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Abstract

The main objective of the study was to identify the factors contributing to the usage of enterprise resource planning systems at the organisational layer, the departmental layer and the end-user layer in Higher Education Institutions (HEIs) in Pakistan. The conceptual framework of this study is based on the Unified Theory of Acceptance and Use of Technology (UTAUT) developed by Venkatesh, Morris, Davis, & Davis (2003). The multi-level conceptual model developed for the study was tested empirically using three distinct questionnaires for analytical layers. Primary data was collected from 18 higher education institutions in Pakistan; 86 responses from the organisational layer, 143 from the departmental layer and 1088 from the end-user layer. Structural equations were formulated to investigate the effect of factors at three layers contributing to the usage of Enterprise Resource Planning Systems (ERPS). Organisational training was found to be the only factor not making a significant contribution to the usage of enterprise resource planning systems while all other factors included in the conceptual framework were proved to be significant. The model formulation and application of SEM techniques to investigate the determinants of usage of ERPS in HEIs in Pakistan is the unique contribution of this study.

Keywords:

Enterprise Resource Planning Systems (ERPS); Information Systems; UTAUT; Technology Usage; Structural Equation Modelling (SEM); Higher Education Institutions; Pakistan.

Introduction

Realizing the challenges of improving the quality of higher education, the role of educational developers and the use of innovation to stimulate growth, Higher Education Institutions (HEIs) have been increasingly opting for Enterprise Resource Planning Systems (ERPS) to gain competitive advantage, to reduce operational costs and to enhance effectiveness. Following the global ERPS revolution in which a vast majority of Fortune 500 companies adopted ERPS (Ross & Vitale, 2000; Scott & Wagner, 2003), the higher education sector in many countries around the world have also adopted for ERPS. Countries where ERPS have been adopted and studied include, United Kingdom (Pollock & Cornford, 2004), Belgium, France and Switzerland (Charlier et al., 2004), Slovenia (Zornada & Velkavrh, 2005), United States of America (King, Kvavik, & Voloudakis, 2002), Columbia (Graham, 2009), Jordan (Abu-Shanab & Saleh, 2014) and Australia (Abugabah & Sanzogni, 2010; Fisher, 2006; Nielsen, 2002; Rabaa'i, 2009). Over the past few years, ERPS has recorded significant growth in Higher Education sector worldwide (Waring & Skoumpopoulou, 2012).

Many research studies were conducted on different aspects relevant to the implementation of ERPS but very few focused on its usage. A major criticism was the disproportionate focus on only on the technical issues while the requirements of organisational stakeholders were ignored. Kotsemir and Meissner (2013) claimed that researchers developed complex models supported by mathematical tools, but data deficiency prevented them from validating the models effectively. Moreover, the stakeholders involved and the specific culture of organisations and countries were ignored. These aspects were vital in the debate as both play an important role that can lead to success or failure of ERPS in any organization. In addition, most of the research studies were conducted by framing micro-level/individual-level factors, thereby ignoring the macro/organisation-level determinants. Furthermore, the majority of the ERPS studies were based on data from developed countries (Abugabah & Sanzogni, 2010; Charlier, et al., 2004; Fisher, 2006; King, et al., 2002; Nielsen, 2002; Rabaa'i, 2009) or focused on the corporate sector to evaluate assimilation of ERPS (AlGhamdi, Nguyen, & Jones, 2013; Bradford & Florin, 2003; Ke & Wei, 2008; Wang, Shih, Jiang, & Klein, 2008).

To stay abreast of the global challenges, Higher Education Commission (HEC) of Pakistan (a constitutionally established organization whose responsibility is to fund, monitor and provide accreditation facilities to the HEIs in Pakistan facilitated eight public sector universities to customize and implement Campus Management Solution (CMS). It is observed research on ERPS usage in HEIs in Pakistan was scarce, as a result of which, there was limited understanding of the factors affecting the use of ERPS. Conducting research on ERPS in Pakistani context can contribute to gain a comprehensive understanding of the dynamics of ERPS usage in the unique socio-cultural context (Walsham & Sahay, 2006, p.13). In Pakistan, research on this topic received limited attention to date. A study examined the usage of ERPS in telecommunication sector (Kanwal & Manarvi, 2010), another study was conducted on cross-examination of ERPS usage across various industries of Pakistan (Shad, Chen, & Azeem, 2012). The study by (Anjum, Sadiq, Marwat, Khan, & Sami, 2015) focuses on the implementation of ERPS in health care sector. It can be observed that HEIs were unable to gain much focus of researchers, particularly concerning the ERPS usage. There was a clear research gap on ERPS usage in HEIs overall and especially in Pakistan.

The objective of the study is to identify the factors contributing to the usage of ERPS at the organisational layer, departmental layer and end-user layer in HEIs in Pakistan. This study addressed the usage of ERPS in HEIs of Pakistan to identify the factors contributing to the usage of ERPS at the organisational, the departmental and the end-user layers. The practical implication of the research is the dissemination of analysis results to HEC and top management of each HEI and the bodies may take necessary measures to increase ERPS usage in the education sector.

Current research on the usage of ERPS

ERPS is a business management system that consists of multiple software integrated into one package, used to handle all business processes of the organization from all functional departments (Ross, 2007). ERPS combines data from all functional areas of the organization into one real-time database to facilitate various departments to conveniently share information (Fowler & Gilfillan, 2003) as well as disseminate information throughout the organization (Schlichter & Kraemmergaard, 2010). For more than three decades ERP systems were used by

manufacturing industry. More recently, HEIs opted to deploy ERPS and spent in excess of \$20 million each to implement modern ERPS (Abbas, 2011; Swartz & Orgill, 2001).

More traditionally, the subunits of HEIs used to store most of the data locally. This led to certain issues at the organisational level, including data duplication and lack of access to data when needed. This subsequently led to an inefficient output during the task processing (Fowler & Gilfillan, 2003). The failure of ERPS implementation was reported to be up to 75 percent (Thavapragasam, 2003), and typically ranging from 40 to 90 percent (Shanks, 2000). The reasons included resistance by users, ambiguity about the perception of the users, failure to accommodate cultural changes, and business process re-engineering failure (Fowler & Gilfillan, 2003). These reasons contributed to increased difficulty in convincing employees about potential benefits (Park, Suh, & Yang, 2007). Consequently, variation was found in the level of achievement from highly satisfactory to complete failures (Fowler & Gilfillan, 2003). Institutional forces might play a significant role in the post-implementation absorption of ERPS, where absorption was the extent to which the use of technology diffused across the organization at all layers to materialize the benefits of implementation. Accordingly, there was a need to identify technically strong users to help fellows adapt through extensive training. Another possibility was that the top management announced ERPS implementation only to satisfy stakeholders or because of external pressures without being committed fully to diffusion (Liang, Saraf, Hu, & Xue, 2007).

