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An Empirical Investigation of the Factors Affecting Data Warehouse Technology Success in Medical Institutions

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Recently, due to the expansion in data complexity and manageability issues, data warehousing become one of the tops focuses on information systems researchers and practitioners especially in healthcare. Medical institutions are capturing, storing, and analyzing a very complex and huge quantity of data that has big volume, velocity, and variety. These big data come from a variety of sources, including personal information, patients record, and other sources that making the jobs very challenge to be done. Therefore, a demand has been created to implement a data warehouse technology in medical institutions to support their decisions making. This paper depicts a problem regarding the complexity of the data in medical institutions in Saudi Arabia. In this study, a cross-sectional survey was used to investigate a model of data warehousing success particularly in a single intensive industry such as medical institutions. The findings of the study show that certain variables in both organizational and technological dimensions have a significant influence on data warehousing success.

Keywords: *Data warehousing, Health informatics, IS implementation, Partial Least Squares, Medical Institutions.*

Introduction

Medical industry is sorted as a high information demands industry, where Information Technology (IT) plays a significant role to recover the excellence of facility and to gain a modest benefit. In instruction to deal with this big data and to complete the cycle of Decision Support System (DSS), a demand has been created to tool the Data Warehouse Technology (DWT) in medical institutions (Watson, 2014).

Since the 1990s, data warehousing developed unique of the greatest significant growths in the info systems arena (Wixom & Watson, 2001). Leaders and decision makers are considering DWT to be in their top strategic agendas. The main goal of a DWT is to comprise a set of data and tools designed to assist decision making (Neogi et al., 2013). In every Data Warehouse Application (DWA), data comes from different sources both internal and external that requires a data warehousing setting with tall suppleness, healthier adaptability, and effective support to brand a choice (Lopes, Times, Matwin, Ciferri, & de Aguiar Ciferri, 2014; Oliva & Felipe, 2018).

Most of the Saudi medical institutions have already implemented the data warehouse technology in instruction to manage the existing databases which needs huge wealth expenditure and too take a decent contract of growth time, has a actual tall option of disappointment (Hwang, Ku, Yen, & Cheng, 2004). Unluckily, greatest of the studies absorbed on the technical and working features of the acceptance of DWT (Brodinova et al., 2019; Silver et al., 2001; Ţăranu, 2016), other than concentrating on the managerial and strategic levels. To bridge this gap in the research works, the goal of this empirical study is to explore what issues contribute to the successful implementation of the DWT within Saudi's Healthcare institutions. The results presented in this study can certainly be a decent orientation for medical institutions to found and grow working plans within Saudi Arabia. Also, academia container usage the answers of this study as a basis to pledge other connected educations in the field of data warehouse technology.

Data Warehouse Technology

The story of the data warehouse initiates with the evolution of information and decision support systems (DSS) back in the late 1988. (Park & Kim, 2013) presented Simple concept of the data warehouse to illiterate various issues related with commercial enterprise tactics and statistics structure that define the glide of information from operational systems to decision support surroundings. They have suggested building a database that can read-only and store data operating for users to extract information for decision supporting and analyzing.

Architecture of Data Warehouse (DW)

Data warehouse technology and their architectures vary depending upon the need of a specific medical institution. The fundamental reason for building a DW in any medical institution is to improve the quality of the info to satisfy choice creation request. The basic initiative data warehouse architecture as shown in Fig.1 contains four components that include data sources, Extract-Transform-Load (ETL) process, Data Warehouse (DW), and front-end applications used for analysis, reporting, and mining information.

