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Developing a Holistic Model for Assessing the ICT Impact on Organizations: A Managerial Perspective

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ABSTRACT
Organizations are currently more dependent on Information and Communication Technology (ICT) resources. The main purpose of this research is to help the organization in order to maintain the quality of their ICT project based on evaluation criteria presented in this research. This paper followed several steps to support the methodology section. Firstly, an experimental investigation conducted to explore the values assessment criterion, an organization may realize from ICT project such as information systems, enterprise systems and IT infrastructure. Secondly, the investigation is further based on empirical data collected and analyzed from the respondents of six case studies using questionnaire based on the findings of literature review. Finally this paper propose the development of a holistic model for assessing business values of ICT from the managerial point of view based on measured factors. The study has contributed in this field practically and theoretically, as the literature has not shown a holistic approach of used eight distinct dimensions for assessing ICT impact over business values. It has combined the previous researches in a manner to extend the dimensions of measuring ICT business values. The model has shown its significance for managers and ICT decision makers to align between business strategies and ICT strategies. The findings suggest that ICT positively support business processes and several other business values dimensions. The proposed holistic model and identified factors can be useful for managers to measure the impact of emerging ICT on business and organizational values.

KEY WORDS: ICT Business Value, Holistic Model, Assessment, Information Systems Management

1 INTRODUCTION

ORGANIZATIONS are currently more dependent on ICT resources. the literature review suggesting that ICT has had a positive impact over business strategies has been shown in different past studies (Melville et al. 2007; Maçada and Beltrame 2012). Several benefits has been proposed and evaluated from different researchers. This study is based on ICT business values framework presented by (Gregor et al., 2016; Shang and Seddon, 2002; Saleem *et al*., 2017). This research mainly focuses on firm's practices of indifferent and sometimes disorganized in order to assess the quality of their ICT investment, especially those investments which ultimately lead to underutilization of ICT resources.

During last few decades organizations have invested heavily in ICT adoption. Globally organizations are investing on ICT (Naveh et al., 2015; Deng et al., 2015; Song et al., 2015; Ren et al., 2013) to adopt the current working environment, creating a competitive advantage and to improve the firm performance. According to statistics, overall global ICT spending expected to reach $3.5 trillion in 2017 (Gartner, 2016). The major categories discussed in recent report where the organizations are mainly investing in: data center systems, software, devices, IT services and communication services as shown in Table 1. Several surveys indicate that substantial percentage of ICT projects fail to justify the expected list of benefits predicted before implementation.

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Failure rates vary, in published reports based on the selected samples of different types of ICT project, the failures rates recorded from 15% to 25% (Al-Shehab et al. 2005; Keil et al. 2000). Keil *et al*., (2000) stated that 30%-40% are failed as demonstrated project escalation while Al-Shehab *et al*., (2005) explained that 51% of project failures are due to time constraints and are not fulfilling the wished-for functionality predicted before project implementation. Furthermore, some project troubled during software development phase (Smith and Keil, 2003). Regarding the post implementation evaluation report, Hancock (1999) reported that 46% of the projects ran over cost and also do not provide complete promised functionality. And about 74% of the projects were troubled during development phase (Smith and Keil 2003). The statistics suggested that the proper ICT evaluation can decrease the projects' failure rate. The assessment methods can perform evaluation and suggestions for future investment in such projects (Todorova 2006; Saleem et al., 2016). In literature review, based on the above discussion several projects can be found which consist of large ICT investment such as; ERP Implementation (Ullah et al. 2013; Al-Ghamdi and Saleem 2014; Al-Mudimigh et al. 2009), Automated Decision Support Systems (Saleem and AL-Malaise 2012), Portal Implementation (Al-Mudimigh and Ullah 2011; Al-Mudimigh et al. 2011) and CRM System (Al-Mudimigh et al. 2009).

Presently, latest technologies such as Internet of Things (IoT) and big data are providing ubiquitous network of connected devices and smart sensors which promoting the concept of smart and connected communities (SCC) (Sun *et al*., 2016). In addition, another terminology has been introduced to deal with the connected communities in order to assess big amount of user generated data available online called Web Observatory (Hall *et al*., 2014). A web observatory is a kind of ICT investment, which required capable IT infrastructure including the list of hardware and software to extract, store and analyze big data. It offers the insights of communication between online communities related with specific field, to analyze and generate some useful information. Organizations trends over using big data and connected system are well supported by other ICT projects (Jamjoom and Hindi, 2016a; Jamjoom and Hindi, 2016b Jamjoom, 2017).

In addition, there are several kinds of system organizations are using to support their business processes which involve large amount of investment every year such as; Knowledge management system (Al-Rasheed and Berri 2016), Computer Applications (Al-Rasheed and Berri 2017), Service Oriented Architecture (Jamjoom et al. 2012), and Enterprise Systems Training Programs (Jamjoom and Al-Mudimigh 2012). Whereas the framework provided in this study can help to measure these type of latest technological ICT projects. Indeed the latent impact of ICT in an organization, make its evaluation even more complex (Dadayan 2006). The lack of evaluation and ICT project management techniques are the key issues discussed in previous studies (Irani and Love 2001; Carcary 2009). Due to dispersed impact of ICT investment, there is still a need of proper methodology, which can provide satisfactory post evaluation assessment based on business values of ICT (Maçada and Beltrame 2012; Saleem et al. 2012). Therefore, this paper propose the development of a holistic model for assessing business values of ICT from managerial point of view based on extracted factors.

The findings suggest that ICT positively supports business processes, and the proposed holistic model and identified factors can be useful for managers to measure the impact of emerging ICT resources. Ultimately, this study answer the question about how organizations can evaluate the post implementation benefits achieved from already implemented ICT project. Furthermore, the paper is structure as follows:

- Methodology for classifying the ICT business values
- Review and consolidating ICT business values
- Case study overview
- Result and analysis
- Factor analysis
- Proposed framework

Table 1. Worldwide IT Spending Forecast (Gartner Report, October, 2016)

	2016 Spending (Billions of U.S Dollars)	2016 Growth (%)	2017 Spending (Billions of U.S Dollars)	2017 Growth (%)
Data Center Systems	173	1.3	177	2.0
Software	333	6.0	357	7.2
Devices	597	-7.5	600	0.4
IT Services	900	3.9	943	4.8
Communication Services	1,384	-1.1	1,410	1.9
Overall IT	**3,387**	**-0.3**	**3,486**	**2.9**

2 METHODOLOGY FOR CLASSIFYING ICT BUSINESS VALUES

ORGANIZATIONS are eager to invest in ICT to increase their productivity growth, operational capabilities, powerful network, and faster access to information systems. ICT is being considering a powerful tool, which can handle the strategic and operational objectives of the organization by providing better products and services (Torrent-Sellens et al. 2015; Morfoulaki et al. 2015). Researchers distinguish and categorize ICT investments by linking them with the organization's basic plan of the investment, which is further classified based on the performance criteria and specific objectives initiated for increasing business performance (Maçada and Beltrame 2012).