Various sectors received different levels of attention by researchers of innovation diffusion (E. M Rogers, 2003). For example, the education sector gained very little attention, i.e., only 8 percent of all diffusion and usage publications were conducted on education sector (E. M Rogers, 2003). Researchers acknowledged that the usage of innovations was dependent on the regional culture and more specifically on the culture of the organization (Al-Zaabi, Choudrie, & Lebcir, 2012; Choudrie, Umeoji, & Forson, 2012; Wejnert, 2002). Advancement of a culture of instrumental command and control could contrast with the values of HEI (Waring & Skoumpopoulou, 2012). Macfadyen and Dawson (2012) argued that institutional resistance was found in the culture of academic institutions. It was emphasized that the head of an HEI must play a motivating role to successfully manage the process of innovation. In the usage of an information system, numerous problems were faced by organizations, including cultural and behavioral issues of the employees. Although culture was very complex to understand but it could offer a better understanding when considering the social and physiological aspects of electronic implementation in the public sector (Choudrie, et al., 2012). Considering Asia and specially focusing on the sub-continent, research on the local culture suggested that employees were accustomed to being a part of one organization, and specifically, working in one functional area for the whole job tenure within that organization; this could develop resistance to accepting innovations and their willingness to change themselves may be adversely affected (Rajapakse & Seddon, 2005). Considering the usage of ERPS in an HEI, end-user could have been resistant to learn cutting edge technologies (Macfadyen & Dawson, 2012). Findings of researches conducted on ERPS in the developed countries may be generalizable to Pakistan (Khan, Amin, & Lambrou, 2010) subject to cultural aspects and local values. Researchers also acknowledged the existence of barriers to ERPS usage in the unique cultural context of Pakistan, including a tendency to blame everything on government or other individuals, complaints of poor IT infrastructure and lack of adequate training (Khan, et al., 2010). A study on manufacturing firms in Sialkot [city] in Pakistan acknowledged the multiple layers within an organization; however, empirical evidence for top management support and organisational culture was collected only from the end-users (Mir, Sair,

& Malik, 2014).

In recent years, some research studies were conducted on ERPS in various public and private organizations in Pakistan. For example, Shad et al. (2012) focused on four public organizations in Pakistan (NADRA, OGDCL, PTCL, HEC) and concluded that ERP implementation is affected by contextual factors. Similarly, Khan et al. (2011) investigated the barriers to successful implementation of ERPS in Pakistan and found a large gap between the promises of vendors and reality faced by the end-users of ERPS. Other researchers focused only on the users and the institutional level, for example, Hameed et al. (2012) focused on the management and organizations but did not explicate the contextual issues specific to the industry or the country. Other studies, compared the implementation of ERPS in the developing and the developed countries. For example, Kanwal & Manarvi (2010) took a sample of 255 respondents to exploring the factors affecting users' behavior of ERPS in the telecommunication-based organization in Pakistan.

In Pakistan, to implement ERPS in universities, a central body that works under the Government of Pakistan called Higher Education Commission (HEC) purchased Campus Management System (CMS) for the eight public sector HEIs in Pakistan in (2009). HEC projected to implement CMS to all public sector HEIs across the country (HEC Pakistan, 2009) while few private sector HEIs were already using different ERPS (Nizamani, Khoumbati, Ismaili, & Nizamani, 2014). Existing studies on HEIs in Pakistan indicate poor performance and dissatisfaction of stakeholders (Schlichter & Kraemmergaard, 2010). These studies also state that ERP systems did not produce the desired results (Batada & Rahman, 2014). There was a need to conduct further studies in ERPS in Pakistani context in general (Mir, et al., 2014) and HE sector in particular (Shah, et al., 2011). Although relevant empirical and conceptual studies are emerging, existing research on HEIs remained underdeveloped (Abbas, 2011). Vega and Brown (2011) asserted the need to conduct multi-level research that addresses usage process at each level of the organization. Thus, as the literature review shows there is a need to analyze the extent of usage of CMS at different levels of stakeholders in the HEIs in Pakistan.

In this study, individuals who can influence the increase in the usage of CMS in the context of an HEI, positively or negatively are split into three layers, namely organisational layer, departmental layer and end-user layer. The top layer of an organization consists of top management and policy makers. Strategic planning at this level not only affects the overall organisational performance but the usage of ERPS also. The nature of decision-making at this layer generates the trickle-down effect of usage process to the lower layers of an organization. In the context of Pakistan, power distance between the layers of management, as well as the power distance between the management and employees was generally very large (E. Khilji, 2002).

The second layer, consisting of departmental heads, has direct interaction with the end-users of ERPS. Departmental heads are responsible for making decisions and taking measures to ensure that the policies regarding usage of ERPS received from the organisational layer are effectively implemented at the lower level to produce the desired results. In the context of Pakistan, there could be a marked discrepancy between the written and the implemented policies with little accountability or proper measures to monitor the progress of implemented policies (S. E. Khilji & Wang, 2006).

The last layer consists of ERPS end-users who directly interact with the system, and therefore, empirical research at this layer carries prime importance to acquire a comprehensive understanding of the usage process. In the context of Pakistan, the role of end-users may vary due to lack of uniformity in training given to the end-user, difference in learning orientations etc. These factors are discussed in the conceptual model discussed below.

Conceptual model

The conceptual framework of this study is based on the Unified Theory of Acceptance of Information Technology (UTAT) developed by Venkatesh et al (2003). This theory explains the acceptance of information technology by an individual. It basically unifies eight models that explain determinants of acceptance and usage of information technology. These models include Theory of Reasoned Action (TRA) by Fishbein and Ajzen (1975), Technology Acceptance Model (TAM) by Davis et al (1989), Motivational Model (MM) by Davis et al (1992), Theory of Planned Behavior (TPB) by Ajzen (1991), Model of PC Utilization (MPCU) by Thompson et al (1991), Combined TAM and TPB (C-TAM-TPB) by Taylor and Todd (1995), Innovation Diffusion Theory (IDT) by Rogers (1995) and Social Cognitive Theory (SCT) by Compeau and Higgins (1995).

The factors specified by each of the above-mentioned theories that explain acceptance and usage were empirically tested by Venkatesh et al (2003). Seven constructs turned out to be significant direct determinants of intention and usage. These constructs include performance expectancy, effort expectancy, social influence, and facilitating conditions. In addition, Venkatesh et al (2003) also identified a set of moderators that moderate the effect of the above-mentioned determinants of usage of information technology. The moderators include gender, age, voluntariness and experience.

In this study, it has been theorized that the usage ERPS can be explained by splitting individuals working in an HEI into three layers, namely organisational layer, departmental layer and end-user layer. The determinants of usage identified by Venkatesh et al (2003) were used to identify factors that explain the usage of ERPS in HEIs in Pakistan. A careful review of literature helped in enlisting several items for each of the seven constructs of UTAT. Preliminary discussions with individuals from each layer helped us in specifying the set of determinants of usage of ERPS in each layer. The individuals were selected randomly from each layer. Factors specific to the organisational layer are organisational culture, benefit realisation, human resource availability, tolerance for conflicts and risks, collegial support and collaboration, decision making and control, organisational alignment, training, and setting up learning structure. Factors specific to the departmental layer are operational support, managerial patience, active advocacy, management participation in ERPS learning sessions, management citizenship behaviour, power sharing, and performance based reward policy. Finally, factors specific to the end-user layer are training, learning orientation, behavioural intentions, acceptance and usage of the system, participation and support, resistance, ease of use, usefulness, motivation, and user satisfaction.

