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Measuring Performance Through Enterprise Resource Planning System Implementation

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ABSTRACT The evaluation of enterprise resource planning (ERP) systems for performance enhancement in public sector organizations is a crucial concept due to its different nature from private concerns. The objectives of this paper are to explore the relationship of the common performance enhancement factors in the context of the gap between the real and ideal ERP performance of public sector organizations in Pakistan and to explore the overall difference between the ideal and real ERP performance in those organizations to provide some guidelines to the public sector in Pakistan. The difference between the ideal, i.e., the expectations of the organization before implementing ERP, and the real performance of ERP in Pakistani public sector organizations is the main source of identifying the impact of common performance indicators on the ERP overall performance. Different researches have been conducted to find the critical success factors in various areas of ERP, like strategic, managerial, technical, and contextual factors, but the impact of the common factors that affect the ERP performance as a whole has never been investigated. Little research has been conducted on the performance factors, especially in the large-scale public sector organizations in developing countries like Pakistan. We performed data analysis considering descriptive statistics, reliability analysis, correlation analysis both in ideal and existing situations, and paired sample t-test. We found, based on the paired sample t-test, that there is no gap between the ideal and existing ERP systems for time and database variables, but there is a gap between the ideal and existing ERP systems in functionality, user-friendliness, flexibility, reliability, service, vendor support, and the overall performance of the ERP system deployed in the government sector of Pakistan.

INDEX TERMS Enterprise resource system, public organization, performance evaluation.

I. INTRODUCTION

The continue process with high rate of advances in information and communication frameworks makes numerous new commercial chances yet additionally provokes a variety of new technical challenges around expanding frameworks' trustworthiness, accessibility, flexibility, and auditability. These difficulties or challenges are under dynamic research, with remarkable progress is to support the reliable software and management [1]. The purpose of ERP system is to incorporate entire company's data in one place and give a major picture, with the assistance of an information system [2]. ERP has helped the companies to achieve their set strategic goals [3], and efficiency and competitive advantage [4], [5] over their rivals. Dynamism and the need for ongoing change in business environment has influenced organizations making them to rethink about strategies of business, respond rapidly to the changing condition and compete effectively to adopt advanced technological innovations [6]. Presently ''ERP serves numerous industries, endeavoring to computerize - activities from supply chain, stock control, manufacturing planning, production sales support, client relationship management, HR, and some other data oriented management procedures [7].

Because of economic growth, in Asia developing countries and Latin America are getting attention of enormous ERP companies [8]. There are extensive number of potential customers existing in these markets. These clients are proprietors and supervisors, try to develop their organizations and compete at worldwide level however can't do this due to no capacity for adopting new technologies so can't meet global standards [9]. There is little research on these organizations and ERP software venders are not very much aware of their

client's needs. Most of the research deal with adoption of ERP in developed countries so that's why there is need of investigation about ERP in developing countries like Pakistan.

The aim of the study is to check the difference between actual and real key performance enhancement factors of ERP projects in Pakistan's public organizations which is not yet investigated before. Enterprise Resource Planning (ERP) has progressed in the present century with diverse perspectives; researchers have defined ERP well in diverse techniques, such as ERP systems facilitating the mixture of business processes and transaction-oriented data right through an organization [10]. It is further defined that ERP is the core reason for an enduring cost decline and the provision of comprehensive reports for all the large-scale organization's stakeholders in a timely manner [11]. With the passage of time, ERP systems have been commercialized and defined, such that ERP is a commercial software package that helps organizations in automating their business processes. Considering ERP in the business perspective, it can be stated that ERP is an off-the-shelf software suite which facilitates organizations in optimizing their business process flow functionality based on real-time data [12]. So far, different studies have been done on ERP and it is formulated that ERP is an integrated solution based on a centralized database, providing tremendous benefits by minimizing time, cost, errors and labor data analysis and by the planning of reports in innovative ways for problem solving as well as interacting with the organization's stakeholders.

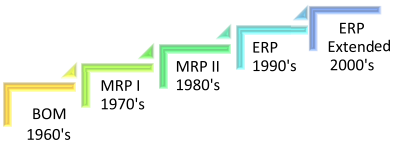


FIGURE 1. Evolution of ERP system. Source [13] "Motwani, Akbulut, Mohamed, and Greene. (2008)".

The phenomenon of ERP is not new, having a long history of about 60 years and passing through various evolutionary stages with the varying needs of the organizations (Fig. 1). The evolutionary stages are surveyed by Law and Ngai [14], in which it is shown that ERP systems have gone through a range of development cycles since 1960. Inventory management was undertaken for manufacturing systems. Most of the organizations were involved in Material Requirements Planning-I (MRP-I) in the 1970s, MRP being considered the best electronic information system at that time. In the 1980s MRP-I was expanded to MRP-II for unifying manufacturing procedures and sharing management undertakings [15]. MRP-II was considered a completely different method from the earlier MRP-I [16]. By 1990, MRP-II started to cover human resources, engineering, business, finance, and project management. Unlike MRP-I, MRP-II was not a software alone, but a mixture of computing resources, data integrity skills and planning skills. Fig. 2 shows that how and when ERP evolves from MRP to ERP II. For the first time a concept

Years	Title	Main features
1945	«30 Glorious»	Organisation of production principles (based on F.W. Taylor – H. Ford ideas)
1965	MRP 0	Material Requirements Planning (based on O. Wight – J. Orlicky ideas)
1975	**MRP I**	Closed Loop Material Requirement Planning, setting of production planning and its execution control on workshop level (Miller-Spregue)
1980	**MRP II**	Manufacturing Resource Planning based on data from suppliers and customers. Forecasting, planning and production controlling.
1985	MRP II+	Implementing of JIT (Just in Time) concept, weak spot optimisation
1990	**ERP**	Enterprise Resource Planning, Materials Planning, Order Entry, Distribution, General Ledger, Accounting, Shop Floor Control
1996	Extend ERP	Scheduling, Forecasting, Capacity Planning, e-Commerce, Warehousing, Logistics
2001	ERP II	Project Management, Knowledge Management, Workflow Management, Customer Relationship Management, Human Resource Management, Portal Capability, Integrated Financials

FIGURE 2. MRP- II flow chart. Source "https://www.pinterest.com/pin/131941464053795004".