The investment in building IT infrastructure is one of the major categories in which organizations are spending a tremendous amount, considering long term assets due to its impact on the shareholder's and organization's structure (Weill and Broadbent 1998; M. Broadbent et al. 1999). This type of investment has multiple measurement criteria such as IT assets return. Therefore, enterprises are eager to implement effective and long term valuable infrastructure associates with the organization (Byrd and Turner 2000). (Eastwood 2008; Broadbent et al. 1999) stress upon the importance of ICT infrastructure investments by associating it with one of the major strategic objectives of the firm. IT infrastructure includes main storage data centers, high performance machines and others to provide fast processing capabilities for the organization (Maçada and Beltrame 2012). Therefore, a large IT infrastructure feasible for the organization dealing with online services and high level information processing also assists in the decision making process (Melville et al. 2004).

Furthermore, researchers has proposed a variety of typologies for defining ICT types of investment based on the measuring criteria, performance factors, and specific objectives of investment, whether the investment is for infrastructure, information processing, organizational benefits, operational processing or others. (Mirani and Lederer 1998) suggested three types of ICT investments; strategic, informational, and transactional while (Weill and Broadbent 1998) categorized another model for defining types of ICT investments as strategic, informational, transactional and infrastructure. The categories were based on the organizational objectives, which enhance the ideology of ICT investment where each of them has a list of attributes associated with the possible outcomes of those investments as depicted in Figure 1. Different kinds of ICT resources; transactional, informational, strategic and infrastructure, are employed at the organization to support numerous firm's objectives (Aral and Weill 2007).

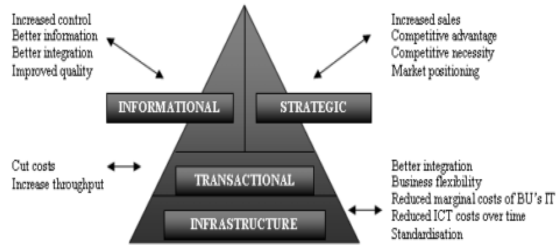

Figure 1. Types of ICT investment based on the Organization's Objectives (Weill and Broadbent 1998)

(Gregor et al. 2006) added another category of ICT investment entitled as transformational, which was the work based on the classifications (strategic, informational, organizational) initially presented by (Turner and Lucas 1985). Transformational ICT investments are associated with the restructuring and redefining of the business processes and business relationships with others (Dehning et al. 2003). Furthermore, more work has been done in classifying ICT investments based on the measurement criterion. (Shang and Seddon 2002) distinguish ICT investments by defining five categories as; operational, managerial, strategic, IT infrastructure and organizational.

The following sub-sections elaborate more details by explaining each of the ICT investment extracted from literature review which are based on organizational objectives. This research extracted and integrated eight distinct type of ICT investment based on business objectives to cover the broader impact of ICT projects on business values.

2.1 *Review and Consolidating ICT Business Values*

Currently, new technologies aggravate the organization's interest over investing more as well as to adopt some evaluation methodologies to justify those investments. ICT investments can help the organization to improve their business models and processes which further lead to increase the firm's performance (Saleem et al. 2015). It supports the economic growth as well as building competitive advantage in the market is one of the benefits can be achieved through incorporating business and technology. Therefore, to understand its possible list of achieved benefits scholars have broadly categorized them based on organizational objectives as discussed in following sub-sections.

2.1.1 Strategic

Accomplishing the list of strategic benefits is one of the major objectives of the organization to which ICT can bring in more better ways such as; competitive advantage, better product and customer relations (Maçada and Beltrame 2012; Han and Mithas 2013). Researchers point out many benefits which are aligned with ICT and business strategy (Gregor et al. 2006). A model proposed by (Rivard et al. 2006) clears the concept of integrating ICT resources with competitive strategies to enrich the performance of the organization. A set of items measurement for strategic benefit extracted from literature has impact and can achieve from ICT investment is shown in Table 2.

2.1.2 Informational

Improved and integrated information in regard of accessibility, flexibility and quality is the major benefit considered under the category of Informational Benefits which is largely impacted by ICT investments (Mirani and Lederer 1998). The ICT investments for information determination (Ren et al., 2014) are aimed to improve information and communication for the decision making process in an organization (Gregor et al. 2006). Strategic planning and different formats of information processing (Aral and Weill 2007; Maçada and Beltrame 2012) are some other informational benefits that can be accomplished through investing in ICT. There can be different other benefits under this category can be achieve through different methods such as data mining (Al-Mudimigh et al. 2009; Saleem and Malibari 2011; Al-Mudimigh et al. 2009). Table 2 illustrated list of item measures with the sources collected from literature review occurring under the category of informational benefit for complete understanding.

2.1.3 Transactional

Another kind of benefit is transactional benefits such as; enhancing employee productivity and firm performance in regards of profitability (Weill 1992). ICT investment in purpose of transactional benefits help in reducing managerial and labor cost (Mirani and Lederer 1998). It actually helps to explore the number of benefits which ICT resources can cover up without any interaction from humans (Maçada and Beltrame 2012). (Sabherwal and Jeyaraj 2015) also included the transaction ICT benefits while measuring the business value of ICT. In addition, labor productivity and total financial assets are two measures used by (Saldanha et al. 2013) for ICT impact to get transactional benefits. Extracted measures from literature review associated with transactional benefit are shown in Table 2.

2.1.4 Transformational

ICT investments create a constructive impact on the capacity and structure of the organization due to changes occurring during the development phase. It also gives positive value to the firms, known as transformational values (Gregor et al. 2006). The idea of transformation values can be described as having new or improved business processes and added values in a new structure of the business (Brynjolfsson and Hitt 2000). Moreover, ICT's ability to reform business processes, improve business plans, and to facilitate employees' activities refer to measuring variables for transformational dimension (Mooney et al. 1996). The integration of ICT resources in existing business processes and achievement of new ICT skills are some of the major benefits denoting ICT transformation investments (Cronk 2005). Table 2 illustrated measuring variables associated with transformational benefit acquisition from ICT investment.