Building upon the conceptual framework discussed above, a conceptual model shown developed for this study. First, it proposes an examination of usage of ERPS across three major layers, i.e., organisational, departmental and end-user which is in line with the multi-level approach for identifying factors of usage of ERPS. Secondly, the model identifies specific factors for each of

the three layers that will be tested in the form of research hypotheses. The factors of usage at the organisational level are organisational culture, human resource availability, tolerance for risks and conflicts, collegial support and collaboration, decision making and control, organisational alignment, training, benefit realisation and setting up learning structure. The factors of usage of ERPS at departmental level are operational support, managerial patience, and active advocacy, management participation in ERPS learning sessions, management citizenship behaviour, power sharing and performance-based reward policy. Finally, the factors of usage at the end-user level are absorptive capacity, training, learning orientation, behavioural intentions, acceptance and usage of the system, participation and support, resistance, ease of use, usefulness, motivation and user satisfaction.

The conceptual model developed for this study is shown in Figure 1. The model shows factors that explain the usage of ERPS across three layers, i.e., organisational, departmental and end-user in HEIs in Pakistan. Secondly, the model identifies specific factors for each of the three layers.

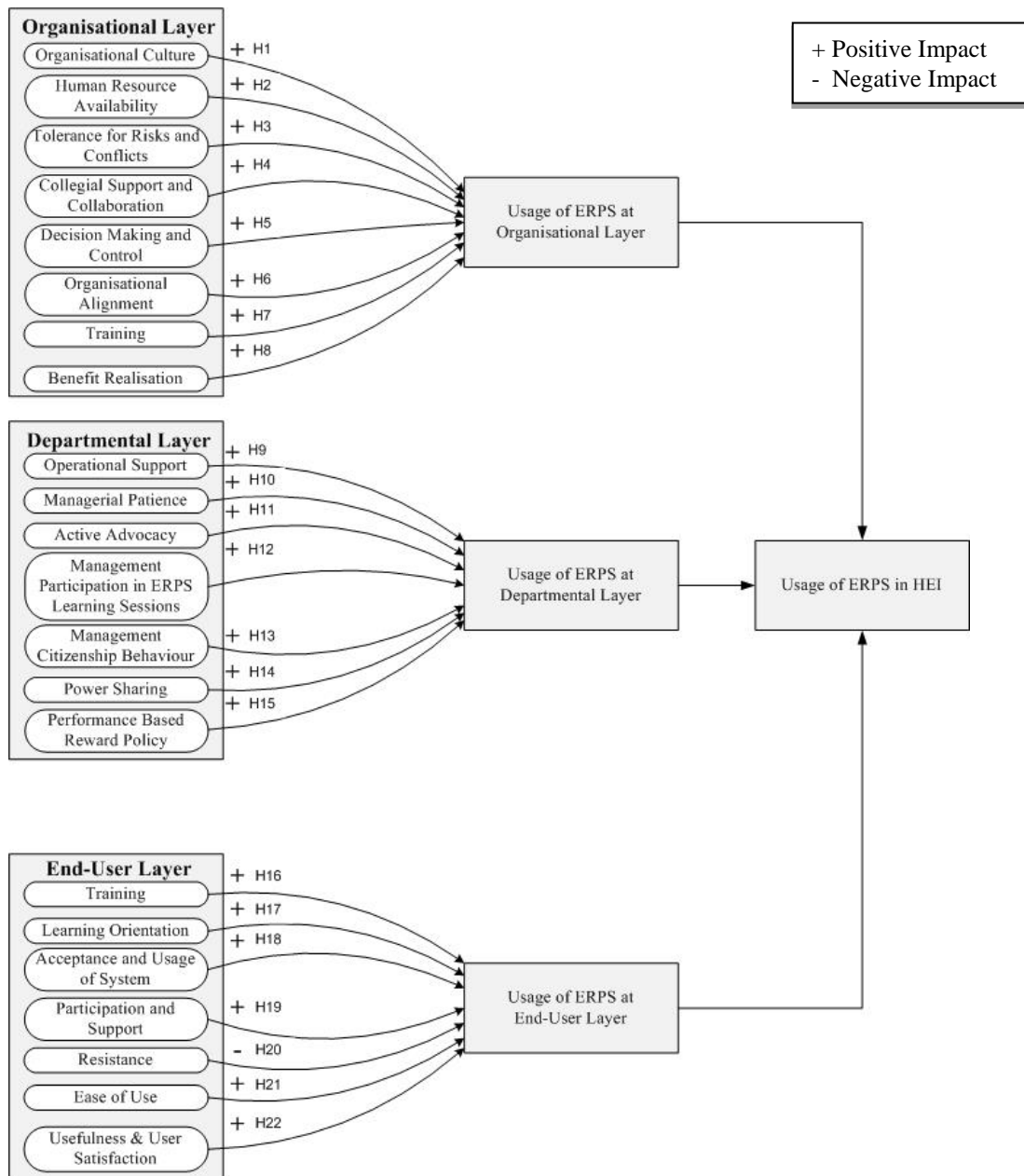


Figure 1-Conceptual model for usage of ERPS in HEIs in Pakistan

Methodology

Sample

Cross-sectional data was collected from 18 HEIs located in nine cities of Pakistan. This makes almost 50 percent of the total HEIs using ERPS. HEIs that were using ERPS fulfilled the criteria of the required sample for the study. The researcher relied on the personal network with influential persons to get access to the respondents.

These HEIs were selected using judgmental sampling technique (Saunders, Lewis, & Thornhill, 2011). This technique allows the researcher to select the respondents on the basis of his personal

judgement. This method may lead to bias. To overcome the possibility of having a bias in sample selection, data from almost 50 percent of the total population has been taken. Precisely, more than 1400 questionnaires were filled of which 1351 questionnaires were valid. 34 cases with more than 50 percent missing observations were dropped. This led to further reduction in the sample size to 1317 complete responses. Of these 1317 responses, 86 responses are from the organisational layer, 143 are from the departmental layer and 1088 are from the end-user layer.

Questionnaire and scaling

To empirically test the conceptual model outlined in Figure 1, three questionnaires were developed. The first questionnaire was used to take the responses from the organisational layer. Organisational layer constitutes the deans, heads of the departments and officials who were working at the top administrative positions for ERPS policy making in HEIs. It was assumed that organisational culture, human resource availability, collegial support and collaboration, decision making and control, organisational alignment, training and benefit realization influence the usage of ERPS at the organisational level. The second questionnaire was designed to measure the effects of factors that explain usage at the departmental layer. Departmental layer constituted of faculty members working as departmental heads at HEIs. Factors that were assumed to be determinants of usage at the departmental level included operational support, managerial patience, active advocacy, management participation in ERPS learning sessions, management citizenship behavior, power sharing and performance-based reward policy. The third questionnaire was structured to investigate the usage of ERPS at the end-user level. End-users were the administrative staff and faculty members who were the users of ERPS at the HEIs. Factors that were assumed to be explaining variation in the usage at end-user layer included training, learning orientation, acceptance and usage of the system, participation and support, resistance, ease of use, usefulness and user satisfaction. The factors accounted for as the determinants of usage of ERPS in the three layers mentioned above were based on the UTAUT. The three questionnaires were pre-tested and refined before the complete data collection.

Layder's (1993) research map was adapted as a conceptual tool where the organisational, departmental and end-user layers were seen as distinct but interlinked layers. As shown in Figure 2, the three layers (organisational, departmental and end-user) have unique but interlinked focus and objectives.