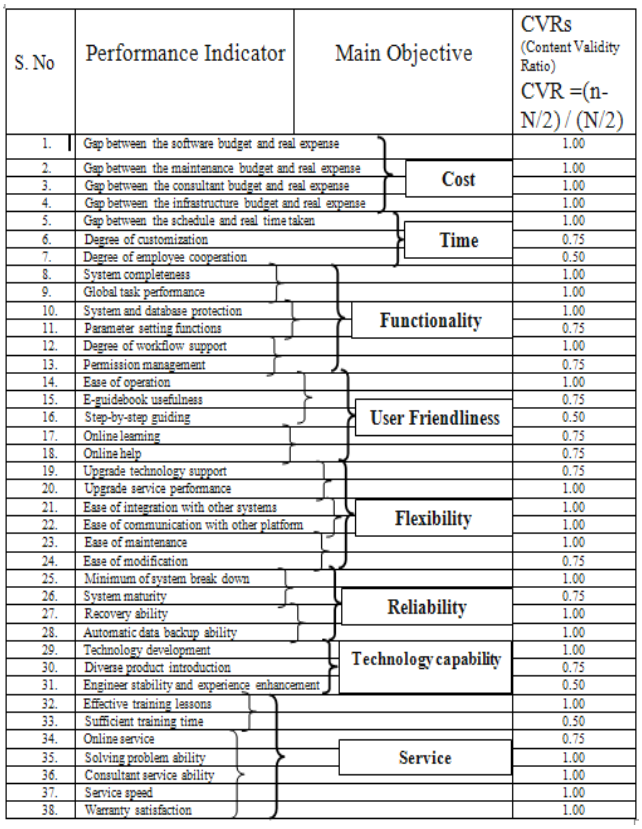
was built to address enterprise-level planning, when different factors of an organization were integrated to ensure that there was no duplication of data and to allow accurate prediction by using customer feedback. This extension of MRP-II was now known as ERP.

The paper is structured on 5 sections i.e. Introduction, Related work and Organization, Methods, Data Analysis and Recommendations & Discussion. Every section is briefly explained in the sequence discussed above.

II. RELATED WORK AND ORGANIZATIONS

The evolution of ERP since the 1960s as Bill of Materials (BOM) and still in its extended form in 2000 was elucidated [17]. The gap between ideal and real outcomes for implementation of any ERP package can be reduced by broad Business Process Reengineering and Alignment (BPR&A) [18], [19], as explored by Nah *et al.* [20]. As there is a cross-functional inter-relationship between the business process and the ERP system, an ERP system is always subject to a high level of risk if the relationship is not properly expressed and communicated between all stakeholders and it can become so complicated that it may lead the project towards failure, as defined by Brown and Vessey [18]. There are many ERP systems like PeopleSoft, SAP, Oracle, JD Edwards and BAAN that have penetrated the market because of their all-embracing character and suitability. A high customization cost, radical cultural, human and organizational change, and complicated ERP system implementation can drive customers to examine the implementation plan carefully, as reported by Brown and Vessey [18].

There are certain factors that determine the success of ERP implementation, which are top management commitment, a competent implementation team, training, accuracy of data, availability of measurement criteria and clear objectives and goals [21]. The most common performance enhancement factors explained below in Fig. 3, if addressed properly will have an enormous impact on the performance of ERP projects.



S. No	Performance Indicator	Main Objective	CVRs (Content Validity Ratio) CVR =(n-N/2) / (N/2)
1.	Gap between the software budget and real expense	Cost	1.00
2.	Gap between the maintenance budget and real expense		1.00
3.	Gap between the consultant budget and real expense		1.00
4.	Gap between the infrastructure budget and real expense		1.00
5.	Gap between the schedule and real time taken	Time	1.00
6.	Degree of customization		0.75
7.	Degree of employee cooperation		0.50
8.	System completeness	Functionality	1.00
9.	Global task performance		1.00
10.	System and database protection		1.00
11.	Parameter setting functions		0.75
12.	Degree of workflow support		1.00
13.	Permission management		0.75
14.	Ease of operation	User Friendliness	1.00
15.	E-guidebook usefulness		0.75
16.	Step-by-step guiding		0.50
17.	Online learning		0.75
18.	Online help		0.75
19.	Upgrade technology support	Flexibility	0.75
20.	Upgrade service performance		1.00
21.	Ease of integration with other systems		1.00
22.	Ease of communication with other platform		1.00
23.	Ease of maintenance		1.00
24.	Ease of modification		0.75
25.	Minimum of system break down	Reliability	1.00
26.	System maturity		0.75
27.	Recovery ability		1.00
28.	Automatic data backup ability		1.00
29.	Technology development	Technology capability	1.00
30.	Diverse product introduction		0.75
31.	Engineer stability and experience enhancement		0.50
32.	Effective training lessons	Service	1.00
33.	Sufficient training time		0.50
34.	Online service		0.75
35.	Solving problem ability		1.00
36.	Consultant service ability		1.00
37.	Service speed		1.00
38.	Warranty satisfaction		1.00

FIGURE 3. PI alignment with respect to CVR for ERP project implementation. Source [22] "Shad, Chen, & Azeem (2012)".