2.1.5 Organizational

(Shang and Seddon 2002) proposed that ICT investment implications on overall firm performance and working environment in terms of learning and execution of business strategies were referred as organizational benefit as shown in Table 2. A research conducted on 43 US corporations, suggests that ICT resources regularly assist various organizational plans such as; integrating business processes, improving communication skills, empowering the employees and setting the common vision in the development plan (Peters et al. 1982). Ultimately, ICT investments provide a positive shift in organizational culture (Detert et al. 2000) and speed up the development framework for organization (Andreu and Ciborra 1996).

2.1.6 Operational

ICT investments help improve daily activities and operational processes to enhance the working capability of the organizations such as; speeding up processes and increasing operation volumes (Weill 1990). Process cycle time reduction and productivity improvement are some other benefits that can be achieved by investing in operational objectives of the enterprises (Weill and Broadbent 1998). A summary of all benefits and business value can be achieved from operational ICT investments as extracted from the literature review depicted in Table 2.

2.1.7 IT Infrastructure

Setting up the standards of the organization and making business processes more flexible are the common aims of every organization which can be achieved through building capable IT infrastructures (Shang and Seddon 2002). Researchers suggest different measures as shown in Table 2, manageable through large IT infrastructures including computers, mainframes, etc. with more storage and processing capabilities (Melville et al. 2007; Altalhi et al. 2017). Building IT infrastructures based on the business strategies provided help to get benefits in several ways such as; reduced ICT costs in different business units and flexible business environments (Maçada and Beltrame 2012).

2.1.8 Managerial

ICT has an impact on both operational as well as management processes (Mooney et al. 1996).

Generally, processes involved in an organization are a mixture of coordination and production technologies (Malone 1987). Business management techniques are a combination of resources allocation, monitoring, and supporting business strategic decisions (Shang and Seddon 2002). Firm performance is considered as a dependent variable in measuring the ICT investment for managerial perspectives (Sabherwal and Jeyaraj 2015). (Irani and Love 2001) presented that ICT cost is associated with managerial perspective to help in decision making and firm performance. Many scholars relate ICT investment's influence to attaining several managerial benefit as summarized in Table 2.

The above discussion about the ICT investment's impacts, it can justify that each ICT investment have one or many objectives before its implementation (Saleem et al. 2013). The findings of this section helped the researcher in order to characterizing the measuring dimensions and their measuring items, which used in the framework for measuring ICT business values as shown in Table 2.

2.2 Case Study Overview

Research on measured business values generated from ICT investment involves people, organizations, and projects collectively. The research idea is focused to learn and understand the ICT values and benefits from a user and organization's perspectives, which ultimately requires the behavior, strategic and organizational factors to be learned from different case studies in this field. Therefore, as discussed by (Khalifa et al. 2005), the case study approach is appropriate for ICT research and has been adopted by several authors (Maçada and Beltrame 2012; Shang and Seddon 2002; Gregor et al. 2006; Bobeva and Williams 2003; Griffiths and Stern 2004; Roberts and Spiezia 2009; Slocum and Lee 2014; Lee et al. 2015; Torrent-Sellens et al. 2015; Manuel and Pérez 2015; Ongaki and Musa 2015; Morfoulaki et al. 2015; Bologa and Lupu 2014; Hong and Ghobakhloo 2013; Han and Mithas 2013). This highlights the importance of case study in ICT research. Multi-case studies (six cases) are adopted for this study. The multiple case studies support the results though replication and reconfirmation responses and reduce the chances of error (Eisenhardt 1991).

Saudi Arabia (SA) is the selected region in which the research methodology was applied. As stated by Saudi Arabian General Investment Authority (SAGIA), more than 27 million consumers and numerous global organizations, Saudi Arabia is the largest ICT market in overall Middle East. Especially, the ICT industries operating in KSA comprise over 53% of the total market running in Middle East (SAGIA 2016). Therefore, over 15 organizations were contacted from different sources via telephone and email conversations. Finally, six companies were short listed of varying sizes and across industries mentioned; airlines, education, manufacturing, operation and maintenance, bank, and telecommunication. All participants have shown their interest to take a part in this study but emphasized to keep their information confidential due to organizational policy and privacy issues. Therefore, all six case studies and their participants were kept confidential, although researcher has provided the some details about, number and ratio of participants in each case study is shown in Table 3.

2.3 Data Collection

The data has been collected from six case studies to develop an integrated list of evidences in support of developed questionnaire instrument on the bases of Table 2. The findings from questionnaire have been analyzed and presented in statistical format in order to understand well. The list of the participants selected in the case study were based on their experiences and involvement in ICT projects in corresponding organization. Majorly, selected participants were part of the ICT team, executives, managers, directors, and especially those who are working as a consultant or decision-maker for managing and investing in ICT projects as depicted in Table 3. Interval scales were used in this study to measure and examine how strongly participants agree or disagree with the given list of statements. The likert scale used from 1 to 7, where "1" represents the level of "Strongly Disagree" and "7" displayed "Strongly Agree." which designed to examine how strongly subjects agree or disagree with the statement (Sekaran and Bougie 2010). The liker scale has been used and positively supported by previous researches for measuring ICT business values (Maçada and Beltrame 2012; Gregor et al., 2006).

2.4 Descriptive Study and Factor Analysis

However, prior to the data analysis, different steps were performed to prepare and clean the data for analysis. Due to numerous variables used in this research, we performed a descriptive study to identify and explore the used variables and their relationship to each other. Further, a descriptive approach was used to explore and analyze the mean, variance, and standard deviation for the research variables. In order to test the goodness of data (Sekaran and Bougie 2010), factor analysis and reliability test were conducted. Two types of factor analysis were performed: first, exploratory factor analysis (EFA) using SPSS, to determine the underlying structure in a data matrix (Hair et al. 2010). EFA helped us to analyze the correlations between the different variables in terms of getting a set of variables with common characteristics, known as factors (Maçada and Beltrame 2012). EFA was conducted using principal component analysis to find out the initial factors and then was rotated using varimax criterion.