	Research Elements	Description	Research Focus	Research Objective	Research Methods
USAGE OF ERPS	Context	Macro social forms	Higher Education Industry of Pakistan	To set the factors contributing to usage of ERPS in the industrial context	<ul style="list-style-type: none"> - Systematic Literature Review - Official statistics and reports related to ERPS - National data
	Setting	Immediate environment of social activity	Higher Education Institutes	To examine the factors contributing to usage of ERPS in HEI at the Organisational Layer	<ul style="list-style-type: none"> - Systematic Literature Review - Official statistics and reports related to ERPS - Questionnaire-Org
	Situated Activity	Dynamics of face-to-face interaction	Departments of HEIs	To examine the factors contributing to usage of ERPS in HEI at the Departmental Layer	<ul style="list-style-type: none"> - Systematic Literature Review - Official statistics and reports related to ERPS - Questionnaire-Dep
	Self	Biographical experience and social involvements	End-Users in HEIs	To examine the factors contributing to usage of ERPS in HEI at the End-User Layer	<ul style="list-style-type: none"> - Systematic Literature Review - Official statistics and reports related to ERPS - Questionnaire-EU

Figure 2-Research resource map

(Adapted from Layder, 1993, p.114)

Method of analysis

After cleaning the data collected, data analysis was done using R (Team, 2005). Internal reliability consistency of the multi-item constructs is measured using Cronbach's alpha. To estimate the relationships shown in Figure 1, structural equation modelling (SEM) was used. The model specified was estimated for each of the three layers separately.

Data analysis

At the organisational layer, respondents were the policy makers for ERPS in HEIs. At this layer, 75 percent respondents were from public sector whereas the rest were from private universities. 90 percent of the total respondents from the organisational layer were males. The majority of the respondents belonged to middle age group; 64 percent were from age 26 to 40 and 30 percent were over 40 years while only two respondents were less than 25 years of age. The significant majority was highly educated as 64 percent possessed a Ph.D. or MPhil degree. 28 percent were having more than 20 years of experience while less than 19 percent were having experience less than five years. It has been observed that over 66 percent of the total respondents from organisational layer have more than five years of experience. Regarding ERPS experience, 50 percent were dealing with the system for more than four years. This indicates that majority of the ERPS policy makers were highly educated and also have greater experience of working in HEIs as well as dealing with ERPS.

At the departmental layer, all of the departmental heads were faculty members and 70 percent were from the public sector. Out of all, 71 percent were males, while 60 percent were above 40 years of age. The respondents were educated; 83 percent were having Ph.D. and 16 percent were MPhil. All the respondents were highly experienced; 44 percent were having more than 20 years

of job experience while almost 40 percent were having more than 20 years of working experience in HEIs. Moreover, 30 percent were having more than 20 years of experience working in current HEI where they were working at the moment of responding to the questionnaire. Similarly, 37 percent were having more than 4 years' experience dealing with the system.

At the end-user layer, 78 percent were from the public sector. There were two categories of respondents, faculty members and employees. Out of all, 91 percent were faculty members. The ratio of male and female was 70:30. The respondents from the end-users layer on average are younger than the respondents from organisational and departmental layers. In this layer, 90 percent were of less than 40 years of age. Regarding education of the respondents, 25 percent were having Ph.D. degree while 42 percent were having MPhil degree. Only 9 percent were having bachelor degree while 3 percent were having lower qualifications. Regarding total job experience, around 50 percent were having less than five years of experience while only four percent were having more than 20 years of total experience while 60 percent were having less than five years of experience in HEIs. Moreover, 70 percent respondents were having less than five years of experience in current HEI. Out of 1088, 243 respondents were having more than four years of ERPS usage experience. Table 1 outlines the demographic details of the respondents from the three layers.

Table 1-Demographic statistics

Layer	Frequency	Experience in Years											
		Male		Age (50+)		Ph.D.		Overall (20+ Years)		In HEIs (20+ Years)		Using ERPS (4+ Years)	
Organisational	88	77	90%	21	25%	25	29%	24	28%	17	20%	42	50%
Departmental	143	101	71%	49	35%	118	83%	63	44%	55	39%	42	29%
End-user	1088	771	71%	27	3%	279	26%	47	4%	16	2%	243	22%

To test the reliability of questions measuring each factor, Cronbach's Alpha was calculated for each factor explaining usage at all the three layers and observed to be above 0.90 for each factor showing strong reliability. Moreover, AVE was also checked and found to be above 0.50. Before conducting further analysis, descriptive statistics were generated (Gorard, 2003). At the organisational layer, respondents agreed to the usage of ERPs which had the highest mean value among all variables; while lowest was of organisational culture. At the departmental layer, the majority of the respondents agreed to the existence of operational support with highest mean value while performance-based reward policies showed the lowest indicating that HEIs were not giving any rewards for enhanced ERPS usage. The descriptive statistics are given in Table 2.

Table 2-Descriptive statistics

Organisational Layer	Mean	SD.	Departmental Layer	Mean	SD.	End-user Layer	Mean	SD.
Organisational Culture	3.57	0.51	Operational Support	3.95	0.67	Training	3.00	0.99
Human Resource Availability	3.78	0.56	Managerial Patience	3.92	0.68	Learning Orientation	3.93	0.73
Tolerance for Risks and Conflicts	3.79	0.52	Active Advocacy	3.90	0.66	Acceptance and Usage of System	3.85	0.75
Collegial Support and Collaboration	3.85	0.69	Management Participation in ERPS Learning Sessions	3.56	0.71	Participation and Support	2.97	0.98
Decision-Making and Control	3.81	0.50	Managerial Citizenship Behaviour	3.61	0.70	Resistance	3.89	0.74
Organisational Alignment	3.72	0.66	Power Sharing	3.70	0.76	Ease of Use	3.65	0.88
Training	3.82	0.63	Performance Based Reward Policy	3.49	0.68	Usefulness & User Satisfaction	3.71	0.80
Benefit Realisation	3.82	0.61	Usage of ERPS	3.86	0.89	Usage of ERPS	3.50	0.96
Usage of ERPS	3.91	0.87						

Structural Equation Modeling

Structural Equation Modeling (SEM) is a powerful technique of multivariate analysis. It provides the flexibility to define a single model that accommodated individual question items to define each independent variable and the relationship of the dependent variable with independent variables. It also delivers the most efficient estimation technique with the flexibility to solve a series of regression equations at the same time (Hair, Anderson, Tatham, & William, 1998; Suhr, 2006). Within information system research, SEM is becoming increasingly popular as a systematic analytical tool (Roberts & Grover, 2009) that allows the researcher to establish relationships between dependent variable and independent variables (Kline, 2011). To date, the application of SEM technique remained neglected in the context of ERPS in HEIs in Pakistan; therefore, this study was probably the first of its kind in the Pakistani context.

As the first step in using SEM, a system of equations was structured for each of the three layers. The notation used by Fox (2002) has been applied to construct the three equation systems. In each system of equations, γ represents regression coefficient and measure the effect of a change in each of the independent variables on the dependent variable. The symbol λ represents factor loadings of respective question items. The error terms were symbolized as ζ and ξ .