Reliability, Time, User-Friendliness, Service, Functionality and Flexibility are the seven key performance indicators for ERP performance enhancement and measurement factors. The first factor of performance enhancement is ''Reliability'', which comprises stability and recovery ability, in which stability can be altered through the least system breakdown, system maturity and recovery ability, including an automatic data backup capability to have an impact on performance. The second factor of performance, ''Time'', is mainly measured by the gap between the scheduled and real time taken and the degree of customization by measuring schedule control. The third PI factor is ''Database'', which contains the processed database, data error rate and data completeness. ''User- friendliness'' is the fourth PI factor and involves the simplicity and ease of operation, which is segmented into e-guidebook usefulness and ease of learning, where learning can be done by online tutorials and online help.

''Service'' is the fifth factor which influences the performance of the ERP service and can be measured by the training service and service ability. Effective training lessons for the ERP user can be measured as the training service and online service, and problem-solving ability; the consultant service ability and service speed indicate the service ability. ''Functionality'' is the sixth most common performance indicator and is further divided into three extensive categories. The first category is module completion, which can be measured through measurement of system completeness and global task performance; the second is functionality fitness and can be measured by the level of workflow support and parameter adjusting operators for performance enhancement and measurement; third is security, which is measured through system and database protection and permission management. ''Flexibility'' is the seventh performance indicator for ERP projects and is further divided into (a) upgrade ability, which is measured through upgrades of technology support and service performance, and (b) ease of integration, communication, maintenance, modification and in-house development [22].

Major complexities and failure rates of ERP system implementation and operations were investigated by Nah *et al.* [20] and Chen *et al.* [23]. ERP system implementation had not yet been critically hypothesized in a proper manner. ERP systems were considered as a basis for an effective information management instrument to help organizations to significantly transform their systems to utilize their resources with an innovative and interlinked applications solution. It was also examined how ERP systems assist organizations in establishing standardized processes for their business [24]. Recommendations were made for re-examining all the procedures of the business when ERP is proposed to be executed [25]. The use of ERP systems has been adopted in both private and public sector organizations and have been predominantly focused on efficiency improvements. Both sectors are rapidly implementing ERP as an ideal alternative to their existing systems. Research shows that although ERP implementation in the private sector has advanced the ERP market, the public sector has also shown a keen interest in improving its organizational structure by adopting specific functionalities from ERP vendors. The ERP implementation methods widely adopted in the private sector should also become part of the culture and regulations of the public sector [26]. It is important to note that the private sector has persuaded the public sector to adopt ERP methods and techniques [27].

Support for the technical performance of a system is usually provided by ERP vendors or the team from the organization involved in implementation of the ERP system. Business process improvement (BPI) and user satisfaction widely influence the implementation of ERP for organization performance [28]. Organizational performance is directly related to the level of agreement related to the severe competitive pressure and goals of the organization, while the performance impact of ERP is usually realized by the ERP implementing firms in the later years of the implementation [29]. Infrastructure (hardware) investment is required for performance regulation for an organization implementing ERP, and these organizations indicate their development of new business performance and control measures to achieve high results and output [30].

A. LIFE CYCLE FRAMEWORK OF ERP

A common ERP life cycle framework consists of phases and dimensions, where phases are different stages of the ERP system and dimensions are the various viewpoints from which phases can be analyzed properly. The dimensions part of the

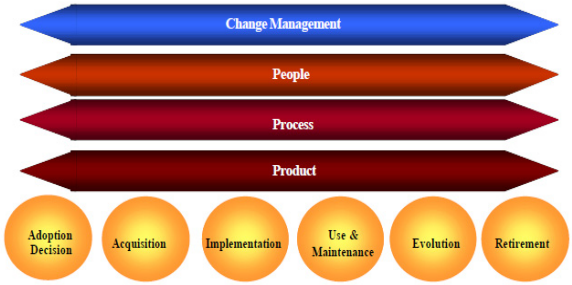


FIGURE 4. ERP Life Cycle. Source [31] "Esteves, J., & Pastor (1999)".

framework contain related issues. For example, the change management dimension consists of management of strategic change, culture issues, business process re-engineering and roles and skills. (Fig. 4). Nowadays, almost all issues emphasis only the acquisition and implementation phases, because the technology is new for some organizations after implementation, so it is important to form an ordinary vision to avoid future problems. Each issue and problem should be properly analyzed and described according to the dimensions of the framework.

In almost all organizations, ERP is considered a combined package of different business processes. The scope of the ERP reflects the limits of automation of business processes. For instance, Fig. 4 shows how the HR and Finance processes can be integrated in the ERP with an automation method. Normally, the business functions which are automated with Finance and HR are income tax planning, payroll, actual deduction, entry and exit processes, allocation of employee IDs, pay and performance appraisal. A continuous flow of employee data and information becomes available effectively faster than previously, enabling right decisions to be made at the right time. Fig. 5 shows a typical framework for ERP in which Finance and HR are the focus.

ERP system implementation is completed in order to gain extraordinary business benefits, but these are accompanied by equivalently high risks. Study indicates that ERP benefits organizations by automating processes, giving faster access to accounts details, rapid product and service look-up and ordering, reducing time and saving money, producing more innovative reports for management, lowering paper and processing costs, bringing management improvements, strongly integrating organization-wide methods, and giving easy access to trend data with the objective of predicting and empowering departments in their decision-making. ERP allows organizations to refine their communication, with easy information interchange between departments because of similar or single-system usage [32].

