR4	The training on ERP system was of adequate length and detail
	TR5	The trainers were knowledgeable and aided me in my understanding of the ERP system
Complexity (CX)	CX1	Using a ERP system takes much time from my normal duties
	CX2	Working with ERP is so complicated, it is difficult to understand what is going on
	CX3	Using the ERP system involves much time doing mechanical operations (e.g., data input)
	CX4	It takes too long to learn how to use a ERP to make it worth the effort
Compatibility (COMP)	COMP1	Data captured in the ERP system and their format match my current data needs
	COMP2	The ERP system matches my current processing procedure
	COMP3	The changes caused by the adoption of ERP are compatible with the existing operating practices
	COMP4	The adoption of ERP is compatible with the firm's IT infrastructure
Perceived usefulness (PU)	PU1	Using the ERP system improves my performance in my job
	PU2	Using the ERP system in my job increases my productivity
	PU3	Using the ERP system enhances my effectiveness in my job
	PU4	I find the ERP system to be useful in my job
Perceived ease of use (PEOU)	PEOU1	My interaction with the ERP is clear and understandable
	PEOU2	Interacting with ERP does not require a lot of my mental effort
	PEOU3	I find the ERP to be easy to use
	PEOU4	I find it easy to get the ERP system to do what I want it to do
Intention to use (IU)	IU1	I intend to use the ERP system for performing my job as often as needed
	IU2	To the extent possible, I would frequently use the ERP system in my job
Usage (USG)	USG1	On average how frequently do you use ERP?
	USG2	On average how much time do you spend per day using ERP for job related work
	USG3	How do you consider the extent of your current ERP use?

(*continued on next page*)

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(*continued*)

Construct	Items	Question items
Individual performance (IP)	IP1	The company ERP environment has a large positive impact on my effectiveness and productivity in my job
	IP2	ERP and its services are important and are a valuable aid to me in the performance of my job
Panoptic empowerment (PE)	PE1	Management relies a great deal on me to ensure proper operation or processing when I use the system.
	PE2	Much is left to my discretion to ensure proper operation or processing when I use the system
	PE3	I have considerable autonomy in deciding how to carry out my work
	PE4	Job descriptions in my organization are highly specific and very detailed
	PE5	The procedures to carry out a task are spelled out very clearly
	PE6	Employees are very closely supervised to ensure that they are conforming to the standard procedures established
	PE7	The ERP system provides very complete and comprehensive information about how well or badly I have done my work
	PE8	The ERP system provides very accurate information about how well or badly I have done my work
	PE9	The ERP system provides very immediate information about how well or badly I have done my work.
	PE10	The ERP system provides very reliable information about how well or badly I have done my work
	PE11	If there is an error, it is very easy for my supervisor to trace when, where, and by whom it was committed through the ERP system
	PE12	The ERP system provides the supervisor with very detailed information on the source of error
	PE13	It is very convenient for my supervisor to access the system to review my work performance
	PE14	My supervisor is constantly updated on the status of my work performance
	PE15	My supervisor is highly aware of any mistakes I have committed in my work

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