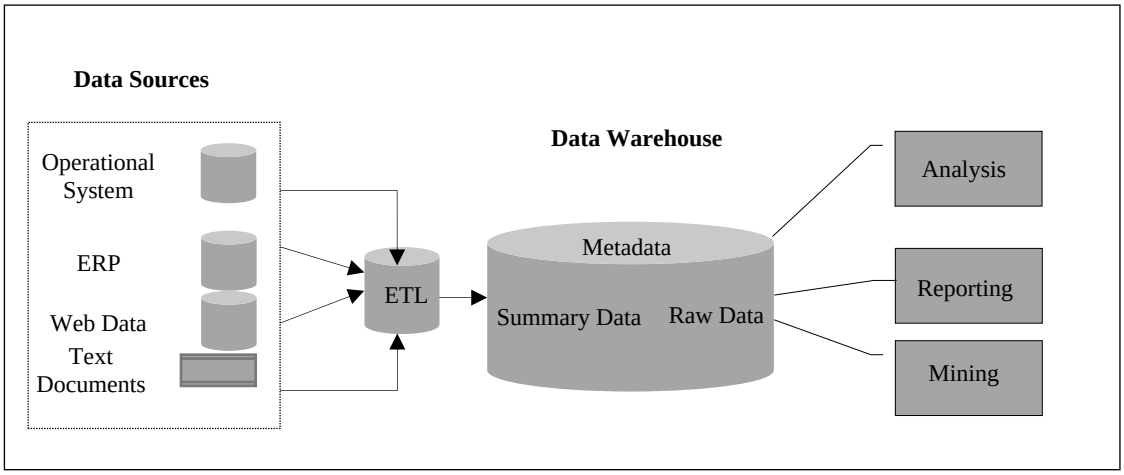

Fig. 1 Enterprise Data Warehouse Architecture

Related Work

Previous studies on data warehousing focused on technological and operational issues (Kimball & Ross, 2011; Subramanian & Wang, 2019), data quality related to the system implementation issues (Kademeteme, Kalema, & Pretorius, 2017; Subramanian & Wang, 2019), and system's performance issues (Khan, Ahmad, Imran, Alharbi, & Jan, 2017; Rahman, 2016). Several researchers have investigated certain factors that contribute to the successful adaption of data warehouse technology in public organizations (Hwang et al., 2004; Wixom & Watson, 2001). To accompaniment the prior studies, this have a look at performed an empirical survey to look what elements have an effect on the real implementation of data warehouses technology in medical institutions.

(Wixom & Watson, 2001) lead a research study that examined a model of data warehousing achievement where they deliberated lengthily the chief issues that affect the success adaption of data warehouse technology. They found a significant relationship among the device high-quality and data first-rate elements and perceived net advantages. It become located that control assist and sources assist to cope with organizational issues that get up at some stage in warehouse implementations; assets, person participation, and fairly-professional mission team participants growth the likelihood that warehousing projects will end on-time, on-finances, with the proper capability; and various, unstandardized source structures and terrible improvement technology will boom the technological issues that undertaking groups should conquer. They argued that organization support and capitals factors assistance to speech structural issues that arise throughout warehouse applications. This study tinted a hole in the works around data warehouse technology does in infrastructure projects and it is obvious that DW is significant areas for future research.

Research Model

Research problem and objectives

This study is important for the Medical Institutions to comprehend the critical issues, which determine the application of the data DWT. Also, there is limited investigation concentrating on the decision-making and strategic features and deliberating the medical manufacturing in general, and in Saudi Arabia in specific, this study is committed to delivering additional insights to supplement the findings from earlier studies. There are two goals of this study including:

1. To observe the important fulfillment elements, so that you can affect the adoption of data warehouse technology in medical institutions.

2. To examine the elements that can be implemented to cause further studies of the adoption of statistics warehouse technology in the Saudi Arabia.

Research model

A large range of factors that can have an impact on the achievement of DWT implementation has been noted in the literature. To develop the research model, the Information Technology

(IT) implementation, Information Systems (IS), and DW works were studied to classify issues that supposedly touch DW achievement. This investigation model comprises the next two sizes as discussed in this research: the structural measurement and technological measurement, as exposed in Fig. 1. The pertinent issues are sorted in all measurement founded on the prior theoretical and empirical investigation deliberated in the literature unit.