ERP implementation results in radical organizational changes which contain a lot of risk and rigidity. The strong linkages and interdependencies among database components and diverse business procedures involve countless risks [34]. This study investigates the application of the seven most common performance enhancement aspects in five large public organizations of Pakistan. It also explores the factors

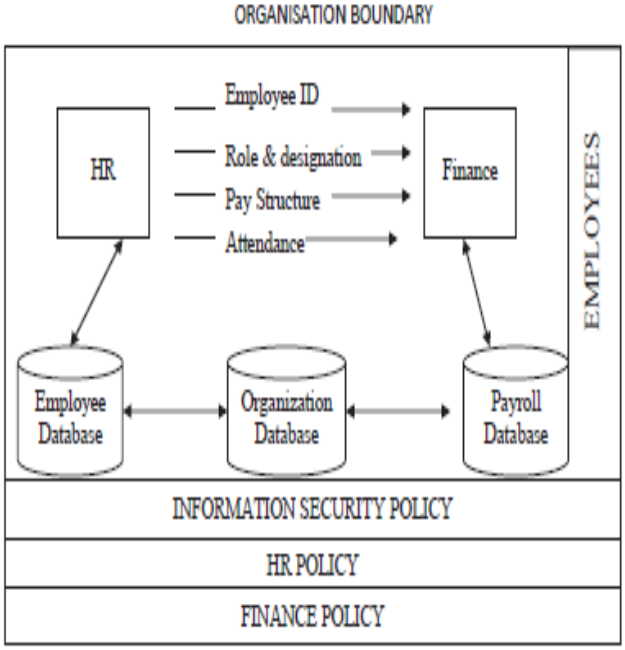


FIGURE 5. A typical ERP framework which covers the HR and Finance departments. Source [33] "Ganesh, Mohapatra, Anbuudayasankar, & Sivakumar. (2014)."

that affect the success of ERP implementation, which are technology-related issues, end-users, the internal environment, and implementing team, and besides this the impact of implementation on organizational performance. The critical success aspects in many parts of the ERP system, whether technical, strategic or managerial, and contextual factors. have been extensively studied, but performance enhancement factors that affect ERP performance have never been explored. There is a shortage of analysis of the performance factors especially in large public organizations and particularly in developing countries like Pakistan.

Database management and performance enhancement of enterprise systems are inter-related phenomena. Management of the process database, the data error rate and assurance of data completeness [35] lead the whole enterprise towards performance enhancement. At the time of planning and productivity analysis of ERP projects, a strong emphasis placed on the process database through detailed analysis for successful implementation of an ERP system was researched by Law and Ngai [36]. The data used for the legacy system may initiate problems with the success of ERP projects, as suggested by Wright and Wright [37] and Markus and Soh [38]. Errors or faults in the data may create critical problems with the implementation of ERP projects and these problems can be transferred from one module to another [39]. However, public sector organizations can alter their data into the required ERP input format, as reported by Gattiker and Goodhue [40]. After the analysis process, the databases of different projects are usually entered into the process database for ERP, as explained by Gulledge [41].

The data error rate (DER) is considered as a sub-component of the database which could affect the efficiency and effectiveness of the whole enterprise system both negatively and positively. Data processing delays which generally cause a rise in cost and time in business processes are mostly because of the DER [42]. Minimization or positive control of the DER or data accuracy ultimately affect the whole enterprise database, which ultimately contributes to the performance enhancement of the ERP [43]. Data completeness, if ensured tightly, enhances the overall performance of the system by enabling the required output to be executed in a timely manner with the right information from the enterprise system. The service level enhancement of an enterprise system is generally a bridge for information output in order to meet service level agreements [44]. The enterprise system quality is studied in the context of the integration of ERP, reliability, functionality, data quality and flexibility. To increase performance, a system recovery and stability capacity makes the whole system more reliable. System stability is usually affected by many changes in business goals during the ERP implementation procedure [45]. The ERP system's effectiveness for performance enhancement is usually calculated by the system stability, which eventually adds to the reliability of the enterprise system by allowing it perform better [46]. High system reliability relies on an automatic data backup ability and a stability and recovery ability [47]. Enhancement of the recovery ability makes the complete system more reliable and eventually increases the enterprise's system performance. Development of an ERP system is done on the basis of best organizational practices, but it is not necessarily suitable for every organization's business process, as reported by Chien and Tsaur [48]. The ease of operation of an enterprise system greatly increases the system performance, through a step-by-step command system and a user-friendly graphic interface [49]. User-friendliness is ensured by ease of performance, which enables the enterprise system to perform better. Measurement and analysis of the ease of learning comprise the provision of online help, online learning and a guidebook for user-friendly foundation which can later enhance the enterprise's system performance [50].

Service quality is primarily derived from the skill set developed amongst the internal stakeholders of the ERP, which ultimately plays an important role in the performance enhancement of ERP projects. The skill set includes the right type of team members, including professionals with business and technical expertise from inside the organization and, of course, consultants from outside [51]. Teams should have the right blend of the required skill set for quality service provision and should be assigned due responsibility to take decisions. Service includes the training services and service ability [52]. Companies face the most critical problems when they neglect user training [53]. In organizations, training for the new business process becomes a top priority where ERP has been implemented, and companies that spend a large amount on user training find that this investment in user education brings dividends and leads towards ERP project success [54].

Effective training lessons combined with sufficient training time result in enhanced performance of the enterprise system. ERP training with the skills which are recognized as the foundation for ERP success positively affects system performance, but requires that vendor and/or consultant support has to be ensured [55]. Service ability is a smaller component of the service quality of the enterprise system and covers online service, problem-solving ability, consultant service ability, speed of service and warranty satisfaction [48]. Vendor support regarding service ability is specifically required to enhance system performance. The flexibility of ERP systems to some extent refers to ERP system upgrading in order to define new business models and processes [56]. A balance between standardization and flexibility will be established at the time of allocating the enterprise system package, depending upon actual organizational and industrial needs [57]. A huge amount (such as millions of dollars) is invested in purchasing the ERP system implementation, yet not even a small portion of that amount is ever spent on investigating the most suitable one from among the many options, and this is considered a high risk in the ERP system analyzed by Cumbie *et al.* [58].