Table 2. **List of Benefits and Item Measures for each benefit**

Label	Measuring Dimensions	No. of Items	Sources
Str1	Strategic	1. Creating Competitive Advantage	(Gregor et al. 2006)
Str2		2. Aligning ICT strategy with business strategy	
Str3		3. Establishing useful links with other organizations	
Str4		4. Enabling quicker response to change	
Str5		5. Improving customer relations	
Str6		6. Providing better products or services to customers	
Inform1	Informational	7. Enabling faster access to information	
Inform2		8. Enabling easier access to information	
Inform3		9. Improving information for strategic planning	
Inform4		10. Improving information accuracy	
Inform5		11. Providing information in more useable formats	
Transac1	Transactional	12. Savings in supply chain management	
Transac2		13. Reducing operating costs	
Transac3		14. Reducing communication costs	
Transac4		15. Avoiding the need to increase the workforce	
Transac5		16. Increasing return on financial assets	
Transac6		17. Enhancing employee productivity	
IT_Inf1	IT Infrastructure	18. Improving business integration	(Shang and Seddon 2002)
IT_Inf2		19. Improving business flexibility	
IT_Inf3		20. Reducing the marginal cost of a business unit's IT	
IT_Inf4		21. Reducing IT costs	
IT_Inf5		22. Improving organizational standardization	
Transf1	Transformational	23. An improved skill level for employees	(Gregor et al. 2006)
Transf2		24. Developing new business plans	
Transf3		25. Expanding organizational capabilities	
Transf4		26. Improving business models	
Transf5		27. Improving organizational structure/processes	
Opr1	Operational	28. Cost reduction	(Shang and Seddon 2002)
Opr2		29. Cycle time reduction	
Opr3		30. Productivity improvement	
Opr4		31. Quality improvement	
Opr5		32. Customer service improvement	
Mngr1	Managerial	33. Better resource management	
Mngr2		34. Improved decision making and planning	
Mngr3		35. Performance improvement	
Mngr4		36. Improved overall operational efficiency	
Mngr5		37. Improved overall effectiveness of decisions	
Org1	Organizational	38. Changing work patterns	
Org2		39. Facilitating organizational learning	
Org3		40. User Empowerment	
Org4		41. Building common vision	
	Overall 8 dimensions	**Overall 41 measuring items**	

Table 3. Details of Participants in each Case Study

IT Executives	IT Project Managers	IT Projects Team Members	ICT and Business Users	Case Study	No. of Participant in Numbers	No. of Participant in Percentage
Sector Manager Architecture and Standards	Manager IT Services and Support	Senior Application Specialist	IT Services and Support Section	Airlines	40	20.5%
Vice Dean of Quality and Development-IT Projects	Director of IT Assessment Unit	Head of Developer Team-ICT Project	IT Administration	Education	35	17.9%
Head of IT Department	IT Project Manager	Application Developer	Technology and Innovation Center	Manufacturing	31	16.0%
Director of IT Operations	Manager IT Services	SAP Administrator	ICT Center	Operation and Maintenance	32	16.4%
Director e-services, IT Department	IT Project Manager	Supervisor e-services	Maintenance and development center	Bank	27	13.8%
Board Member – IT Department	Manager Technology and Operations	Software Engineer	Technology and Operation Department	Tele-communication	30	15.4%
Total					**195**	**100%**

Second, confirmatory factorial analysis (CFA) using AMOS 21 was performed to analyze the different relationship within the measurement model (Maçada and Beltrame 2012). Structural equation techniques refer to an addition to several multivariate analysis techniques, which relate to different variables related to multiple regressions with factorial analysis, in order to concurrently evaluate the set of dependent variable. In addition, structural equation helped us in the evolution of the research variable’s relationship from EFA to CFA (Hair et al. 2010). As discussed by (Ullman and Bentler 2003), structure equation modeling is kind of statistical method that allows us to analyze the relationship between one or many independent and dependent dimensions. Accordingly, to validate the pre-developed model CFA conducted. In this research, there are 41 independent (measurements items) variables used in the instruments, and eight dependent (dimensions of benefits) variables, their relationship was developed through the application of CFA. As a final result, a confirmative instrument was developed for measuring ICT business value.

3 RESULTS ANALYSIS

BASED on the data collected from the six business organizations, we first presented the summary of each dimension by calculating the mean value of each and variance in the case studies, as illustrated in Table 4.

Table 4. Mean of Benefits Dimensions and Variance in Case Studies

Dimensions	No. of Items	Case Studies	
		Mean	Variance
Strategic	6	5.3	2.8
Informational	5	5.1	2.5
Transactional	6	5.4	2.4
IT Infrastructure	5	5.3	2.5
Transformational	5	5.5	2.5
Operational	5	5.6	2.6
Managerial	5	5.6	2.1
Organizational	4	4.9	2.3
Total	**41**	**5.3**	**2.4**

As shown in Table 4, the mean values for each of the benefit dimensions is above 5.0 in case studies, except organizational, which has the lowest mean in all dimensions with a mean value of 4.9. Furthermore, the findings show some consistency in case studies for all dimensions, while the “organizational dimension” has the lowest means value. One possible explanation for low mean score is the low relativity of “organizational items” with ICT resources. The discussion with ICT experts revealed the point that “creating common visions” and business understanding are active components of each organization, but, as far as ICT projects are concerned, they are partially dependent. “Operational” and “managerial” dimensions are equally highly agreed-upon benefit dimensions from case studies. This finding is consistent with findings of past studies (Shang and Seddon 2002) about “organizational,” “operational,” and “managerial” benefits related to ICT projects. At the current stage, the findings suggest that all of the dimensions are considerable for measuring ICT projects as evidence collected from ICT experts in case studies. The data is further analyzed using EFA to determine the underlying structure in a data matrix and correlation between the measuring dimensions. Therefore, the following sub-sections explained the instrument reliability and detailed discussion on EFA results.

3.1 Assessing Instrument Reliability

In this study, to assess the internal consistency of the instrument's scales, a reliability test was performed. Cronbach's alpha is a coefficient used for reliability that shows how good the items set as positively correlated to one another. Cronbach's alpha varies from 0 to 1, the greater value shows high internal consistency (Sekaran and Bougie 2010). Table 5 demonstrates the values of Cronbach's alpha for all variables used in this study. Normally, the lowest acceptable value is 0.70 (Hair et al. 2010). It reveals that the Cronbach's alpha of each measure is >0.70; therefore, all values considered adequate varying from 0.807 to 0.949 in all factors, and 0.965 in the instrument as a whole, which signifies that the instrument is highly reliable.

