Utilization of Business Intelligence Tools among Business Intelligence Users

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Abstract

The study was an investigation of the impact of perceived usefulness and perceived ease of use of business intelligence (BI) tools among users. The relationship between and among the dependent variable (utilization of BI tools) and the independent variables (perceived usefulness and perceived ease of use) was investigated through the lenses of technology acceptance model (TAM). Other objectives for the current research were to build a model to predict users' utilization of the independent variables, and to generalize the results of the research to the IT population. Data for the current research was collected utilizing a survey questionnaire, designed by the researcher, with a 5-point Likert scale to interpret responses to the survey questions. The analysis consisted of descriptive statistics and multiple regressions models. A prediction model was structured using generalized linear models. The result of the study was the development of a prediction model for BI tools utilization through the lenses of a technology acceptance model (TAM). The model highlighted the importance of up-to-date information provided by current BI tools, ability of BI tools to provide users with more analytical tools to accomplish their jobs, the degree to which BI tools allow users to present convincing arguments, the ability of BI tools to provide users with more possible solutions, the ability of BI tools to reduce the time required to accomplish jobs, and the ability of BI tools to help users make relevant business predictions.

Introduction

Business intelligence (BI) is an umbrella term for technologies, applications, and processes for gathering, organizing, storing, reporting, and analyzing data. BI includes databases, data marts, and data warehouses to integrate, store, and analyze data. Tools are available to cleanse; standardize; extract, transform, and load (ETL) data; and tools are used for reporting, dash boarding, visualization, data and text mining, predictive analytics, enterprise performance management, and decision support systems [1]. Making smart decisions based on factual data to achieve and sustain a business competitive advantage is the main reason behind investing in BI tools and technologies by providing decision makers with effective, clear, and timely information about the internal and external factors affecting an enterprise's products, services, and customers. All these factors play major role in the ability of an enterprise to succeed and even to survive in a dynamic and rapidly changing environment [2].

Members of organizations, regardless of their level, must not rely on intuition only. Decision-making processes must be well supported by reliable and high-quality information about an organization that can

be accessed when needed. Gathering the data in today's world is relatively easy; converting the data into useful information is the challenge organizations are facing. Other challenges include presenting the information in a common business language that is simple, and does not require expert technical knowledge or direct communications. Regardless of the processed data, information in the system must be of high quality, accurate, timely, and clear. [3] stated that the greater the difference between the effects of good and bad decisions, the greater the importance of possessing reliable and quality information in an organization system.

Problem Background

Howard Dresner, a researcher from Gartner group, introduced business Intelligence as a concept in the 1980's [4]. Factors such as rapid development of information systems (IS) field, intense competition, complexity of business data, and the desire for consistent decision-making criteria have been the driving forces behind business organizations adoption of BI tools into their processes [5]. Organizations use business intelligence tools to improve performance, to make smart decisions, and to increase profits [5]. BI is also used to meet or exceed customer expectations by better serving their needs. Organizations are increasingly relying on BI tools in their processes and operations. [6] indicated that the total investment in BI tools is approximately $50 billion a year, and the total is steadily growing with introduction of new desktop analysis tools, data mining, and data warehousing techniques, data extraction, and many other tools.

Business organizations are consistently showing interest in investing in BI tools. These organizations are seeking to achieve consistency in the decision-making process by basing the process on facts and intelligent information. In addition, by acquiring and investing in BI tools organizations hope to utilize a return in areas such as efficiency,

productivity, and customer satisfaction [7]. However, recent studies showed that business users—power users and end users—are using no more than 20% of BI tools proactively and efficiently in accomplishing their tasks. [8]noted that there is a wide gap between two types of BI users: power users and end users. He added BI tools' promising benefits are achieved when end users and frontline employees start to utilize BI tools.

In a highly competitive environment, executives and upper-level managers are not the only ones who need access to business intelligence; business unit managers, sales and marketing personnel, suppliers, vendors, customers, and other members of an organization must have updated information to do their jobs and related tasks. Regardless of the user of BI, the demands remain the same; everyone wants a flexible, easy to use, and to understand tools and techniques that provide users with the information they need in a timely, accurate, and secure way. These requirements are demanding BI tools capable of aligning business processes with live data to provide business intelligence at all levels of an organization, and use intuitive and easy visuals for delivering information to power- and end-users. The ability of an organization to deliver the access for quality information to its members increases the success and competitive advantage for the organization over time, under changing circumstances.