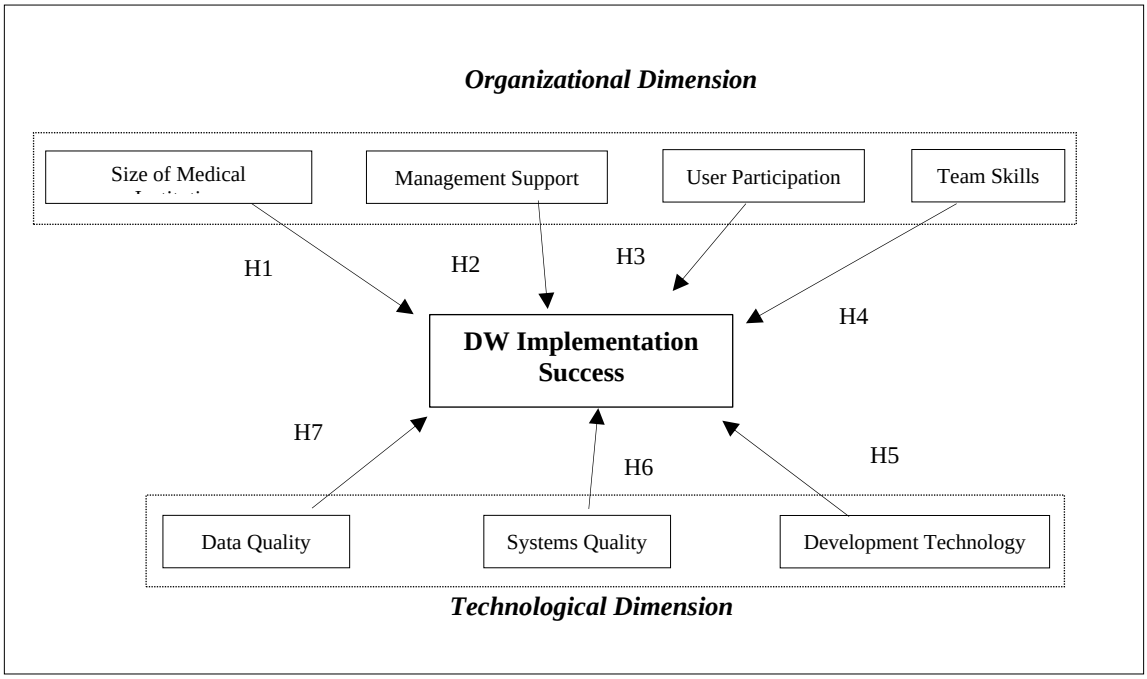

Fig.1. Proposed Research Model

Hypotheses and variables

This research suggests an investigation model and connected hypotheses regarding the most influential factors affecting the acceptance of statistics warehouse technology founded on the data calm after the Saudi's medical institutions.

Organizational dimension

The organizational data time is consuming as well as very expensive and challenging job to get done. In order to overcome unexpected barriers during the execution of the DW certain organizational factors must be taken into attentiveness. This section provides a summary of prior studies that addressed the most significant issues for organizations to reflect throughout

the acceptance of data warehouse technology. Founded on the research model, two sizes are used to measure the issues, which touch the successful implementation of data warehouse technology (Aftab & Siddiqui, 2018; Ariyachandra & Watson, 2010). Top organization provision refers to the promise and provision from older management and key stakeholders. organization provision has been an important issue in many IT implementation literatures (Hopfgartner, Schuetz, & Schrefl, 2017; Zellal & Zaouia, 2016). The scope of the group has been originate to be important issue that affect the adoption and development of DWT. Numerous consequences in the preceding study showed that the superior the scope of the group, the additional capitals and wealth can be assigned to accept novel DWT (Hwang et al., 2004; Rahman, 2017). User participation has increasingly been recognized as an important part of information systems design the last decades. According to (Kulkarni, Robles-Flores, & Popovič, 2017), operator contribution is an structural mutable that means users' energetic involvement in the initial development section and the post-deployment levels that affects the continued improvement and evolution of structures. An investigation of the extant works designates that user contribution positively impact the adaption of DWT development and process (Hwang et al., 2004; Wixom & Watson, 2001). Team skills considered to be a major component of the adaptation of any technology and it includes together practical and interpersonal aptitudes. A side by robust technical and relational services can identify the requirements of complex technical projects and get the job done effectively (Liu & Cross, 2016).

H1. The size of the medical institution touches the adoption of data warehouse technology

H2. The top management support of the medical institution touches the adoption of data warehouse technology

H3. The user participation of the medical institution touches the adoption of data warehouse technology

H4. The team skills of the medical institution touch the adoption of data warehouse technology

Technological dimension

In footings of the technological measurement, three factors of system achievement were designated as existence the greatest suitable for this study: system quality, data quality, and development technology. Empirical studies (e.g., (Wixom & Watson, 2001) (Hayen, Rutashobya, & Vetter, 2007) have found that these factors are related DW success.