Continuous upgrading and maintenance are important factors to increase the performance of the ERP system [59]. A basic tool of ERP is integration. Ease of integration has to be the main characteristic of an ERP for it to be taken as a genuinely enterprise-wide system [60]. A flexible ERP system is one that provides ease of integration and communication with other systems [61]. Major ERP vendors are constantly using their knowledge, abilities and energies to ensure performance enhancement through increased functionality in their products to the benefit of themselves, the market and their customers [62]. ERP module completion ensures the necessary functionality for incrementing ERP performance. To improve the system completeness, the performance of the system across the network has to be confirmed [63]. Functionality fitness comprises the extent of workflow support. For ERP performance enhancement, the functionality fitness should be observed and upgraded. If the system and database defense and permission management are constantly calculated and controlled, the safety of the complete system will help the organization by identifying any undesirable interruption from any side and will stabilize the performance of the entire system [64].

Enterprise system vendors try to identify curative measures in contradiction of the negative perceptions of their actual and potential clients regarding time management, the ERP cost and the improvement in customer care and satisfaction. Software vendors play their role as implementing partners with their customers by creating a comparison of the ERP system and the customers' needs [65]. IT consultants are employed to ensure success in ERP projects. To acquire a high quality consultant does not mean transferring ownership

of the project, but it does mean fully utilizing their skills and knowledge, since hiring a high quality consultant is very expensive for the business [66]. Most ERP success stories are based on the strong relationship of the ERP vendor's support and services and the ERP implementing firms [67]. Reference [68] tells the story of the ''Big Five'' out of the top hundred ERP suppliers, who have approximately 70% of the international ERP market with a progress rate of 61%.

Exploration of the gaps between the ideal and actual most usual performance enhancement aspects of ERP projects in public organizations in Pakistan emphasizes the investigation of the application of the seven most common performance enhancement factors in five large public organizations of Pakistan. According to [8] and [69], some firms have three kinds of technical customization opportunities which are table configuration, module selection and code modification for modifying the systems (see [70]). Performance enhancement features that influence the performance of the ERP are ''Database, Reliability, Time, Service, Functionality, User-friendliness and Flexibility'' [30]. To improve enterprise system performance, firms have to measure the gap between what was projected and what is the actual production. Research has revealed that there are different strategies for the successful implementation of ERP, which are organizational, technical and people strategies [71]. Used a multi-member analytical hierarchy process to find the relative importance of the critical success factors in different strategies for the ERP implementation process [2]. Some technical strategies that can be used to determine the ERP success consist of ERP complexity, technical aspects of ERP installation, time and cost of implementation, and adequacy of in-house technical expertise. Complete and detailed technical planning is compulsory, and contains database migration, the implementation road map and customer customization efforts. When all the technical implementation has been carried out, then we can declare that the project or attempt at ERP implementation is live, which means that the ERP is implemented successfully. The ERP implementation failure in a company was examined in two different phases through a project-based perspective, revealing how to improve ERP implementation.

B. PAKISTAN'S LARGE ORGANIZATIONS

ERP implementation in Large organization has a significant effect on overall performance of organization which ultimately effect on economy of a country. The National Database Registration Authority (NADRA) commenced its functions through civil registration in March 2000. To execute the ERP system in NADRA was considered rather complicated and difficult because of its organizational structure and the nature of its work. A large-scale implementation of the Oracle ERP suite was done in NADRA in addition to a leading human-centric BPM platform. NADRA accomplished its professional goals in terms of accuracy, reliability and appropriateness after adopting the ERP suite, but it is yet to be explored whether or not NADRA gained all the anticipated business objectives and goals through ERP implementation, and how NADRA can increase its ERP performance to achieve the maximum output [7]. According to NADRA officials, ERP was selected because NADRA already had a qualified workforce that were well-aware of Oracle technology. Now NADRA is performing after ERP Implementation to identity card personalization, e-drivers' license, e-vehicle identification and monitoring, e-tolling and e-fueling dispensing, multi biometric border control, arms' license, access control like facial, iris and fingerprints, kiosk – electronic point of sale (PoS) and e- commerce platforms and services include data warehousing & data center, network infrastructure development, project management, disaster recovery and backups, software integration and development and data acquisition. (www.nadra.gov.pk).

The Higher Education Commission (HEC) of Pakistan in 2006 granted ERP implementation permission to the Siemens Pakistan Engineering Company for SAP built modules implementations like HR (Human Resource Management), FI/CO (Finance and Controlling), HEC Project System and MM (Material Management). HEC showed a strong interest in skills development by training of its staff with SAP modules for making the ERP project successful. HEC provides its services in HR development which includes scholarship programs, faculty hiring, provision of authentic supervisors for upcoming researchers, provision of foreign experts to Pakistani education industry, and scholarship management programs (www.hec.gov.pk). HEC also assist in quality education in higher level, research and development programs; promote technological and educational reforms within HEC and in universities and technical institute of Pakistan.

Oil and Gas Development Company Limited (OGDCL) was a pioneer in using Oracle Financials among public organizations of Pakistan, and the company's annual sales increased by almost Rs.100.26 billion (2006-2007). Ora-Tech, an ERP vendor, implemented Oracle Financials to assimilate their organizational business process which resulted in a visible increase in functional efficiency. OGDCL is getting benefits from Oracle Financial following services like Inventory control, purchasing, Human Resource and Payroll functions, commercial Budgeting, treasury, internal control manager, BI, Enterprise Planning and Budgeting Modules (www.ogdcl.com).

PTCL (Pakistan Telecommunication Company Ltd.) adopted the ERP system in all its sub-companies to provide a wide-ranging innovative solution to enhance its services and resource management, which increased the performance of this largest telecoms group of the country. Ora-Tech provided Oracle Financials services to enhance the performance of the company in financial and material management, procurement, project systems, operations and maintenance and HR (www.ptcl.com.pk).

