Factors Influencing the Successful Implementation of BIS

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Abstract

Business intelligence systems (BIS) are an important component of modern organization's information infrastructure. They enable organizations to understand business environment, recognize opportunities, help decision makers to make better decision, and improve organizational performance. To implement a BI project successfully and to gain the associated benefits, BIS stakeholders need to understand the critical success factors (CSFs). As CSFs support them to optimize their resources and efforts through focusing on those significant factors that support the successful implementation. In this research, a critical success framework for BIS implementation was proposed. The framework gathered critical success factors and divided them into Organization, Technology, Environment and Process categories.Questionnaire was used to collect data and SPSS program was used to analysis the collected data. The results show that there is a strong positive relationship between CSFs and successful implementation of BIS (R=0.818). Also, all the CSFs except complexity have a positive significant relationship with successful implementation at 1% and 5% level of significant. Finally, results show that the CSFs have positive significant effect on organization's performance.

Keywords—*Business Intelligence Systems (BIS); Critical Success Factors (CSF); Organization's Performance (OP); Business Intelligence Implementation (BII); Business Intelligence Model (BIM).*

I. INTRODUCTION

Now a day's business intelligence systems have attracted the attention of academics and practitioners because of their influence on performance of organizations [1-3]. BIS can handle large amounts of information to help identify and develop new opportunities. Making use of new opportunities and implementing an effective strategy can provide a competitive market advantage and long-term stability.

The effective implementation and use of BI is important for organization performance. So, the factors that contribute to the successful implementation are critical and complex to any organization.

The CSFs of BIS implementation remains poorly understood and there are limited studies on it and the existing studies provide limited breadth and depth of analysis with limited scope [4]. Also, there are limited empirical studies concerned the CSFs of BIS implementation. So, the objective of this study is to explore the factors that are necessary for the successful implementation of BIS, and study empirically the effect of CSFs on the successful implementation of BIS.

II. RELATED WORK

A.Business Intelligence Systems

Business Intelligence (BI) is one of the basic techniques for analyzing data of business process and supporting the process of decision making in organization. It might be considered as the most recent stage among the development phases of Management Information Systems during the last decades [5]. BI is the process of converting raw data into valuable information for more effective strategic and operational insights, and decision-making purposes so that it produces real business benefits [6].

Business Intelligence Systems (BIS) utilize the data collected from organization and transformed it into information and knowledge that organizations need at the right time to make the right decisions to ensure sustainability and build shareholder value [7]. BIS allow organizations to store, retrieve and analyze large amounts of data about their operations and allow them to improve strategic and tactical decisions, and gain competitive advantage of the industry [8].

There are many definitions of BIS,and one of the most relevant definitions is having the right access to the right data or information needed to make the right business decisions at the right time [9]. Yoon et al. [10], stated that BIS is a new business technology that is defined as a collection of tools and technologies that include the data analysis and query to produces rich reports presentations given a high accuracy in decision-making process.Kadoli et al. [11], mentioned that the common purposes of BIS are reporting, online analytical processing, analytics, data mining, process mining, complex event processing, business performance management, benchmarking, text mining, and predictive analytics.

B. Business Intelligence Implementation Models

The effective implementation and use of (BIS) is important for making better decision and enhancing organization's performance. The implementation of (BIS) is a complicated and there are many factors that contribute to the successful implementation and use of BI, but there are no commonly-agreed success measures for implementing BIS [4].

In 2013, Sangar&Iahad [16], proposed a conceptual framework to identify factors that are critical to the successful implementation of BIS. They identify CSFs and classified them into technological and managerial categories. Also, in 2013, Kulkarni and Robles-Flores [17], developed a BIS success model based on factors related to analytical culture, leadership commitment, and user involvement. The results show that analytical culture has a positive effect on both data capability and BI systems capability.Boonsiritomachai [18], developed a framework includes eleven factors to explore the factors that affect the adoption BIS in the small and medium-size enterprises (SMEs) in Thailand and to recognize the current state of the adoption of BIS in it. Mesaros et al. [19], identified seven factors that are necessary for BIS successful implementation and use.

Also, in 2015, Ahmad developed a model that study the effect of both perceptive factors and internal firm's Factors on the successful deployment of BIS, and the effect of the successful BIS deployment on sustainable competitive advantage [20].