H5. The data quality touches the adoption of data warehouse technology in medical institutions

H6. The system quality touches the adoption of data warehouse technology in medical institution

H7. The development technology touches the adoption of data warehouse technology in medical institution

Methodology

Research Design

Being a substantial body of works on issues moving DWT in dissimilar settings proposes a measurable method (Kortüm et al., 2017). A questionnaire-based review was thought to be the greatest real method to fold an outline of Saudi's medical institutions towards DW And related elements. A survey turned into selected because a questionnaire method may be beneficial whilst sources are confined, a big pattern is involved, consent may be obtained, and the nature of the information required, and the size approach are already recognized (Easterby-Smith, Thorpe, & Jackson, 2012). In this study, the research was constrained due to the Covid-19 pandemic and the difficulty of reaching out to a big amount of defendants who were themselves physically discrete. Interaction particulars were calm after the medical institutions and social media by (Blair, Czaja, & Blair, 2013) to checkered that it was unspoken as envisioned.

Data Collection and Study Participants

A link of survey was directed to the participants in the example populace. The example populace comprised names (i.e., CEO/COO/CIO/CFO, Vice President/General Manager, Director, Manager, Controller, Project Manager, Program Manager, Senior Analyst, Data Architect, Data Analyst, Technician Support, Programmer, and Users) who were employed full-time in Saudi Arabian medial institutions. Participants conventional an email that limited a shelter communication that blanketed a hyperlink to the web-based survey and commands to complete the survey at their comfort. The defendant had to solution every question to preserve to the subsequent segment of the survey.

Data Analysis and Discussion of Findings

Demographic Information

A demographic analysis was executed in survey items of gender, age, positions category, and years of knowledge in Medical Institutions in Saudi Arabia. Results presented that males signified 56.8% of the sample (N=81) where women signified 43.2% of the conventional sample. The positions group included titles such as CEO/COO/CIO/CFO, Vice President/General Manager, Director, Manager, Controller, Project Manager, Program Manager, Senior Analyst, Data Architect, Data Analyst, Technician Support, Programmer, and Users. Lastly, the year of involvements group reached from 1 (Less than 1 year), 2 (1–5 years), 3 (6 – 10 years), 4 (11 – 15 years), 5 (16 – 20 years), 6 (21 – 30 years), and 7 (More than 31years). Table 1 Demonstrations a summary of the demographic data analysis of this study.

Table 1. *Demographic Data Analysis (N=81)*

Item	**Frequency**	**Percentage**
Age		
Male	*35*	*56.8%*
Female	*46*	*43.2%*

Type of Medical Institutions		
Government Institution	50	61.7
Private Institution	31	38.3
Current Position		
CEO/COO/CIO/CFO	*10*	*12.3%*
Vice President/General Manager	*7*	*8.6%*
Director/Manager/Controller	*7*	*8.6%*
Project Manager/Program Manager/ Senior Analyst	*20*	*24.7%*
Data Architect/Data Analyst, Technician/Support/Programmer	*13*	*16%*
Users	*22*	*27.2%*
Other	*2*	*2%*
Years of Experiences		
1–5 years	*22*	*27.2%*
6 – 10 years	*15*	*18.5%*
11 – 15 years	*14*	*17.3%*
6 – 20 years	*8*	*9.9%*
21 – 30 years	*14*	*17.3%*
More than 31	*8*	*9.9%*

Validity and reliability Analysis

A prior to facts evaluation, the studies device was assessed for its reliability in addition to assemble validity. Cronbach's Alpha become used to measure the inner constancy of each the character and structural concepts. The organizational concepts comprised objects connected to the next variables: size of the medical institution, top organization support, organizational resources, user participation, team skills. The technological concepts also comprised substances connected to the next variables: data quality, system quality, and development technology. In this investigation study, the Cronbach's Alpha for altogether concepts were overhead the satisfactory advantage of 0.7. but the construct of Technological Dimension was at 0.60. The removed nasty alteration (AVE) was too intended to amount the meeting cogency. The consequence, as exposed, is that the AVE standards for altogether mixtures are abundant advanced than 0.50 as it was recommended by (Hair Jr, Hult, Ringle, & Sarstedt, 2021).