The main functions of PIFRA (Project to Improve Financial Reporting and Auditing) are to provide public sector accounting and financial services, to provide suggestions

for economic policy-making and management and to give support in institutional training and development, providing separate auditing and account functions. As PIFRA is extensively involved in the financial matters of public departments, it is essential to get ERP systems to enhance its performance. SAP provides services in the following sectors: inventory control, purchasing, human resources and payroll functions, commercial budgeting, treasury, internal control management, enterprise planning and budgeting modules.

Technology upgrading has already been initiated in SBP (State Bank of Pakistan) and an ERP system was already implemented in 2002. Oracle Financials was implemented with the strategy to increase the bank's performance in inventory and purchase order system, human resource management system, general ledger, accounts payable, payroll system and fixed assets. Major duties of SBP are increased due to ERP which more than the conventional functions of central bank which include economic growth objective in its law and aiding for the growth of new financial institutions to encourage financial intermediation. Along with other responsibilities State Bank of Pakistan also guided the use of credit corresponding to giving importance to development projects also delivering subsidized credit for the development projects (www.sbp.org.pk).

III. METHOD

From the above literature it is hypothesized that there is a gap between the real and ideal database, reliability, time, service, functionality, user-friendliness and flexibility performance enhancement factors of ERP. A framework was proposed for the performance evaluation of an implemented ERP system and the measurement methods of the ERP objectives were explained through an empirical study in Taiwan by Chien and Tsaur [48]. The Content Validity Ratio (CVR) of all the surveyed performance indicators that were obtained as the outcome of the survey were first calculated then confirmed with a cut value, which is calculated according to $\alpha = 0.05$. PIs lower than the cut value were excluded in order to positively measure the implementation objectives [30].

Performance enhancement indicators are shown in the theoretical model, which have been analyzed for performance enhancement in ERP projects. These are the most common performance enhancement factors which, if considered correctly, have a great impact on the performance of ERP projects. Additionally, it is reported that ERP-applying firms usually realize the influences of the ERP on their performance in subsequent years of implementation [68]. A time-lapse study resulted in evidence of the interdependencies of both direct and indirect success aspects, with mutual effects on each other in similar ways for improved or poor performance [69].

For this study, the sample (n=300) was taken from five ERP projects running in the public sector in Pakistan. The convenient sampling technique is used because of cultural factors in Pakistan. The respondents of the questionnaires were ERP system users in public sector organizations in Pakistan. Moreover, informal discussion with the respondents and the literature review are undertaken to help in concluding this research. For the data analysis, the following values may be determined, including the Mean, Standard Deviation, Correlation and paired sample t-test using SPSS software.

Technically, correlation refers to any of several types of association between mean values, but more generally correlation can refer to any withdrawal of two or more random variables from independence. There are many correlation coefficients, frequently denoted as ρ or r, for measuring the degree of correlation. The Pearson correlation coefficient is generally used for analysis but is suitable only for a linear association between two variables (which can even be withdrawal if one is a nonlinear function of the other). The purpose of the paired sample test is to compare the mean of two independent samples. In this test each data point or score we are focusing on is paired with another data point or score. This is because the two data points or score are taken from the same variable.

IV. DATA ANALYSIS

We measured Cronbach's alpha for real and ideal variables. The values of all variables in the real performance are > 0.65, and the overall model for the real performance Cronbach's α value is 0.75. So, we can conclude that all the variables (time, functionality, user-friendliness, flexibility, database, reliability, service, vendor support, and Overall model) is reliable.

TABLE 1. Reliability of ERP implementation in real & ideal system.

Real ERP Implementation		Ideal	
Variables	α	Variables	α
Time	0.71	Time	0.71
Functionality	0.72	Functionality	0.70
User-friendliness	0.71	User-friendliness	0.82
Flexibility	0.85	Flexibility	0.86
Database	0.81	Database	0.85
Reliability	0.83	Reliability	0.67
Service	0.73	Service	0.71
Vendor support	0.74	Vendor support	0.71
Model (overall)	0.75	Model (overall)	0.81

For the ideal performance, all the variables in the reliability test are in acceptable level of Cronbach's α. Also, the reliability test for the overall model of ideal performance is 0.81, which is > 0.65, so we can conclude that all the variables are reliable (Table 1).

The correlation (r) value of the relationship between time and real overall performance is 0.571, which shows a weak positive relationship between these two variables. The r value of the relationship between time and ideal overall performance is 0.412, which shows a weak positive relationship between these variables. The r value of the relationship between functionality and real overall performance is 0.435, which shows a weak positive linear relationship between the two variables. The r value of the relationship

between functionality and ideal overall performance is 0.463, which shows a weak positive linear relationship between these variables. The r value of the relationship between user-friendliness and real overall performance is 0.591, which shows a moderate positive linear relationship between these two variables. The user friendliness and ideal overall performance relationship r value is 0.737, which shows a positive linear relationship. The r value of the relationship between flexibility and real overall performance is 0.681, which shows a moderate positive linear relationship between the variables. The flexibility and ideal overall performance relationship r value is 0.687, which shows a moderate positive linear relationship between both variables. The database and real overall performance relationship value is 0.678, which shows a moderate positive linear relationship between these variables. The r value of the relationship between the database and ideal overall performance is 0.686, which shows a moderate positive linear relationship between these variables. The r value of the relationship between reliability and real overall performance is 0.647, which shows a moderate positive linear relationship between these variables. The reliability and ideal overall performance relationship's r value is 0.641, which shows a moderate positive linear relationship between these two variables. The service and real overall performance relationship's r value is 0.684, which shows a moderate positive linear relationship between these two variables. The r value of the relationship between service and ideal overall performance is 0.576, which shows a moderate positive linear relationship between these variables. The r value of the relationship between vendor support and real overall performance is 0.521, which shows a weak positive linear relationship between these two variables. The relationship between the vendor support and ideal overall performance's r values is 0.613, which shows a moderate positive linear relationship between these variables (Table 2).