Recently, Owusu & Said [1], proposed an integrated model of factors that affect the adoption of BIS, and the benefits of post adoption in banking sector in Ghana.

In 2010, Yeoh &Koronios [12], developed a CSFs framework consists of seven factors crucial for BI systems implementation. They categorized the CSFs into 3 categories and measured implementation success of BI system from two key dimensions: infrastructure performance and process performance. The results indicated that non-technical factors are more influential and important than technological. Whereas in 2011, Schieder&Gluchowski [13], developed a model for measuring the success of BI Based on the updated model of information systems success presented by DeLone& McLean [14]. Anjariny et al. [15], developed a model consists of six categories for assessing organizations' readiness toward BIS in the Malaysian organizations.

III. RESEARCH MODEL

To achieve the research goal, a critical success model for BIS implementation was proposed based on the models and the factors suggested by [14, 20 – 26].The proposed model consists of two main parts as shown in fig 1:

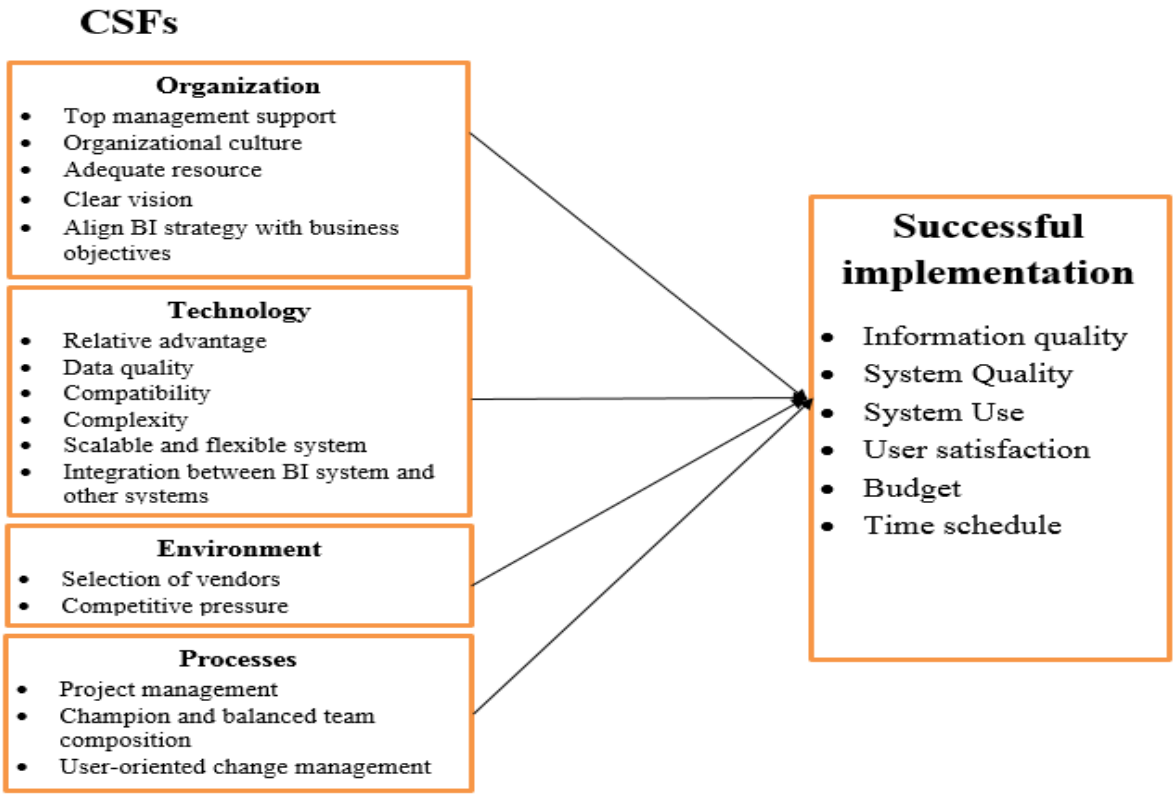

Fig1. Research Model

- **Part (1): Critical Success Factors:** which include the most common 16 CSFs classified in fourcategories as follow: Organization category, Technology category, Environment category and Processes category as shown in Table 1.
- **Part (2): BI Implementation Factors:**which include: System Quality, Information quality, System Use, User satisfaction, Time schedule, and Budgetas shown in Table 2.