[9] noted that the expected benefits from investing in IT tools are realized only when they are adopted by their intended users. Users' acceptance of BI tools is one of the most important requirements to satisfy [10]. [11] Noted that users may become quickly frustrated and may abandon new applications when they perceive those applications as confusing, requiring much effort, or as too complex to use.

Problem Statement

In rapidly changing markets and environment, decisions are made by many members in organizations. BI users: power users and end users, theoretically, must complete one another. The power user's job is to produce information and to make tactical and strategic decisions for the organization; while the end user's job is to use the information provided by the power users to make day-to-day decisions. Users demand high quality, clear, and simple information that is easy to extract and use to make the right decisions. BI tools are intended to help users in getting the information they need to make the right decisions. Regardless of the amount of investment in BI tools, users at different levels still consider and perceive BI tools as complex and difficult to use [8][10]. This suggests that there is a gap between deployment and utilization of BI tools between power users and end users. The current research served to investigate the impact of perceived usefulness and perceived ease of use on BI tools utilization among those users.

Purpose of the Study

The researcher investigated some of the factors that influence the utilization of BI tools by studying a sample of BI users, which included power users and end users. The study included a technology acceptance model (TAM) with its constructs (PEOU and PU) as a main framework to study the relationship between and among the research variables. Integrated into the TAM's two constructs were five extraneous variables: information quality, age, experience, social influence, and job relevance. The researcher derived these variables mainly from IDT and related literature on the research subject.

Model Summary

Utilization of BI tools = PU + PEOU

PU= Social Influences + Job Relevance

PEOU= Information Quality + Experience + Age

Research Model

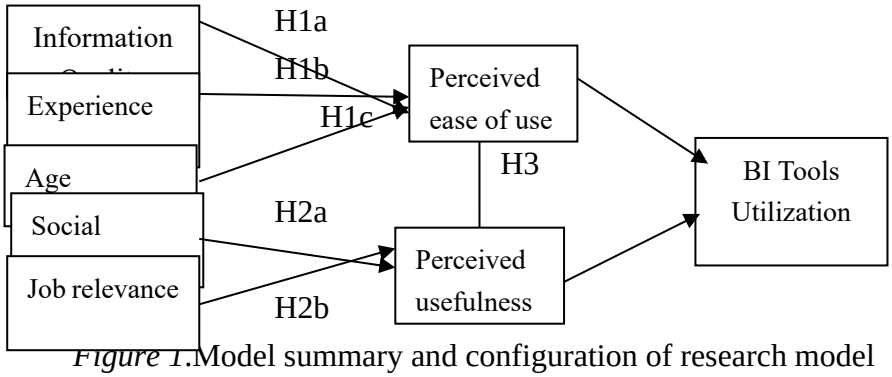

Figure 1.Model summary and configuration of research model

Research Question: The research question for this study was as follows:

What are the impacts of perceived usefulness and perceived ease of use on business intelligence tools utilization rate among BI users: power and end users?

Research Hypotheses: The current research included three hypotheses:

H1: Users' perception of ease-of-use of BI tools has an impact on BI tools utilization.

H1a: Information quality has an impact on users' perception of BI tools ease-of-use.

H1b: Users' experience has an impact on their perception of BI tools ease-of-use.

H1c: Users' age has an impact on their perception of BI tools ease-of-use.

H2: Users' perception of the usefulness of BI tools has an impact on BI tools utilization.

H2a: Social influence has an impact on users' perception of BI tools usefulness.

H2b: Job relevance has an impact on BI users' perception of BI tools usefulness.

H3: Perceived ease-of-use has an impact on perceived usefulness.

Significance of the Study

Given the fact that organizations invest vast amounts of resources in the development and adoption of BI tools, and the fact of low utilization of these tools by the intended users, the importance of understanding BI tools utilization by users arises. This study may contribute to the body of knowledge in both the field of business management and management information systems by explaining additional factors of why intended users of information systems reject or avoid utilizing new technologies and tools.