TABLE 2. Correlation of ERP implementation: real & ideal.

Variables	Real Performance	Ideal Performance
Time	.571**	.412**
Functionality	.435**	.463**
User-friendliness	.591**	.737**
Flexibility	.681**	.687**
Database	.678**	.686**
Reliability	.647**	.641**
Service	.684**	.576**
Vendor support	.521**	.613**

**Correlation is significant at the 0.01 level (2-tailed)

A. PAIRED SAMPLE t-TEST

The paired sample t-test was performed on the variables mentioned in our model, with the purpose of finding the gap between the ideal/conceived ERP performance and the real/actual ERP performance. Intuitively, it can be foreseen that there may be a gap between the ideal and real ERP systems, but our research work establishes a mechanism for evaluating the difference between the two, for which the t-value and the significance value are calculated as shown in table-3. Time can be regarded as having different natures, such as the system development, implementation and operation times. From our survey, it can be concluded by looking at the results that there is a negligible or no gap between the real and ideal ERP systems. We applied the paired sample t-test shown in table-3 below, which entails that we have 0.341 as the t value, and a 0.754 significance value, which clearly shows that there is no gap between the two.

TABLE 3. Paired sample t-test analysis-real to ideal.

Variables	t	Sig.
Real Time-Ideal Time	0.414	0.754
Real Functionality- Ideal Functionality	3.004	0.045
Real User-friendliness- Ideal User-friendliness	6.877	0.000
Real Flexibility- Ideal Flexibility	-3.604	0.01
Real Database – Ideal Database	-0.477	0.634
Real Reliability- Ideal Reliability	-10.22	0.000
Real Service- Ideal Service	-7.340	0.000
Real Vendor Support- Ideal Vendor Support	-8.619	0.000
Real Performance – Ideal performance	-8.017	0.000

The functionality of the ERP system can be regarded in different dimensions, like functionality fitness, module completion and security, where the functionality fitness includes the degree of workflow and functions supported by the ERP system in total [28]. We applied the paired sample t-test shown in table-3 below, which entails that we have 3.004 as the t value, and 0.045 as the significance value, which clearly shows that there is a gap between the real and the ideal ERP system. User- friendliness can be regarded as a factor that can provide ease of operations, for which skills development is a major concern. We applied the paired sample t-test shown in table-3 below, which entails that we have 6.877 as the t value, and a 0.000 significance value, which clearly shows that there is a gap between the real and the ideal ERP system.

Flexibility can be regarded as ease in the contingency plans for the development, integration, modification, maintenance and upgrading of ERP systems. We applied the paired sample t-test shown in table-3 below, which shows that we have -3.064 as the t value, and a 0.01 significance value, which clearly shows that there is a gap between the real and the ideal ERP system. Databases can be regarded as the most important factor which can affect the performance of the ERP system in a random fashion throughout the organization, and normally a hierarchical approach is followed at the service level. We applied the paired sample t-test shown in table-3, which shows that we have -0.477 as the t value, and a 0.634 significance value, which clearly shows that there is no gap between the real and the ideal ERP system.

Reliability can be regarded as the consistency of the ERP system in attaining business goals. Business goals can vary in nature and the ERP system has the capability to adapt to these variations without major changes in the system parameters. We applied the paired sample t-test shown in the table-3, which shows that we have -10.22 as the t value, and a 0.000 significance value, which clearly shows that there is

TABLE 4. Hypothesis acceptance and rejection.

No.	Description	Accepted/ Rejected
H_1	There is gap between real time and ideal time	Rejected
H_2	There is a difference between real reliability and ideal reliability	Accepted
H_3	There is a gap between real functionality and ideal functionality	Accepted
H_4	There is a gap between real user-friendliness and ideal user-friendliness	Accepted
H_5	There is a difference between real flexibility and ideal flexibility	Accepted
H_6	There is a gap between real database and ideal database	Rejected
H_7	There is a gap between real services and ideal services quality	Accepted
H_8	There is a difference between real vendor support and ideal vendor support	Accepted
H_9	There is a gap between real and ideal overall ERP performance	Accepted

a gap between the real and the ideal ERP system. Service can be regarded as the skills set developed by the internal stakeholders that play an important role in operating the ERP systems and the services provided by the service providers, for which training services and service ability are critical factors because most of the problems in service delivery are due to a lack of training and of timely support for system failures. According to our survey, it can be concluded by looking at the result that there is a gap between the real and ideal ERP system. We applied the paired sample t-test shown in table-3, which shows that we have -7.340 as the t value, and a 0.000 significance value, which clearly shows that there is a gap between the real and the ideal ERP system.

Vendor support is mainly focused on acquiring the expertise of a third party as consultant and plays an important role in improving the functionality of the ERP system. We applied the paired sample t-test shown in table-3, which shows that we have -8.619 as the t value, and a 0.000 significance value, which clearly shows that there is a gap between the real and the ideal ERP system. By applying the paired sample t-test, it is shown that there is a gap between real performance and ideal performance, as table-3 shows a t value of -8.017 at a significance level of 0.000, so it is a significant factor for ERP enhancement.