Table 1. Critical Success Factors of BIS

Categories	Factors
Organization	Top management support
	Clear vision
	Adequate resource
	Organizational culture
	BI Strategic Alignment
Technology	Data quality
	Integration between BI system and other systems
	Scalable and flexible system
	Compatibility
	Complexity
	Relative advantage
Environment	Selection of vendors
	Competitive pressure
Process	Champion and Balanced team skills and composition
	User oriented Change management
	Project management

Table (2): Successful Iimplementation Factors

Measures	Factors
Information quality	Accuracy
	Sufficient information
	Clear information
	Up to date information
System quality	System reliability
	Ease of use
	Ease of learning
	Recover from error
System use	Frequency of use
	Purpose of use
User satisfaction	Overall satisfaction with BIS
	Pleasure of using BIS
Budget	Cost required
Time schedules	Period required

IV. RESEARCH METHODS

A. Research Tool

To fulfill the objective and achieve the goal of this research work, a questionnaire was designed to investigate the effect of the critical success factors on business intelligence system success and the effect business intelligence system success on organization's performance. It was designed based on [4, 18, 22, 24 & 26 - 30] studies. Several professors and IS professionals were interviewed to modify the statements (content validity).

The designed questionnaire consists of three main parts. The first part isDemographics: which includes participants and organization information. The first part isCSFs of BIS: which includes organization; process; technology and environment characteristics and has 45 statements. The third part isSuccessful Implementation: which includes system use; user satisfaction; information quality and system quality, Budget, Time schedule and has 14 statements.

Online interviews were conducted with professors and professionals who had experience in IS, BIS and ERP from: Egypt, United Arabic Emirates, Saudi Arabia, China, Hong Kong to review and modify the statements (if necessary).

B. Research Sample

The target population of our research is managers, IS professionals, and higher-level officers who have a good level of BI utilization in their organizations. Forty Egyptian organizations were selected randomly based on their experiences in BIS implementation. After personal contact and via LinkedIn Network, twenty organizations were participated in the study. Four copies from the questionnaires were distributed via Email and LinkedIn Network to each organization. The participants were asked to rate their perception towards the CSFs and BIS implementation within their organizations on a five-point Likert-type scale with anchors from “Strongly agree” to “Strongly disagree”.

C. Data Collection

Data were collected during the period March 2017 – July 2017. Some of the managers in the selected organizations were very corporative. On the other hand, some managers didn’t agree to response the questionnaire. Fifty-two questionnaires out of eighty were received questionnaires as shown in Tables 3, 4, 5&6.

Table 3. Number of received questionnaires based on sector

Sector	No. of organizations / participants / respondents	Percentage of respondents

Information Technology(IT)	6 /24 /19	36.54
Industrial	4 / 16 / 10	19.23
Services	2 / 8 / 4	7.69
banking	3 /12 / 5	9.62
Telecommunications	3 /12 / 11	21.15
Retail and whole sales	2 / 8 / 3	5.77
Total	**20 / 80 /52**	**100%**

Table 4. Number of Received Questionnaires Based on Type

Organization type	No. of organizations / participants / respondents	Percentage of respondents
Government and Public	7 / 28 / 14	26.92
Private	13 / 52 / 38	73.08
Total	**20 / 80 /52**	**100%**

Table 5. Number Of Received Questionnaires Based on Organization Size

Organization size	No. of organizations / participants / respondents	Percentage of respondents
76.92	14 / 56 / 40	Large
23.08	6 / 24 /12	Medium
100%	**20 / 80 / 52**	**Total**

Table 6. Demographical Analysis

Variables	Group	Percent
Gender	Male	86.50%
	Female	13.50%
Age	25-30	26.92%
	31-40	50%
	40 -50	23.08%
Education	Bachelor	71.15%
	Diploma	7.70%
	Master	19.23%
	PhD	1.92%
Position	CIO	19.23%
	Senior manager	19.23%
	IT manager	19.23%
	Sales manager	11.54%
	Project manager	9.62%
	BI analyst, Consultants, BI Specialist	21.15%

V. RESULTS AND DISCUSSIONS

A. Reliability Analysis

Cronbach's Alpha test was applied to all elements of CSFs, successful implementation, by using SPSS version 20. A commonly accepted rule of thumb for describing internal consistency using Cronbach's alpha is shown in Table 7.