Table 5. **Reliability of Instrument Measure**

Factors	No. of Items	Cronbach's alpha
Strategic	6	0.902
Informational	5	0.949
Transactional	6	0.910
IT Infrastructure	5	0.865
Transformational	5	0.906
Operational	5	0.899
Managerial	5	0.940
Organizational	4	0.807
Overall items	**41**	**0.965**

3.2 Discussion on Exploratory Factor Analysis

This section discusses the details of exploratory factor analysis technique, while the confirmatory factor analysis will be discussed in a later section. The EFA is performed by fulfilling all the requirements and considerations prescribed by different scholars (Hair et al. 2010; Foster et al. 2005). They suggested that the factors can be acceptable if eigenvalues are greater than 1, the Keiser-Meyer-Olkin (KMO) measure, which assesses the sampling fit of items, should be 0.6 or above, and Bartlette's sphericity test should be less than the alpha value, which assesses the presence of correlations between the dimensions. To determine the validity of the instrument as a whole, all items were entered at the same time by using the principal component analysis method to obtain an initial factors solution with varimax rotation and Kaiser Normalization. The results demonstrate that seven factors were extracted with an eigenvalue greater than 1, and the total explained variation was 74.07% in the items. The measure of sampling adequacy is greater than 0.6, suggesting that all items must be included in the factor analysis. The KMO value was 0.922, which, according to (Kaiser and Rice 1974) can be labeled as "marvelous" and cleared the sample test as "fit." The KMO value suggesting that factor analysis was appropriate, the Bartlett's test (0.00) has significance, and implying that items are correlated.

Exploratory factor analysis provided with the appropriate factor loading and proportion of variance for each dimension is showed in Table 6, which reveals that the EFA discriminated against seven factors out of eight initially proposed benefits dimensions. The results demonstrate that most of the items were loaded properly to their associating dimensions: managerial, informational, operational, strategic, transactional, transformational, and IT infrastructure, as shown in Table 7. However, as the purpose of possible data reduction procedure for this study using EFA, organizational dimension was not approved as a separate category of a benefit gained from ICT projects. All factors loaded within the interval from 0.382 to 0.910; for this interval, most of them are measured good for the significance of the factor load (Hair et al. 2010). The seven factors table suggests that all factors contribute significantly well to the proportion of variance, while altogether the variance explained 74.04%. The seven factors solution of EFA is illustrated in Table 6. The extracted seven factors are interpretable based on most items loading in the same factors. To explore all items loading in each factor, the suppress value was given as 0.10. The seven factors extracted are known as factor 1 (managerial), factor 2 (informational), factor 3 (operational), factor 4 (strategic), factor 5 (transactional), factor 6 (transformational), and factor 7, which are identified as IT infrastructure.

As depicted in Table 7, seven factors are extracted from the EFA test. The only values shown in the table are above 0.10, while empty cells demonstrate that the values in those cells were less than 0.10. Altogether, seven factors were extracted (based on eigenvalues greater than 1), where the highest value in each row points out the item loaded in which to factor. To analyze the eight factor analysis, EFA with a maximum of eight factors extraction was run, but none of the items were loaded into factor 8. Therefore, seven factors analyses are discussed in this section. Initially results highlight the loading of items with their corresponding factors. It is evident that most of the items of each measure are properly loaded in a similar factor which indicates that the respondent's level of understanding for each item with their corresponding measure was satisfactory. Participants showed an item's high agreement along with the measures. The differentiation and discrimination in each dimension is significantly shown through exploratory factor analysis.

Table 6. Dimensions Factor Load and Breakdown of Variance for each Construct

Dimensions	Factor Load	Proportion of Variance
Managerial	0.455 to 0.815	13.03%
Informational	0.661 to 0.910	12.26%
Operational	0.699 to 0.865	9.94%
Strategic	0.382 to 0.734	10.26%
Transactional	0.573 to 0.729	9.72%
Transformational	0.481 to 0.708	9.63%
IT Infrastructure	0.640 to 0.796	9.20%
Cumulative Variance		**74.04%**

On the other side, Table 7 is quite revealing in several ways. First, only the items posited to measure organizational dimensions were loaded separately in different factors with value ranging from 0.382 to 0.610. The item Org3 (user empowerment) was loaded and showed that overlapping with factor of managerial with factor loading 0.461, which was considerably acceptable and was nearly too moderately an important factor loading as 0.5. The item has kept in managerial dimensions to be confirmed using CFA procedure, as it showed that participants may consider this item closely related with managerial skills to empower the user through ICT resources. User empowerment suggested one of the employee's skills, which can improve his or her performance but requires manager's approval. The EFA highlight Org3 can be one of the measuring items in managerial dimension as related with other items in managerial Mngr2 and Mngr3. This study strengthened the finding of past studies in Australia (Shang and Seddon 2002), where organizational benefits were the least-agreed-upon component (13%) for measuring benefits of IT values. The research finding in previous research also pointed out those organizational benefits can be achieved through managerial benefits. Second, Org2 (facilitating organizational learning) and Org4 (building common vision) was clearly loaded into the factor of transformational with factor loading 0.610 (important) and 0.481 (considered acceptable). The transformational benefits are related to improving organizational capabilities with building new business plans. The loading of Org2 and Org4 are purely related with business understanding and organizational learning, which indicates the participant's perception about these two items, are actually enhancing business transformation benefits. Thus, both of these items remained under transformational factors then considered for the CFA procedure. Third, Org1 (changing work pattern) is the last item theorize to measure organizational dimension, which was cross-loaded into the two factors of strategies with factor loading 0.382 and in factor managerial with loading of 0.365, which makes only a small difference, although Org1 (changing work patterns) can better be merged with managerial factor according to its implication in business and leaning toward managerial aspects. Results, however, highlight that it seems difficult to understand participant reading for this item. Due to low factor loading and cross-loaded in two factors, the decision was made to discard this item based on the result of EFA which remain 40 measuring items in the framework.

In conclusion of this section, other than organizational benefits measure, all items were loaded more than 0.5 factor loading, which is considered good for the significance of the factor loads (Hair et al. 2010). Except Transf4 (improving business models) was loaded with 0.489, which is considerably good. This item shows its connectivity with transformational factor as loaded with similar factors. Therefore, it is further kept to be confirmed through confirmatory factor analysis. Before, discussion on CFA, the unidimensionality for construct validity were applied as presented in the succeeding section.