V. RESULT AND DISCUSSION

A. HYPOTHESES CONFIRMATION

It was observed from the results that two of the hypotheses (time and database) are rejected while the rest of the hypotheses can be accepted. It is concluded from the result that the time variable shows there is no gap between the real and ideal time because, as assumed, time is regarded as system development time, implementation time and operation time, which affect the performance of the ERP system. Moreover, it is considered that the similar organizational structure of the respondents from the five public sector organizations have similar ERP modules. Thus, we do not require any changes in the ERP module implementation and schedule control. For the database variable there is no difference between the real and ideal database, which shows that the ERP system is using the process database effectively and without any errors and also confirms the completeness of the data. The functionality of the ERP system showed that there is a gap between the real and the ideal functionality due to the security and permission management features of the ERP systems of the public sector in Pakistan. Similarly, for user-friendliness it is seen that there is a gap between the real and ideal user-friendliness due to the lack of skills, training and proper documentation in the public sector in Pakistan.

The flexibility of the ERP system showed that there is a gap between the real and ideal flexibility due to the old modules of the ERP systems in the public sector of Pakistan. Reliability shows that there is a difference between the real and ideal reliability due to the time- invariant behavior of the public sector of Pakistan, which discourages the achievement of dynamic business goals. For service, there is a gap between the real and ideal service due to the lack of timely support of system failures and lack of training in the public sector in Pakistan. Vendor support showed that there is a gap between the real and ideal vendor support due to the lack of an active role of the vendor in the public sector in Pakistan. Finally, for the overall performance of the ERP system it is seen that there is a gap between the real and ideal overall performance, because most of the performance indicators have gaps between the real and ideal in the public sector in Pakistan. From the above discussion, it is concluded that there exists a gap between the ERP system in relation to the real and ideal situation, but the direction and magnitude are different for each factor. To implement an ERP system, organizations are required to restructure their business procedures along with the new ERP system and this often needs organizational changes to integrate the ERP systems and determine how different processes of the organization can be revised [62].

In order to minimize the gap between the real and ideal time, we recommend that there should not be any significant changes in our module implementation and schedule control. Moreover, to keep the gap to a minimum, the best schedule control algorithms and similar/ module integration should be implemented in a similar organization. To minimize the gap in the functionality, it is necessary that the ERP system must be made fully functional, secure and rugged. To fulfill any degree of workflow, independent of the size of the organization, the functionality of the ERP system should be focused on as standard practice to satisfy the small and large-scale organizational needs. To minimize the difference and enhance the efficiency of the ERP system, online documentation, support and help are essential requirements. These concerns should be mutually agreed at the planning and policy formulation stage with the surveys provider of the ERP system. They may be overlooked if carried out during the operation stage of the ERP project. It is essential, before deploying the ERP system, to work out the technology in use and the technology trend to be used in the future, considering the organizational demands.

The ERP system expansion and upgrading must be formulated in the time domain, otherwise the whole system may become obsolete or could require multiple ERP technologies in place. In order to avoid any performance degradation, the data management system should be properly managed in terms of the data (read and written) representing the interfaces. In this way, the service level can be enhanced to meet the service level agreements. To ensure reliability, possible business variations must be embedded at the planning stage, so advance features within the software interface are good to consider. Moreover, the whole ERP system must be synchronized at each level of the service. Sophisticated synchronization, error detection and correction, and quick backup systems can enhance the reliability of the ERP system and make it possible to maintain the overall performance of the ERP system. To achieve the best service practices, companies have to spend a lot of money on training and service agreements in terms of warranty for healthier and smoother operations. In order to avoid a gap between the ideal and real ERP systems, the vendors should offer post- sales services and realistic deeds of agreement. In order to achieve the minimum gap in the overall performance of the real and ideal, all the variables explained above should be considered in depth.

Now technology of ERP is shifted towards cloud based in all over the world [2] also in Pakistan, so in future cloud based research can be done in Pakistan [60] which is cheap and effective [72] and flexible and easy to use as compared to traditional ERP [71]. Cloud-based ERP had enabled several organizations to drive in efficient and better way by using computational resources [72]. Although some local suppliers of cloud-based ERP are already worked on cloud-based ERP in Pakistan like Gnerrixsol, BizzTrax, Hisaab.pk, Wizmen, SolutionBots and NetHawk [7]. Along this there are some issues in migration of traditional ERP to cloud system like coordination and management of new system structure gave model to resolve this issue and for security purpose [71], [74] new models are also proposed.

B. CONCLUSION

This study provides a practical tool for managers to evaluate the ERP system in a technical context and to increase their firms' performance through ERP. The rapidly increasing progress of the ERP system in the world has required firms to connect with their suppliers and customers, not only in the host country but also all over the world. If ERP is implemented properly, then it will be successful, and it can help firms with decision-making in all contexts of the firm like strategic, operational, in setting goals and objectives. This study can also help experts to forecast weak points in a firm's ERP implementation and lead them to better planning. Additionally, it should be considered that ERP implementation is an ongoing procedure and ERP outputs are dynamic in nature, so practitioners should fully understand the drivers of ERP in the pre- and post- implementation phases.

Also give significant knowledge to help CEOs and in-house IT managers in the process of decision making and strategic planning for successful adaptation of cloud-based ERP. Specifically, the distinguished cloud ERP advantages and barriers can serve as the base for managers to perform cost benefit analysis and comparison as a part of feasibility study of ERP cloud-based projects. If organizations in developing countries like Pakistan want to make production and services become more broadly utilized in the industry they should encourage the ERP transformation started by different cloud companies. And in research sense this research also adds in ERP knowledge over-all and in cloud-based computing contributes significant bits of knowledge into cloud ERP advantages and boundaries specifically. The result of this study confirmed that numerous past studies about on the spot ERP obstructions, dangers and success factors can still be valid and pertinent to a cloud ERP setting. The research additionally set up cloud ERP benefit and barrier information and knowledge can serve as a decent beginning stage for IS and ERP researchers to do further research on this important topic.

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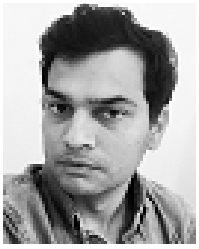

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