Most of the previous studies attempted to justify the investments in BI tools, investigated the benefits of adopting of BI tools, or investigated the factors that motivate and guarantee the success of implementing BI tools in organizations [12][11][9]. Little has been said about the factors that influence BI (end and power) users' perceptions of these tools and the factors influencing users' utilization rate of these tools, so this current researcher investigated these factors through the lenses of TAM and IDT. The knowledge of why new systems are rejected or avoided leads to better system designs, implementation, and better returns on investment. In addition, results of the study may benefit organization managers and leaders in their efforts to increase the rate of utilization of BI tools. In addition, the study serves to acknowledge the findings of other researchers and to build on these findings from a managerial perspective.

LITERATURE REVIEW

Business Intelligence: The present and the future business environment is increasingly dependent on speed, accuracy, timing, and collaborative inter-organizational decision-making [13]. One of the technologies allowing organization members to do so is business intelligence tools. To ensure high-quality decisions, vast amounts of internal and external business data must be integrated and converted into useful information in the lowest possible costs and time to offer decision-makers and organizations significant competitive advantage.

BI tools are playing a major role in improving performance, competitive advantage, and achieving business sustainability. BI is a high-growth field; more and more users are realizing the benefits of such tools, techniques, and software and are demanding more features and access to organizational information to be

able to compete. BI users are in need of continuous support to meet and cope with a constantly changing environment. Operational systems have specific requirements and implementation timelines.
In most cases, success and failure of operational systems can be measured by assigning measurement factors and criteria [14]. BI tools and technologies, on the other hand, have complexities in the implementation, have no clear picture available for factors of success and failure, and no single measurement exists for success. To evaluate BI success, measures have to be developed according to the research objectives and the factors to be investigated.

Business Intelligence Organizational and Technological Definitions

Howard Dresner, a researcher from Gartner Research Group, introduced the term BI in the 1980s. BI is a broad term representing a collection of processes, tools, and technologies helpful in achieving more organizational performance, productivity, profits, and sales and services. BI tools help in organizing and analyzing organizational data in a better way by converting data into intelligent information that can be used by power and end users to make better and faster business decisions [4]. BI refers to integrated systems that provide users with access to and storage capabilities of organizational information that can be helpful in making the right decision at the right time. BI tools are those applications and technologies that are used to collect, capture, access, consolidate, and analyze information to improve decision-making process at different levels in the organization and to capture important metrics on business operation and stakeholders [15].

Organizational Definitions

Various definitions exist in the literature for business intelligence. These definitions reflect either technological or organizational perspective depending on the background of the researcher. Organizationally, BI tools are concepts, methods, and processes used to support the realization of firm's strategy [16]. BI is an umbrella term for decision support [17]. BI tools are means to provide results from collected and analyzed business data to be used in the business domain [18]. Tools help individuals in managing vast quantities of data and to make decisions about organization processes [1]. According to [19] BI tools are used in the process of analyzing organizational information to achieve productivity, efficiency, and more profits by making better decisions in management, measurements, and optimization. [20] Defined BI as a combination of products, technology, and methods to analyze and organize key information that managers and decision makers need to improve organization profit and performance. Finally, Jourdan, Rainer, and [21] Defined business intelligence from an organizational perspective as both a process and product used to transform data into useful information, which can be used by organizations to survive in the global economy and to predict the behavior of the general business environment.

Technological Definitions

Technologically, Dresner defined BI as an umbrella term to describe concepts and methods used to improve business decision-making processes using facts and relevant information. [17] Defined BI as an architecture and a collection of integrated operational, decision support applications, and databases that provide business users and decision-makers easy access to organizational data. [18] Defined BI as a system that

integrates data collection, data storage, and knowledge management with analytical tools. The objective of the system as a whole is to help decision-makers in converting complex data into useful information that can help in achieving and sustaining an organization competitive advantage. According to [5], BI tools are systems that transform data into various information products. [19] Defined BI as an umbrella term that includes data warehousing, reporting, analytical processing, performance management, and predictive analysis that, all together, help and increase the total performance of decision-makers and the business organization.

Regardless of the background of the researcher, [5] noted that the concept of BI could be defined and viewed as a set of tools presenting historical data; users can analyze to make decisions for the present and predict future trends. The main goal of using these tools is to help users in making decisions regarding products, services, and processes based on facts, in a timely manner, to survive and be able to compete.