3.3 Unidimensionality for Construct Validity

Unidimensional measures is a test to conduct on sets of measured variables with only one underlying construct (Hair et al. 2010). Unidimensionality is a critical test to be conducted in the research study, which involved more than two constructs. There are two methods used to measure the unidimensionality of the constructs. The first procedure is using principal component analysis of the block (construct), and the second procedure is the Cronbach's alpha. The result of unidimensionality is depicted in Table 8. The table reveals that the extracted value of Cronbach's alpha of each construct is greater than 0.70. Using the principal component analysis method, the calculated value of the first eigenvalue for each construct is greater than 1, and the second eigenvalue recorded less than 1. As a result, the measures hold to the unidimensionality of the constructs requirement.

Table 7. EFA for Business Values of ICT

Dimension	No. of Items	Items	Label	Factors 1	2	3	4	5	6	7
Managerial	1	Improved overall operational efficiency	Mngr4	**.819**						
	2	Improved decision making and planning	Mngr2	**.802**						
	3	Performance improvement	Mngr3	**.777**						
	4	Better resource management	Mngr1	**.747**						
	5	Improved overall effectiveness of decisions	Mngr5	**.715**						
	6	User Empowerment	Org3	**.461**						
Informational	7	Improving information accuracy	Inform4		**.908**					
	8	Enabling faster access to information	Inform1		**.905**					
	9	Enabling easier access to information	Inform2		**.842**					
	10	Providing information in more useable formats	Inform5		**.806**					
	11	Improving information for strategic planning	Inform3		**.663**					
Operational	12	Productivity improvement	Opr3			**.864**				
	13	Cycle time reduction	Opr2			**.830**				
	14	Quality improvement	Opr4			**.812**				
	15	Customer service improvement	Opr5			**.773**				
	16	Cost reduction	Opr1			**.700**				
Strategic	17	Enabling quicker response to change	Str4				**.740**			
	18	Improving customer relations	Str5				**.697**			
	19	Establishing useful links with other organizations	Str3				**.680**			
	20	Providing better products or services to customers	Str6				**.614**			
	21	Aligning ICT strategy with business strategy	Str2				**.589**			
	22	Creating Competitive Advantage	Str1				**.509**			
Transactional	23	Avoiding the need to increase the workforce	Transac4					**.742**		
	24	Reducing communication costs	Transac3					**.734**		
	25	Enhancing employee productivity	Transac6					**.662**		
	26	Reducing operating costs	Transac2					**.654**		
	27	Increasing return on financial assets	Transac5					**.585**		
	28	Savings in supply chain management	Transac1					**.575**		
Transformational	29	Developing new business plans	Transf2						**.709**	
	30	Improving organizational structure/processes	Transf5						**.674**	
	31	Facilitating organizational learning	Org2						**.610**	
	32	Expanding organizational capabilities	Transf3						**.593**	
	33	An improved skill level for employees	Transf1						**.522**	
	34	Improving business models	Transf4						**.489**	
	35	Building common vision	Org4						**.481**	
IT Infrastructure	36	Improving business flexibility	IT_Inf2							**.796**
	37	Reducing the marginal cost of a business unit's IT	IT_Inf3							**.795**
	38	Improving business integration	IT_Inf1							**.753**
	39	Improving organizational standardization	IT_Inf5							**.699**
	40	Reducing IT costs	IT_Inf4							**.636**

Table 8. Unidimensionality of the Constructs

Factors	No. of Item	Cronbach's Alpha	First eigenvalue	Second eigenvalue
Managerial	6	0.928	4.493	0.600
Informational	5	0.949	4.165	0.352
Operational	5	0.899	3.580	0.520
Strategic	6	0.902	4.085	0.715
Transactional	6	0.910	4.151	0.670
Transformational	7	0.918	4.722	0.600
IT Infrastructure	5	0.865	3.272	0.606
Overall Items	**40**			

3.4 Confirmatory Factor Analysis

This section mainly describes the method conducted for testing the validity of the constructs by performing confirmatory factor analysis (CFA). CFA measurement method is used to analyze the different relationship within the measurement model. The CFA measurement model establishes an important preliminary step before evaluation of the structural model in structural equation modeling, and it enables an evolution from EFA to CFA (Hair et al. 2010; Byrne 2013; Blunch 2008). In justification of the CFA model, convergent validity, composite reliability, and discriminant validity are performed. Before providing an analysis on CFA, the next paragraph presents brief information about structural modeling equation.

Structural equation modeling (SEM) is a type of multiple regression technique, but, in more powerful way, is categorized as a combination of statistical methods, which allow the analysis of the relationship between one or more independent factors and one or more dependent factors (Ullman 2006). Model fits (Table 9), indicates how well the proposed model or structure encounter is correlated between dependent and independent variables; it is a primary interest in SEM validation. Accordingly, in this study, in order to validate the pre-established model, CFA was performed. The approach taken in this study is to build a comprehensive instrument for measuring the business value of ICT. Therefore, all factors were loaded for assessment using AMOS. According to the independent dimensions (exogenous constructs), items in the instrument were properly loaded and finalized through exploratory factor loading, and the dependent variables (endogenous constructs) are the seven dimensions of benefits. All variables were loaded in CFA for analyzing their loading and relationship between independent and dependent variables. In addition to the CFA loading verification, the model is further validated through three type of assessment: convergent validity, composite reliability, and discriminant validity (as details shown in Table 10) of all constructs as described in the succeeding section.

Table 9. Model Fit Index (Hoyle, 1995)

Model Fit Index	Thresholds
Chi-Square x2	• < 3
Goodness-of-fit index (GFI)	• Between 0 to 1 • Close to 1 indicate better fit
Adjusted Goodness-of-fit index (AGFI)	• Between 0 to 1, • can be negative. • Close to 1 indicate better fit
Comparative-fit-index (CFI)	• => 0.90
Root mean square error of approximation (RMSEA)	• <= 0.05 (Good) • 0.05 – 0.10 (Moderate) • > 0.10 (Bad fit)

Table 10. Construct Validity Assessment (Hair et al. 2010)

Validity Assessment	Thresholds
Convergent Validity	• AVE > 0.5
Composite Reliability	• CR > 0.7
Discriminant Validity	• MSV < AVE • ASV < AVE • Square root of AVE greater than inter-construct correlations
CR: Composite Reliability **AVE:** Average Variance Extracted **MSV:** Maximum Shared Variance **ASV:** Average Shared Variance	

3.5 Discussion on Confirmatory Factor Analysis

Confirmatory factor analysis was performed using the maximum likelihood (ML) method, as (Hair et al. 2010) suggested it is the most widely used in the CFA modeling method. For standardized factor loading, (Hair et al. 2010) suggested that 0.7 or higher is a widely accepted value. The initial results of the CFA show that all items loaded under the same construct as resulted from EFA. Although the CFA models verify that was not acceptable due to several issues according to assessment criteria discussed earlier. Although the initial results show that chi-square/df was < 3, all fit indices were < 0.9 and RMSEA calculated near to 0.08. Based on the factor loading weight table, there were some evidences that were not supporting the ideal position of the model. In addition, covariance error is also highlighted from the result. Therefore, some modification was performed, which can make the model fit. The proper modification in the CFA model for improving the fitness of the model is as described (Hair et al. 2010) and same practice conducted in past studies (Maçada and Beltrame 2012).