For the organisational layer, the set of equations is given by Eq-1. The first equation presents the structural piece, whereas the next nine equations indicate the measurement part of the SEM. In other words, Eq-1 explains variation in usage of ERPS at the organisational layer (Y_O) as a function of eight latent variables shown in Fig 1. The next set of equations shows how each of the eight constructs (O_1 to O_8) has been measured. Here, O_1 is organisational culture, O_2 denotes human resource availability, O_3 designates tolerance for risks and conflicts, O_4 stands for collegial support and collaboration, O_5 labels decision making and control, O_6 indicates organisational alignment, O_7 specifies training and o_8 represents benefit realisation. γO_1 to γO_8 are the regression coefficients of factors O_1 to O_8 respectively while λ 's present the factor loadings of the respective question items. ζ_1 and ξO_i are the structural disturbance or errors in equations.

$$Y_O = \gamma_0 + \gamma_1 O_1 + \gamma_2 O_2 + \gamma_3 O_3 + \gamma_4 O_4 + \gamma_5 O_5 + \gamma_6 O_6 + \gamma_7 O_7 + \gamma_8 O_8 + \zeta_1 \quad (\text{Eq-1})$$

$$\begin{aligned}
O_1 &= \lambda_{11}O_{11} + \lambda_{12}O_{12} + \lambda_{13}O_{13} + \lambda_{14}O_{14} + \lambda_{15}O_{15} + \lambda_{16}O_{16} + \xi O_1 \\
O_2 &= \lambda_{21}O_{21} + \lambda_{22}O_{22} + \lambda_{23}O_{23} + \lambda_{24}O_{24} + \lambda_{25}O_{25} + \lambda_{26}O_{26} + \xi O_2 \\
O_3 &= \lambda_{31}O_{31} + \lambda_{32}O_{32} + \lambda_{33}O_{33} + \lambda_{34}O_{34} + \lambda_{35}O_{35} + \lambda_{36}O_{36} + \xi O_3 \\
O_4 &= \lambda_{41}O_{41} + \lambda_{42}O_{42} + \lambda_{43}O_{43} + \lambda_{44}O_{44} + \xi O_4 \\
O_5 &= \lambda_{51}O_{51} + \lambda_{52}O_{52} + \lambda_{53}O_{53} + \lambda_{54}O_{54} + \lambda_{55}O_{55} + \lambda_{56}O_{56} + \lambda_{57}O_{57} + \lambda_{58}O_{58} + \xi O_5 \\
O_6 &= \lambda_{61}O_{61} + \lambda_{62}O_{62} + \lambda_{63}O_{63} + \xi O_6 \\
O_7 &= \lambda_{71}O_{71} + \lambda_{72}O_{72} + \lambda_{73}O_{73} + \lambda_{74}O_{74} + \lambda_{75}O_{75} + \lambda_{76}O_{76} + \xi O_7 \\
O_8 &= \lambda_{81}O_{81} + \lambda_{82}O_{82} + \lambda_{83}O_{83} + \lambda_{84}O_{84} + \lambda_{85}O_{85} + \lambda_{86}O_{86} + \zeta O_8 \\
Y_0 &= \lambda_{91}O_{91} + \lambda_{92}O_{92} + \xi O_9
\end{aligned}$$

Regarding the usage of ERPS at the organisational layer, O_1 organisational culture was not proved to be a contributor to the model, therefore, it was removed from the model. Comparative Fit Index (CFI) value was observed as 0.56 while Root Mean Square Error of Approximation (RMSEA) was reported 0.12 and Standardised Root Mean Square Residual (SRMR) is 0.11. These indicators of model fit produced by SEM presented a weak model fit due to the small data set. One of the limitations of this layer was a relatively small data set due to a limited number of cases in the total population. Table 3 shows SEM model fit indicators.

Table 3-Model fit-organisational layer

RMSEA	CFI	TLI	SRMR	GFI
0.12 (p 0.000)	0.56	0.53	0.11	0.54

The model results showed that all the proposed factors have significant, yet varying, effects on the usage of ERPS. Tolerance for risks and conflicts has the highest effect (0.96) while training has the least effect (0.75) on the usage of ERPS in this layer. Therefore, all the hypothesised factors included in the model were accepted. With regards to the coefficients of determination for SEM (Schreiber, Nora, Stage, Barlow, & King, 2006), the lowest value was 0.75 for training that is in an acceptable range. The highest value was 0.96 for tolerance for risks and conflicts explaining 96 percent of the variation by six question items of the specified factor.

The factor loadings of question items of each independent variable are presented in Figure 3 while standardised regression estimates are given in Table 4.

Table 4-SEM results-organisational layer

	Coefficients	R-square
Human Resource Availability	0.89**	0.80
Tolerance for Risks and Conflicts	0.96**	0.93
Collegial Support and Collaboration	0.93**	0.86
Decision Making and Control	0.93**	0.86
Organisational Alignment	0.87**	0.76
Training	0.75**	0.54
Benefit Realisation	0.81**	0.57

** *p* value < 0.01

The structural model for the organisational layer is given in Figure 3. The factors' loadings are displayed on a single headed arrow for each question item explaining how much a factor explains the relevant variable. The directed arrows connecting dependent and independent variables were labeled with the corresponding regression coefficients. The regression coefficients explain the change in the factor for one unit change in the dependent variable. The R-square values are given in ellipses of factors explaining how well the data fits in the model.