Business Intelligence Success Factors

Business intelligence tools are one of the information system (IS) categories. The success of BI tools and IS is a function of the benefits that can be attained from these tools. The concept of IS success has been researched widely in the literature. Various variables have been used to explain the benefits of utilization such as technological factors, system quality [20], usage by intended users [21], and organizational financial and operational benefits [22].

[23] Identified six main factors that have been used by researcher to investigate and measure BI success. These factors are system quality, system use, users' satisfaction, individual factors, and organizational factors. [24] Categorized these six factors into three broad categories of system-related characteristics, user characteristics, and organizational impact characteristics. In reviewing the literature related to BI success, the current researcher noted that some researchers used one or more factors to study BI success factors. The current research was not conducted to measure or investigate BI success factors. The main concern of the current researcher was to investigate the perceptions of system users in one of the three broad categories noted by [24]. The current researcher attempted to investigate end users' and power users' perceptions of the benefits and advantages of utilizing BI tools.

Dimensions of Technology Adoption

Vast literature exists about the factors that affect adoption in general, and technology adoption in specific. Reviewing the literature and previous research revealed a number of factors affecting the rate of adoption of technology in the IS field and other fields as well. Most of these factors included focus on topics such as top management or executive support, organization structure, organization culture, resources, vendors, external IT consultants and technical personnel. Most of the research conducted in the field of technology and adoption of BI technologies has a focus on the subject from organizational adoption perspectives, targeting the benefits of adopting BI tools in organizations, and the success and failure of adopting BI tools. Little literature exists to compare between BI tools users, and adoption dimensions from BI users' perspective.

[25] Examined the factors affecting BI adoption in private and public institutions of higher education (IHE). Their primary question was whether there is any difference in adopting BI tools between IHE and business

corporations. To answer the question, they proposed 10 factors they believed to have influence on BI adoption. The ten factors investigated were divided into three groups. The first group is technology factors such as perceived costs, benefits, and perceived complexity. The second group is organizational factors such as organization size, ownership structure, absorptive capacity, and executive support. The last group was environmental factors, which included organizational legitimacy, competitive advantage, and stakeholder support. The results of the research revealed that seven of the proposed factors—organizational structure, size, absorption capacity, organizational legitimacy, stakeholder support, perceived costs, and perceived complexity—were significant determinants of BI adoption in IHE.

[26] Analyzed the factors affecting the adaptation of new technologies in small and medium enterprises (SMEs) using studies from different databases with a high concentration of issues related to SMEs. The researchers proposed a framework to represent the factors affecting SMEs adoption to new technologies. The proposed framework divided the factors into external and internal factors. The external factors were customers or suppliers, competitive environment, external IT consultants and vendors, and government. The internal factors were owner, manager or CEO, resources, end users, IT solution (computer application) degree of complexity, and organizational behavior and structure. Ghobakhloo et al. used many studies done by other researchers on the adoption subject.

[21] Conducted research with the main goal of pursuing better measures for predicting and explaining the use of technology. The outcome of the research was the technology acceptance model (TAM), which was based on two theoretical constructs: perceived usefulness (PU) and perceived ease of use (PEOU). The model has been used widely to explain the adoption process for technology and innovations in many fields. Davis explained PU as the extent to which users believe that using the new system will help them perform their jobs better. Davis explained that when users perceived a system as useful, they tend to use it. PEOU, in contrast, refers to "the degree to which a person believes that using a particular system would be free of effort." Davis explained that with all else being equal, the perception of users for a particular application as easier than another one will most likely make that application more accepted and used. In contrast, difficulty or complexity of a system make users to stop or avoid using the system.

The Current Study

The main objective in the current study was to investigate the impact of perceived ease-of-use and perceived usefulness of BI tools and users' perceptions of utilization of BI tools. The other objective was to generalize the results of the study to the population.

Measuring BI Tools Utilization

The researcher investigated business intelligence tools utilization through the lenses of TAM. Using TAM constructs, the research had the following three main hypotheses:

H1: Users' perceptions of BI tools as easy-to-use tools have impact on their utilization of these tools.

H2: Users' perceptions of BI tools as useful tools have impact on their utilization of these tools.

H3: Users' perceptions of BI tools ease of use have an impact on their perceptions of usefulness of these tools.