Furthermore, the results indicate that possible adjustment must be made for improving the model and can pass the assessment test using different criteria. Therefore, first of all, few items were discarded as the factor loading was low. Org3 (user empowerment) were loaded in EFA with another construct factor as managerial with factor loading 0.461, which were also not consider a good factor load. At that stage we kept because it was providing true meaning with managerial construct. But, through CFA, Org3 loaded with 0.62, which was a considerably low value; therefore, it was eliminated to do best model fit. There were more concerns based on factor loading in CFA. Org4 (building common vision) was the similar case in EFA; it was loaded with another construct factor as transformation, where the loading was 0.481, which were also less than 0.5. In CFA, Org4 loading was 0.63; hereafter, it was discarded due to low factor loading.

There was some more modification performed to improve the CFA and fit indexes, which were guided with the factor score weights. Hence, from a strategic factor, Str6 (providing better products or services to customers) factor loading was 0.62, which is lower than the acceptable value of 0.7 in CFA. Despite the low factor loading, the possible explanation for discarding this factor is availability of similar item Str5 (improving customer relations) in strategic construct. Companies try to use different scenarios to improve relations with customers, in which one of the element is by providing them good support and services to facilitate them appropriately. Therefore, Str5 is covering the same benefits to measure instead of Str6. The item was then discarded due to low loading. Similarly, there were two more items: IT_Inf3 (reducing the marginal cost of a business unit's IT) and IT_Inf4 (reducing IT costs), which were < 0.60. Due to low loading, elimination of them can improve the model fit. The possible reason, which can justify their elimination, as both of them were related with cost reduction, which is purely depend on the interest of organizational perspective (government, semi-government and private).

Next, based on the modification indices, it was suggested a misfit lay in the error covariance matrix and represents a correlated error between Transac1 (savings in supply chain management) and Transac2 (enhancing employee productivity) (MI = 15.120). Using the AMOS software, observing the modification indices, the covariance was inserted between the error measures for the dimension Transac1 and Transac2. One possible explanation between the two items is that changes are associated with each other. Supply chain management associated with human activities as well as different ICT resources are connected for proper communication. Workforce may improve their skills and productivity through using new systems and resources employed for improving in supply chain management. This type of covariance is acceptable if the items belong to same construct (Salkind 2006; Kenny 2011).

Hereafter, no more modifications are done, as the model was not showing any improvement. Str4 (enabling quicker response to change) with factor loading 0.68, and Transac1 (savings in supply chain management) with 0.69 were not eliminated, as both of them are good and near the ideal range of 0.7 (Hair et al. 2010). The elimination of both items was also not affecting any improvement in the model. After possible modification, as suggested through different factor estimates, a re-specification was performed and the CFA verifies the re-specification model was acceptable chi-square/df < 3, CFI > 0.9, RMSEA < 0.08. Thus, the model validity was acceptable. The final factor loading in CFA along with convergent validity and composite reliability of construct is presented in Table 11 above with 35 measuring items in the framework.

Referring to Table 12, using Stats Tool (Gaskin 2016) the construct validity assessment is performed to calculate composite reliability (CR), convergent validity, and discriminant validity, using different measure as discussed above such as average variance extracted (AVE), maximum shared variance (MSV), and average shared variance (ASV).

The purpose of all these calculation is to validate the model using SEM criteria. The convergent validity was > 0.50 and the composite reliability was > 0.70. Therefore, based on the analysis, there were evidences that each measurement in the model is valid. Based on the above result analysis and empirical investigation, we developed a holistic model for assessing ICT values, as shown in Figure 2 with 7 dimensions and 35 measuring items.

Table 11. Factor Loading, Convergent Validity and Composite Reliability in CFA

Label	Items	Loading	Convergent Validity	Composite Reliability
Strategic			**0.651**	**0.902**
Str1	1. Creating Competitive Advantage	0.83		
Str2	2. Aligning ICT strategy with business strategy	0.81		
Str3	3. Establishing useful links with other organizations	0.88		
Str4	4. Enabling quicker response to change	0.68		
Str5	5. Improving customer relations	0.83		
Informational			**0.846**	**0.956**
Inform1	6. Enabling faster access to information	0.99		
Inform2	7. Enabling easier access to information	0.85		
Inform3	8. Improving information for strategic planning	0.76		
Inform4	9. Improving information accuracy	0.99		
Inform5	10. Providing information in more useable formats	0.84		
Transactional			**0.608**	**0.902**
Transac1	11. Savings in supply chain management	0.69		
Transac2	12. Reducing operating costs	0.76		
Transac3	13. Reducing communication costs	0.71		
Transac4	14. Avoiding the need to increase the workforce	0.81		
Transac5	15. Increasing return on financial assets	0.91		
Transac6	16. Enhancing employee productivity	0.79		
IT Infrastructure			**0.701**	**0.875**
IT_Inf1	17. Improving business integration	0.87		
IT_Inf2	18. Improving business flexibility	0.84		
IT_Inf5	19. Improving organizational standardization	0.79		
Transformational			**0.658**	**0.920**
Transf1	20. An improved skill level for employees	0.79		
Transf2	21. Developing new business plans	0.74		
Transf3	22. Expanding organizational capabilities	0.87		
Org2	23. Facilitating organizational learning	0.78		
Transf4	24. Improving business models	0.84		
Transf5	25. Improving organizational structure/processes	0.83		
Operational			**0.648**	**0.902**
Opr1	26. Cost reduction	0.73		
Opr2	27. Cycle time reduction	0.76		
Opr3	28. Productivity improvement	0.86		
Opr4	29. Quality improvement	0.86		
Opr5	30. Customer service improvement	0.81		
Managerial			**0.772**	**0.944**
Mngr1	31. Better resource management	0.91		
Mngr2	32. Improved decision making and planning	0.92		
Mngr3	33. Performance improvement	0.72		
Mngr4	34. Improved overall operational efficiency	0.97		
Mngr5	35. Improved overall effectiveness of decisions	0.85		