Table 1. *Results of the reliability and validity tests (N = 81)*

Construct Category	**No. items**	**Cronbach's Alpha**	**Composite Reliability**	**AVE**
Size of Medical institution	2	0.78	0.80	0.70
Management Support	5	0.91	0.90	0.70
User Participants	4	0.85	0.86	0.61
Team Skills	2	0.90	0.91	0.84
Data Quality	4	0.88	0.89	0.67
System Quality	4	0.90	0.91	0.70
Development Technology	2	0.82	0.84	0.71
DWT Succuss	3	0.80	0.82	0.60

Table 2: Cross–loading (N =81)

	SDW	**DQ**	**TD**	**MS**	**SM**	**SQ**	**TS**	**UP**
SDW_2	0.892							
SDW_1	0.768							
SDW_3	0.586							
DQ_1		0.825						
DQ_2		0.827						
DQ_3		0.871						
DQ_4		0.75						
DT_1			0.784					
DT_2			0.902					
MS_1				0.767				
MS_2				0.778				
MS_3				0.808				
MS_4				0.824				
MS_5				0.837				
ODS_1								
ODS_2								
SMI_1					0.847			
SMI_2					0.753			
SQ_1						0.773		
SQ_2						0.777		
SQ_3						0.886		
SQ_4						0.914		
TDS_1								
TDS_2							.	
TS_1							0.95	
TS_2							0.89	
UP_1								0.824
UP_2								0.603

UP_3	0.851
UP_4	0.799

Table 3: Results of PLS analysis (N = 81)

Hypotheses	PLS path coefficient	T Statistics	Decision	P Values
SMI -> DWTS	0.279	12.779	Supported	0.000
MS -> DWTS	0.833	15.809	Supported	0.000
UP-> DWTS	0.702	8.423	Supported	0.000
TS -> DWTS	0.97	11.189	Supported	0.000
DQ -> DWTS	0.9	15.41	Supported	0.000
SQ -> DWTS	1.03	27.259	Supported	0.000
DT -> DWTS	0.58	1.3	Supported	0.000

P<0.1. P<0.05.

Findings and discussion

Organizational Dimension

The link between organizational dimensions including the size of medical institution, Management Support, Team Skills, and User Participants have been well documented (Hopfgartner et al., 2017; Hwang et al., 2004; Inmon et al., 2010). In this research, a much less pronounced relationship (0.2) between the size of medical institution and the success implementation of Data Warehouse Technology (H1). While Management Support demonstrated a strong positive relationship with the success implementation of Data Warehouse Technology (H2). The pronounced relationship (0.7) between the User Participants and the success implementation of Data Warehouse Technology was strong (H3). The relationship between Team Skills and the success implementation of Data Warehouse Technology (H4) was the strongest amongst the organizational issues. This was designated by a standardized constant of 0.97.

Technological Dimension

Prior research showed that Technological Dimension including Data Quality, System Quality, and development of technology production an significant role in successful implantation of the data warehouse technology (Rahman, 2016; Strutt & Helal, 2002; Zellal & Zaouia, 2016). Indeed, System Quality were a greater influence on the success implementation of Data Warehouse than the other factors (H6) with standardized coefficient of (1.03). Data Quality was found to have a positive effect on successful implantation of the data warehouse technology (H5) with standardized coefficient of (0.9). Finally, there was a fairly positive link between development of technology and success implementation of Data Warehouse (H7), but this was much less pronounced among the other components.

Implication and Limitation

The findings of this study donate to the current body of information by providing empirical support for investigating both structural and technological issues that touch the succuss application of Data Warehouse technology in the medical field. However, the investigation is incomplete by its emphasis on Saudi Medical institutions as units of analysis. Furthermore, 81 participants have participated in this research due to the Covid-19 and the difficulty to reach out to a larger audience.

Conclusions

This paper depicts a problem regarding the complexity of the data in medical institutions in Saudi Arabia. Despite the substantial body of investigation into data warehouse technology in the business environment, research that investigates it in medical institutions is usually limited, but particularly in Saudi Arabia. In this study, a cross-sectional survey was used to investigate a model of data warehousing success particularly in a single intensive industry such as medical institutions. The findings of the study show that certain variables in both organizational and technological dimensions have a significant influence on data warehousing success.

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