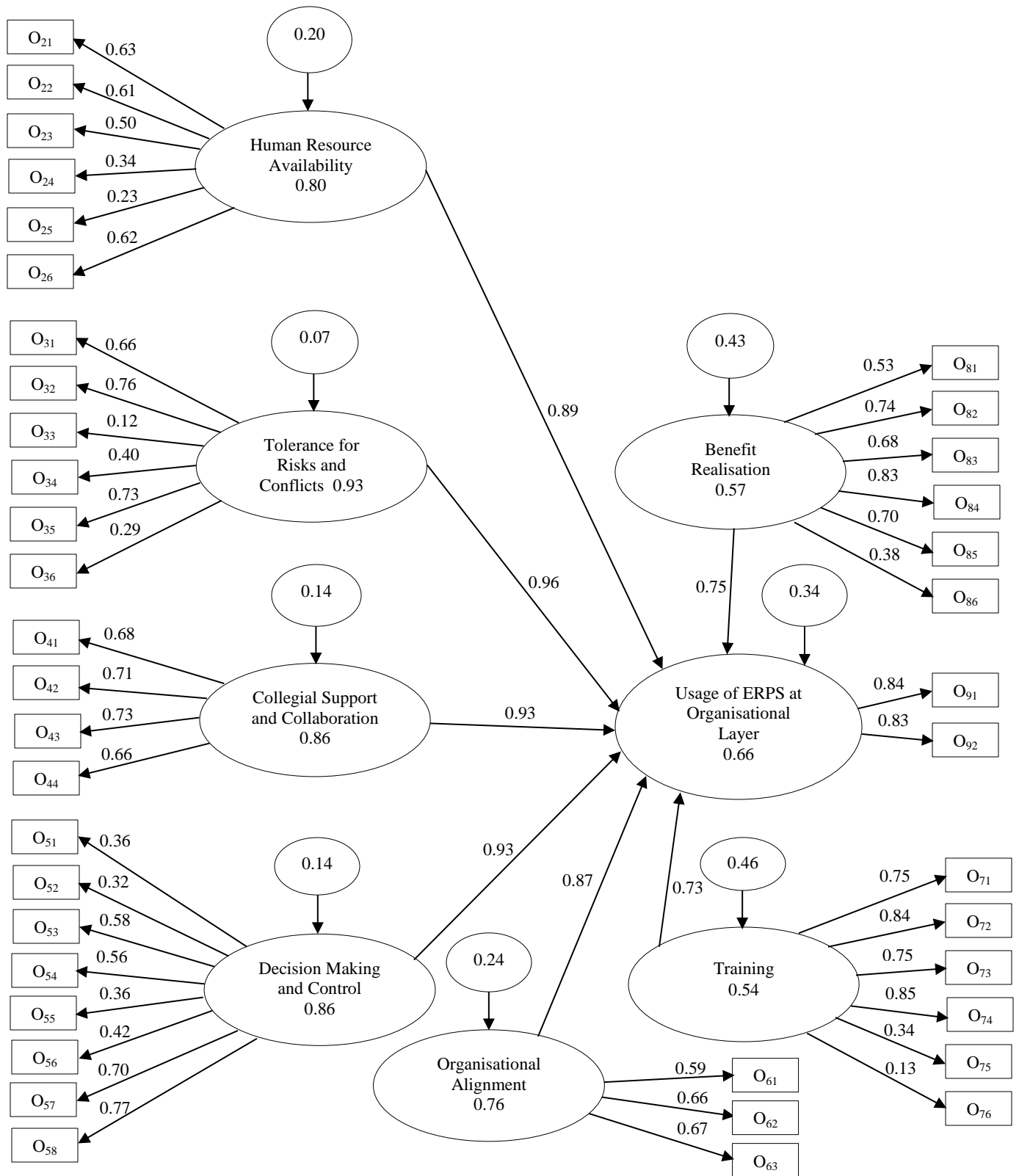


Figure 3-SEM results-organisational layer

For the departmental layer, the following structural equations are formulated (Eq-2). The first equation explains variation in the usage of ERPS at the departmental layer (Y_d). The next seven equations show how each of the eight constructs (d_1 to d_7) has been measured. Here, d_1 is operational support, d_2 denotes managerial patience, d_3 designates active advocacy, d_4 stands for management participation in ERPS learning sessions, d_5 labels managerial citizenship behaviour, d_6 indicates power sharing and d_7 specifies performance based reward policy. Last equation explains the factors that are used to measure the usage of ERPS at the departmental layer. γd_i s are the regression coefficients of factors d_1 to d_7 respectively while λ 's present the factor loadings of the respective question items. ζ_2 and ξd_i are the structural disturbance or errors in equations.

$$Y_d = \gamma_0 + \gamma_1 d_1 + \gamma_2 d_2 + \gamma_3 d_3 + \gamma_4 d_4 + \gamma_5 d_5 + \gamma_6 d_6 + \gamma_7 d_7 + \zeta_2 \quad (\text{Eq-2})$$

$$d_1 = \lambda_{11} d_{11} + \lambda_{12} d_{12} + \lambda_{13} d_{13} + \lambda_{14} d_{14} + \xi d_1$$

$$d_2 = \lambda_{21} d_{21} + \lambda_{22} d_{22} + \lambda_{23} d_{23} + \lambda_{24} d_{24} + \lambda_{25} d_{25} + \xi d_2$$

$$d_3 = \lambda_{31} d_{31} + \lambda_{32} d_{32} + \lambda_{33} d_{33} + \lambda_{34} d_{34} + \xi d_3$$

$$d_4 = \lambda_{41} d_{41} + \lambda_{42} d_{42} + \lambda_{43} d_{43} + \lambda_{44} d_{44} + \xi d_4$$

$$d_5 = \lambda_{51} d_{51} + \lambda_{52} d_{52} + \lambda_{53} d_{53} + \lambda_{54} d_{54} + \lambda_{55} d_{55} + \lambda_{56} d_{56} + \xi d_5$$

$$d_6 = \lambda_{61} d_{61} + \lambda_{62} d_{62} + \lambda_{63} d_{63} + \lambda_{64} d_{64} + \lambda_{65} d_{65} + \xi d_6$$

$$d_7 = \lambda_{71} d_{71} + \lambda_{72} d_{72} + \lambda_{73} d_{73} + \lambda_{74} d_{74} + \lambda_{75} d_{75} + \xi d_7$$

$$Y_d = \lambda_{81} d_{81} + \lambda_{82} d_{82} + \xi d_8$$

At departmental layer, CFI value was 0.80, RMSEA is 0.09, and SRMR is 0.07. The indicators of model fit produced by SEM presented a good model fit. The dataset was also not considered as large dataset having 143 responses. SEM model fit indicators are shown in Table 5.

Table 5-Model fit-departmental layer

RMSEA	CFI	TLI	SRMR	GFI
0.09 (p 0.000)	0.80	0.79	0.07	0.71

Regarding the usage of ERPS at the departmental layer, the results show that all the proposed factors had significant, yet varying, effects on the usage of ERPS. Performance based reward policy had the highest effect (0.93) while managerial participation in ERPS learning sessions had the least effect (0.61) on the usage of ERPS at the departmental layer. Therefore, all the hypothesised factors included in the model were accepted. With regards to the coefficients of determination for SEM (Schreiber, et al., 2006), the lowest value was 0.61 for management participation in ERPS learning session which was acceptable. The highest value was 0.93 for performance based reward policy explaining 93 percent of the variation by five question items of the specified factor. The values are given in Table 6 and SEM diagram of the departmental layer is shown in Figure 4 along with factor loadings of question items of each independent variable, standardised regression estimates and r-square values.

Table 6-SEM results-departmental layer

	Coefficients	R-square
Operational Support	0.81**	0.65
Managerial Patience	0.88**	0.78
Active Advocacy	0.79**	0.63
Management Participation in Learning Sessions	0.61**	0.37
Managerial Citizenship Behaviour	0.81**	0.66
Power Sharing	0.82**	0.67
Performance Based Reward Policy	0.93**	0.86