Table 12. Construct Validity Assessment for each Construct

CR: Composite Reliability AVE: Average Variance Extracted MSV: Maximum Shared Variance ASV: Average Shared Variance	CR	AVE	MSV	ASV	Transformational	Managerial	Informational	Operational	Strategic	Transactional	IT Infrastructure
Transformational	0.920	0.658	0.629	0.455	0.811						
Managerial	0.944	0.772	0.557	0.339	0.746	0.879					
Informational	0.956	0.846	0.412	0.215	0.483	0.313	0.920				
Operational	0.902	0.648	0.300	0.199	0.536	0.548	0.229	0.805			
Strategic	0.902	0.651	0.629	0.396	0.793	0.740	0.503	0.489	0.807		
Transactional	0.902	0.608	0.602	0.420	0.776	0.577	0.642	0.464	0.727	0.780	
IT Infrastructure	0.875	0.701	0.432	0.263	0.649	0.448	0.494	0.316	0.425	0.657	0.837

Note:
For Convergent Validity all constructs have the value of AVE > 0.5
For Composite Reliability all constructs have the value CR > 0.7
Discriminant Validity all conditions are true:
MSV < AVE ASV < AVE
Square root of AVE greater than inter-construct correlations (all diagonal highlighted values in the table are square root of AVE.

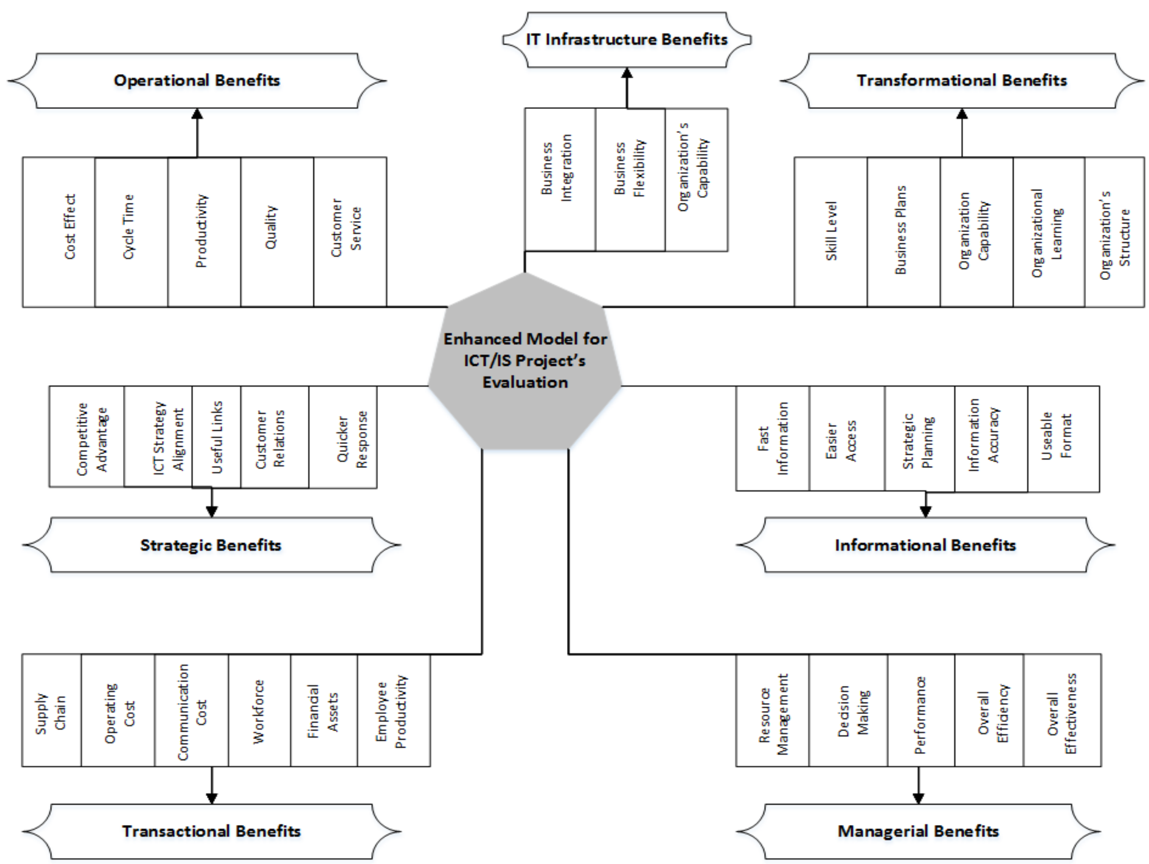

Figure 2. Holistic Model for Assessing Business Values of ICT

4 CONCLUSION AND FUTURE WORK

THE paper has improved the model of (Shang and Seddon 2002; Gregor et al. 2006) in different ways. First it has been proved the transformational dimension is distinct type of benefits an organization can impacted through ICT as proposed by (Gregor et al., 2006). Second the measuring items of this dimensions has improved by moving one item (Facilitating organizational learning) from organizational dimension into it, which has been further validated in this study. Third, the Gregor's model has enhanced after the integration of three more dimensions (operational, managerial and IT infrastructure) in this study that has been validated. The study has further modified the findings of (Shang and Seddon 2002) that proposed the organizational dimension as a distinct factor. *But this study has come up with list of evidences that organizational factor has common in nature which can be encapsulated in other dimensions such as transformational*.

The study has contributed in this field practically and theoretically. It has combined the previous research in a manner to extend the dimensions of measuring ICT business values. The model is significant for managers and ICT decision makers to align between business strategies and ICT strategies. It provides answer to managers that how enterprise can measure impact on business values of ICT projects and to achieve an effective understanding of the effects and process of ICT evaluation. The proposed holistic model can be useful for managers to evaluate the success of ICT projects, depends on measuring items under each category of mentioned benefits; strategic, informational and so on. Validation of framework using a specific real world ICT project would be a further research to be followed. The model is useful for any type of organization (small, medium or large) as the implementation of the model is not based on type of organization, rather it's depend on ICT project type. Measuring those benefits can provide the idea and suggestions for their further work and new investment.

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