The test result is equal to 0.950, this confirms the reliability of the collected data (internal consistency is Excellent).

Table 7. Internal consistency

Internal consistency	Cronbach's alpha
Excellent	$\alpha \geq .9$
Good	$.9 > \alpha \geq .8$
Acceptable	$.8 > \alpha \geq .7$
Questionable	$.7 > \alpha \geq .6$
Poor	$.6 > \alpha \geq .5$
Unacceptable	$.5 > \alpha$

B. Results analysis based on organizations sector

Table 8. shows participants' opinion towards CSFs of BIS and successful implementation. The highest value of the organization category was achieved by the Retail and whole sales sector (4.14) followed by Industry sector (3.98) then Banking sector (3.85), whereas the least value was achieved by the service sector (3.7).

The largest value of technology category was achieved by the Banking sector (4.04) followed by Industry sector (3.99) then Information Technology (3.76), while the lowest value was achieved by the Retail and whole sales sector (3.52).

The largest value of Environment category was achieved by the Retail and whole sales sector (4.45) followed by Banking sector (4.4) then Telecommunications sector (4.33), while the lowest value was achieved by the service sector (3.63). In all sectors Competitive pressure factor have a higher value than selection of vendors.

The largest value of process category was achieved by the Banking sector (4.19) followed by Industry sector (3.89) then Information Technology sector (3.65), while the lowest value was achieved by the Telecommunications sector (3.32).

The highest value of Successful implementation was achieved by the Telecommunications sector (4.46) followed by Industry sector (4.42) then the Banking and the Retail and whole sales sectors (4.34), while the lowest value was achieved by the Services sector (4.18).

This means that the Telecommunications sector have the best Successful implementation compared to the other three sectors.

System use showed high value in Telecommunications sector (4.63) followed by user satisfaction (4.6), while time schedule showed high value in the Retail and whole sales sector (5) followed by budget (4.66).

Time schedule and user satisfaction showed high value in banking sector (4.6) followed by system use and budget (4.4). Time schedule showed high value in Industry sector (4.66) followed by and budget (4.44). User satisfaction showed high value in Information Technology sector (4.58) followed by Time schedule (4.47). User satisfaction showed high

value in Services sector (4.5) followed by information quality (4.35).

Table 8. Participants' Opinion Towards Csfs Of BIS And Successful Implementation

Factors	Sectors					
	Information Technology	Industrial	Services	Banking	Tele-communications	Retail and whole sales
Organization category						
Top management support	4	4.27	3.8	3.9	3.8	3.8
Culture	3.7	3.63	3.86	3.53	3.48	4.6
Adequate resource	3.45	4.07	3.06	3.46	3.54	4.1
Clear vision	3.7	3.81	3.7	3.86	3.39	3.7
Align BI strategy with business objectives	4.1	4.1	4.1	4.5	4.22	4.5
Average	**3.78**	**3.98**	**3.7**	**3.85**	**3.7**	**4.14**
Technology category						
Relative advantage	3.71	4.07	4.1	4.13	3.5	4
Data quality	3.78	4.18	4	4.13	3.36	3.77
Compatibility	3.82	3.92	4.3	3.66	3.87	4.2
Complexity	3.19	3.7	2.7	3.8	3	2.4
Scalable and flexible system	4.1	3.94	3.4	4.5	3.7	3
Integration between BI system and other systems	4	4.15	3.86	4	3.82	3.77
Average	**3.76**	**3.99**	**3.73**	**4.04**	**3.55**	**3.52**
Environmental category						
Selection of vendors	4.19	4.2	3.26	4.1	3.7	4.4
Competitive pressure	4.37	4.38	4	4.7	4.95	4.5
Average	**4.28**	**4.29**	**3.63**	**4.4**	**4.33**	**4.45**
Process category						
Project management	3.45	3.88	3.8	4.46	3.59	3.2
Champion and balanced team composition	3.8	3.98	3.6	4.06	3.27	3.27
User-oriented change management	3.7	3.81	3.35	4.05	3.1	4.25
Average	**3.65**	**3.89**	**3.58**	**4.19**	**3.32**	**3.57**
Successful implementation						
System use	4.4	4.4	4.1	4.4	4.63	4.3
System quality	3.98	4.19	3.9	3.95	4.38	3.4
Information quality	4.2	4.42	4.35	4.1	4.47	4.16
User satisfaction	4.58	4.4	4.5	4.6	4.6	4.5
Budget	4	4.44	4	4.4	4.27	4.66
Time schedule	4.47	4.66	4.2	4.6	4.45	5
Average	**4.27**	**4.42**	**4.18**	**4.34**	**4.46**	**4.34**

B. The Effect of CSFs on the successful implementation of BIS

We used multiple regression analysis to explore the effect of CSFs on successful implementation of BIS and to identify the best predictor of the successful implementation.