** *p* value < 0.01

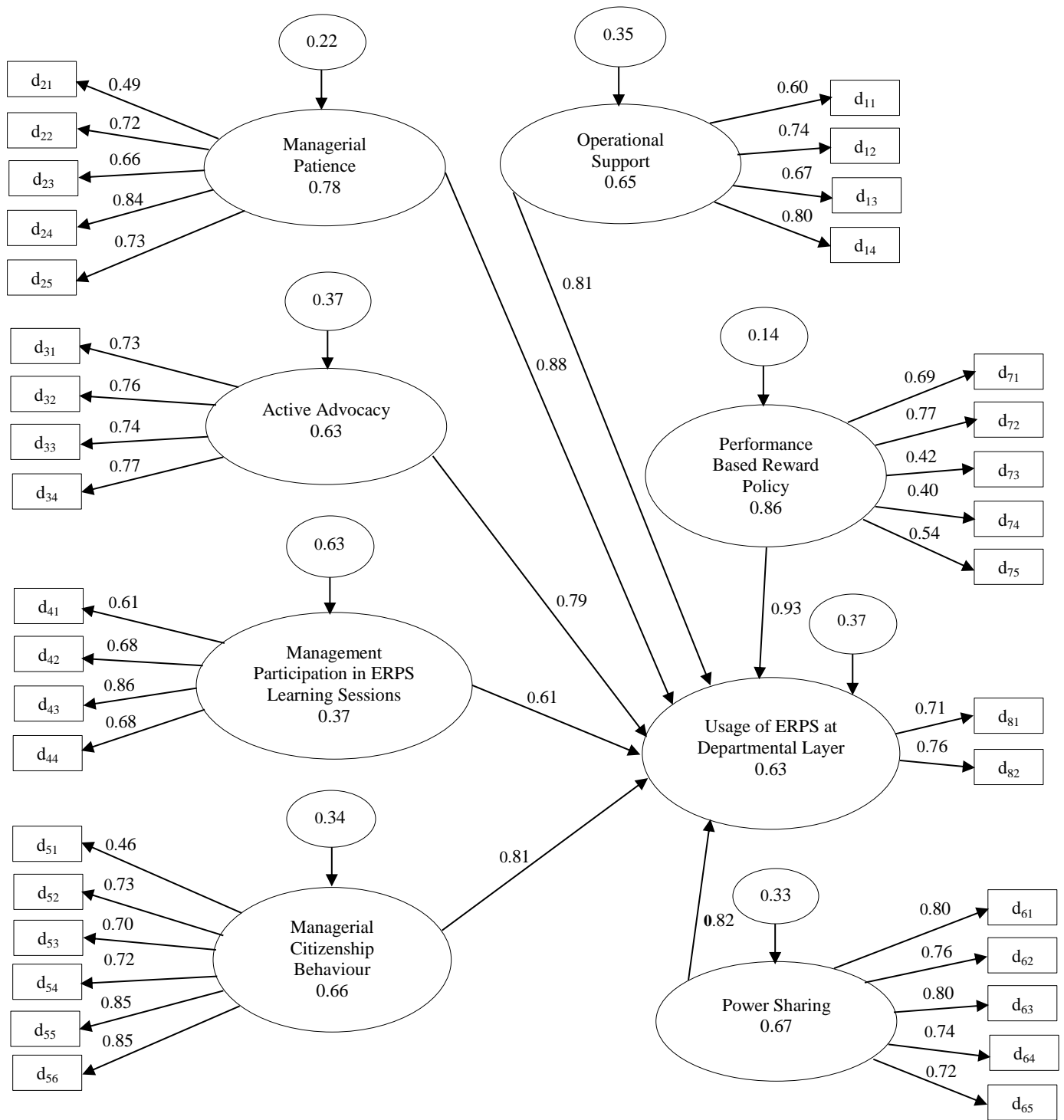


Figure 4-SEM results-departmental layer

For the end-user layer, the following structural equations (Eq-3) are formulated. The first equation explains variation in usage of ERPS at the end-user layer (Y_e). The next equations show how each of the eight constructs (e_1 to e_7 and Y_e) has been measured. Here, e_1 is training, e_2 symbolizes learning orientation, e_3 describes acceptance and usage of the system, e_4 stands for participation and support, e_5 labels resistance, e_6 shows the ease of use and e_7 specifies usefulness and user satisfaction. γ_{e_1} to γ_{e_7} are the regression coefficients of factors e_1 to e_7 respectively while λ 's present the factor loadings of the respective question items. ζ_3 and ξ_{e_i} are the structural disturbance or errors in equations.

$$Y_e = \gamma_0 + \gamma_1 e_1 + \gamma_2 e_2 + \gamma_3 e_3 + \gamma_4 e_4 + \gamma_5 e_5 + \gamma_6 e_6 + \gamma_7 e_7 + \zeta_3 \quad (\text{Eq-3})$$

$$e_1 = \lambda_{11} e_{11} + \lambda_{12} e_{12} + \lambda_{13} e_{13} + \lambda_{14} e_{14} + \lambda_{15} e_{15} + \lambda_{16} e_{16} + \lambda_{17} e_{17} + \xi_{e_1}$$

$$e_2 = \lambda_{21} e_{21} + \lambda_{22} e_{22} + \lambda_{23} e_{23} + \xi_{e_2}$$

$$e_3 = \lambda_{31} e_{31} + \lambda_{32} e_{32} + \lambda_{33} e_{33} + \xi_{e_3}$$

$$e_4 = \lambda_{41} e_{41} + \lambda_{42} e_{42} + \xi_{e_4}$$

$$e_5 = \lambda_{51} e_{51} + \lambda_{52} e_{52} + \lambda_{53} e_{53} + \xi_{e_5}$$

$$e_6 = \lambda_{61} e_{61} + \lambda_{62} e_{62} + \lambda_{63} e_{63} + \xi_{e_6}$$

$$e_7 = \lambda_{71} e_{71} + \lambda_{72} e_{72} + \lambda_{73} e_{73} + \lambda_{74} e_{74} + \xi_{e_7}$$

$$Y_e = \lambda_{81} e_{81} + \lambda_{82} e_{82} + \xi_{e_8}$$

At this layer, all independent variables contributed to latent variable, usage of ERPS at the end-user layer. These indicators of model fit, CFI value was 0.88, RMSEA is 0.08, SRMR is 0.08, produced by SEM presented a good model fit. SEM model fit indicators are shown in Table 7.

Table 7-Model fit-end-user layer

RMSEA	GFI	CFI	TLI	SRMR
0.08 (p 0.000)	0.81	0.88	0.87	0.08

SEM results of end-user layer showed that all the proposed factors had significant effects on the usage of ERPS at that layer. The highest effect was from usefulness and user satisfaction (0.92) while lowest was training (0.39). With regards to the standardised regression estimates, the highest value was 0.92 for usefulness and user satisfaction explaining 92 percent of the variation by four question items of the specified factor. The details are presented in Table 8.

Table 8-SEM results-end-user layer

	Coefficients	R-square
Training	0.39**	0.15
Learning Orientation	0.58**	0.34
Acceptance and Usage of System	0.80**	0.64
Participation and Support	0.46**	0.21
Resistance	0.62**	0.38
Ease of Use	0.75**	0.57
Usefulness and User Satisfaction	0.92**	0.85

** *p value < 0.01*

Moreover, SEM diagram with results for factors affecting usage of ERPS at the end-user layer is presented in Figure 5.

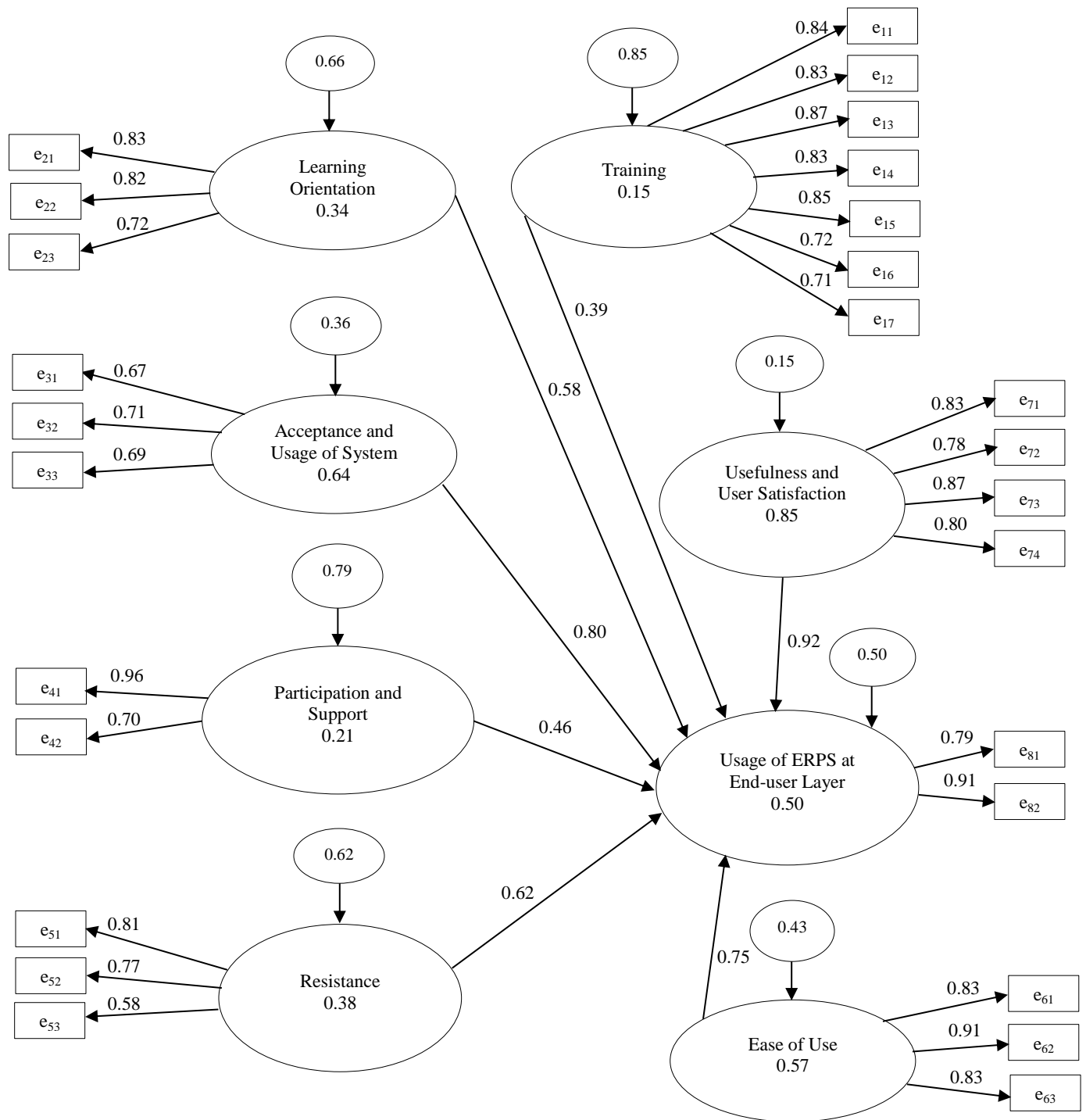


Figure 5-SEM results-end-user layer

Thus, the use of SEM had helped to identify the relevant factors affecting the usage of ERPS at departmental and end-user layers and showed that the majority of the factors represented a large proportion of the variance to measure their relevant concepts.

Discussion

Current literature suggests that there was limited research on the usage of information systems in the Pakistani context. The aim of this research was to examine the factors that contribute to the usage of ERPS across the organisational, the departmental and the end-user layer in HEIs in Pakistan. It first provided an overview of the literature on the usage of innovation and then constructed a conceptual model that suggested a multi-level examination of the factors of usage. For this study, 22 research hypotheses were formulated and 21 hypotheses were proved. Three research questionnaires were designed to examine the factors of usage across the three layers, i.e., organisational, departmental and end-user layer. Layder's (1993) research map was adopted for the conceptual and methodological framework.

Empirical data for the pilot study was collected from eighteen HEIs. A total of 1317 responses were used for data analysis, from three separate questionnaires. Structural equation modeling was employed for data analysis using R. The model fit indices; RMSEA, CFI, GLI, TLI, SRMR; at the departmental and end-user layers presented a good model fit. SEM results also demonstrated that organisational culture did not affect the ERPS usage at organisational layer while human resource availability, tolerance for conflicts and risks, collegial support and collaboration, decision making and control, organisational alignment, training and benefit realisation affected the usage of ERPS in HEI at the organisational layer. At the departmental layer, the findings showed that all the factors; operational support, managerial patience, active advocacy, management participation in ERPS learning sessions, management citizenship behaviour, power sharing, and performance based reward policy; were significant. Finally, at the end-user layer, all the hypothesized factors contributed significantly to ERPS usage at this layer; training, learning orientation, acceptance and usage of the system, participation and support, resistance, ease of use and usefulness and user satisfaction.

Contribution

This study has identified an under-researched topic, i.e., usage of ERPS in higher education sector of Pakistan. It offered original contributions to knowledge in multiple dimensions. Firstly, identification of indigenous manifestations of ERPS usage has contributed to theory development in the under-researched context of Pakistani HEIs. It also has the potential to inform research in other contexts. Secondly, it addresses Carlsson's (2004) calls to use Layder's (1993) research map in information system research as a tool to synthesise a large number of variables in developing a unique multi-layered conceptual model for examining the usage of ERPS.

In terms of contribution to methodology, the study has proposed a multi-layer model and developed three distinct questionnaires for primary data collection to examine the usage of ERPS at the organisational, the departmental and the end-user layers in HEIs.

In terms of contribution to policy, suggestions based on the findings of the study would be disseminated to HEC and top management of each HEI. HEC and top management of HEIs may take the steps to enhance the usage of ERPS in higher education sector. This study is unique in providing Higher Education Commission (HEC) of Pakistan and Pakistani HEIs with an understanding of the significant factors in the usage of ERPS from a multi-level perspective within the organisation.

Significance

This study intended to provide HEIs with an understanding of the significant factors in the diffusion of ERPS from a multi-level perspective. It also showed the potential to contribute to theory development regarding usage of innovations in the under-researched context of Pakistani HEIs and provide indigenous manifestations of ERPS usage that could be utilised by policy-makers. The findings of the research would be used to highlight key areas that need the attention of policy makers, and help in strategic allocation of resources for ERPS usage. Furthermore, the top management of HEIs would use the findings of this research to address the issues local to the HEI and help in overcoming the hurdles to ERPS usage at the end-user layer; and eventually, the implementation of refined policies might speed up effective utilization of ERPS in HEIs of Pakistan.

Limitations

Empirical data for this study was being collected from the higher education sector of Pakistan; therefore, the findings of the study might not be necessarily generalisable to other sectors or countries. Nevertheless, the conceptual model developed in the study might be used to examine the usage of ERPS in other research contexts. With regards to the data collection, large physical distances between the universities in Pakistan were a major challenge. Also, terrorism and security issues in Khyber Pakhtunkhwa, Balochistan and Sindh (three provinces of Pakistan) inhibited the researcher from visiting higher education institutions in these provinces.

The Conceptual Framework presented a review of the existing research in ERPS field, there was limited research on ERPS in the Pakistani context. This posed difficulties in comparing the findings of the current study with other similar research from the same region. Also, limitation of the study was the availability of staff for responding to the questionnaires. As their participation was voluntary, therefore not everyone could be expected to agree to participate in the research. The final limitation of the study was the authenticity of the primary data collected: the information collected from the institutions and end-users would have to be assumed to be honest.

Future research

In future, overall usage of ERPS in HEIs may be estimated based on the results of all three layers by employing an appropriate aggregation method. Also, further SEM techniques and extensions may be applied in examining the usage of ERPS in the Pakistani context. Finally, this study may be replicated in other sectors and in other countries thus providing cross-sector and international comparisons.

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