The results show that CSFs explained 66.9 % (R^2=0.669) of the variance in the successful implementation. The results also show a strong positive relationship between CSFs and successful implementation (R=0.818) as shown in Table 9. (F-test) is significant at $p<0.05$ as shown in Table 10. This confirms the effect of CSFs on the successful implementation of BIS.

Competitive pressure shows high significant influence on organization performance (β= 0. 394, t=2.709, $p < 0.05$), whereas the other factors are not significant as shown in Table 11.

In addition, these results are confirmed with the results of (T-test) whereas the Competitive pressure has a statistical significant effect on successful implementation.

Table 9. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.818	0.669	.486	4.37113

Table 10. Anova Test Results

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	1119.555	16	69.972	3.662	.001[b]
Residual	554.098	29	19.107		
Total	1673.652	45			

We used Pearson correlation to find out the correlation between each factor of CSFs of BIS and successful implementation. Pearson correlation is considered the most familiar measure of dependence between two quantities.

Table 12. shows that all the CSFs except complexity have a positive significant relationship with successful implementation at 1% and 5% level of significant.

Table 11. Statistical Significant for Independent Variables (T-Test)

Factors	B	t	Sig.
Top management support	.002	.009	.993
Organizational culture	-.207-	-.779-	.442
Adequate Resources	.331	1.555	.131
Align BI strategy with business objectives	.163	.786	.438
Clear vision	.061	.433	.668
Project management	-.071-	-.410-	.685
Champion and balanced team composition	-.026-	-.142-	.888
User-oriented change management	-.196-	-1.042-	.306
Relative advantage	.265	.917	.367
Data quality	-.176-	-.745-	.462
Compatibility	.210	1.137	.265
Complexity	-.083-	-.579-	.567
Scalable and flexible system	.133	.796	.433
Integration between BI system and other systems	.068	.378	.708
Selection of vendors	.110	.611	.546
Competitive pressure	.394	2.709	.011

Table 12. Correlation Coefficients Between Csfs Of BIS And Successful Implementation

Critical success factors	Successful Implementation
Top management support	0.486**
Organizational culture	0.463**
Adequate Resources	0.311*
Align BI strategy with business objectives	0.590**
Clear vision	0.531**
Project management	0.472**
Champion and balanced team composition	0.359*
User-oriented change management	0.329*
Relative advantage	0.493**
Data quality	0.438**
Compatibility	0.563**
Complexity	-0.203
Scalable and flexible system	0.391**
Integration between BI system and other systems	0.500**
Selection of vendors	0.449**
Competitive pressure	0.621**

* Correlation is significant at the 0.05 level (2-tailed)
** Correlation is significant at the 0.01 level (2-tailed)

Top management support, Organizational culture, Clear vision, Align BI strategy with business objectives, Relative advantage, Data quality, Compatibility, Scalable and flexible system, and Integration between BI system and other systems, Selection of vendors, and Competitive pressure, Project management have a positive significant relationship with successful implementation at 1% level of significant, and adequate resource, Champion and balanced team composition, and User-oriented change management have a positive significant relationship with successful implementation at 5% level of significant. While Complexity has a negative relationship with successful implementation.

VI. CONCLUSION

This study developed a conceptual research framework to identify factors that are critical in BIS implementation. The framework gathered critical success factors and divided them into Organization, Technology, Environment and Process categories. Based on the discussion of the results, this framework assisted both practitioners and academicians by presenting insights on how to better implement BIS and the critical factors that need to be focused on in each stage of the implementation. The framework identified critical constructs that can be used by academicians for further empirical studies. Moreover, more empirical research

needs to be conducted to better understanding of the different roles played by various stakeholders and how these stakeholders evaluate the success of a BIS implementation.

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