Measuring Ease-of-Use

Perceived ease-of-use (PEOU) in the current study is the degree to which business intelligence users perceive that using BI tools will be free of effort. This factor, as noted by Davis (1989), is influenced by external factors. The current researcher expected the extraneous factors gleaned from the literature to have an influence on PEOU: information quality, user age, and user experience. The researcher anticipated the expected relationship between perceived ease-of-use and the previous three factors to be in the following three sub-hypotheses:

H1a: Information quality has impact on users' perception of ease-of-use.

H1b: Users' experience with using BI tools has impact on ease-of-use.

H1c: Users' age has an impact on BI tools.

Measuring Usefulness

Perceived usefulness (PU) in this research is defined as the degree to which business intelligence tools users perceive that using BI tools will increase his or her job performance. This construct is impacted by social influences and job relevance. The expected relationship between the previous variables and perceived usefulness is hypothesized by the following two hypotheses:

H2a: Social influences have an impact on users' perceptions of BI tools usefulness.

H3b: Job relevance has an impact on users' perceptions of BI tools usefulness.

The researcher measured information quality by asking participants questions related to information accuracy and whether it is up-to-date, easy to understand, easy to analyze; if there are errors; and how close it is to reality. The researcher measured social influences using items such as how users see themselves as valuable; if BI tools improve their status and how other people are seeing them; and if BI tools allow them to be more collaborative with others.

METHODOLOGY: Research Method and Design

Identifying the population of interest is an important first step before selecting the sample. The process of identifying the population includes identifying the group of interest in the research topic, determining the geographical areas where the group can be found, and if necessary, the period of interest [26]. The population of the current research consisted of the IS/IT community, which includes managers, power users, end users, consultants, and executives. The geographic location for the population is organizations within the United States, which use BI tools. Identifying this population helped the researcher to accomplish the main research objective, which was to determine the factors influencing the utilization rate of BI tools, and compare the influence of these factors on end- and power-users.

Sampling Method

The researcher used the probability sampling method (random sampling method in specific). In doing so, the researcher had to meet some criteria such as the ensuring accuracy in including the individuals of interest, using complete and current data, and ensuring that data was not duplicated. In addition,

researcher had to make sure that data did not contain any patterns, and the sample size provided enough confidence to generalize the results to the population.

Sample Size

In the current research, the anticipated sample size was 100–150 cases, to allow the researcher to conduct the necessary statistical tests and to generalize the results obtained from the sample to the whole population.

Instrumentation

The researcher designed the survey for the current research. The survey consists of four sections. The first section is demographic and intended to collect data about participants' age, years of experience, sex, education level, and position in the firm. The second section consists of questions to measure the first independent variable (PU) with its components. The third section contains questions to measure the second independent variable (PEOU) with its components.

The researcher refined the survey in several steps. Initially, several management information systems and information technology experts reviewed the wording and content of the survey questions. Based on their suggestions and feedback, the researcher added, removed, or changed survey questions. Then, the researcher conducted a pilot study using a number of BI tools professionals who have experience with and use BI tools (35 participants). The researcher conducted a factor analysis on the pilot study sample to insure that questions were loading into their assigned constructs. Finally, the researcher finalized the survey questionnaires and sent them to participants using the commercial service provider, Survey Monkey.

RESULTS AND ANALYSIS

Survey Constructs: The survey consisted of 40 questions, and was refined in several steps to insure reliability and validity. The researcher measured information quality as a construct by dimensions such as the degree to which current BI information is up-to-date, precise, and contains few errors; information is to the point, does not contain contradiction, and does not require a lot of processing time (Questions 7, 8, 10, 11, and 12). Measurement of age and experience was by years (Questions 39 and 40). PEOU was measured by the degree to which analyzing BI tools information is easy, and by the degree to which BI tools provide users with the ease of analysis (Questions 9 and 13).

The researcher measured the social influence construct by the degree to which users believe that utilizing BI tools make them seem as more valuable members in their organizations, and the degree to which utilizing BI tools help these employees to make relevant business predictions for their organizations (Questions 20 and 30). The researcher measured the job relevance construct by the degree to which utilizing BI tools increase users' key performance indicators, provide users with analytical tools to accomplish their jobs, increase the speed of information analysis, provide more possible business solutions, and reduce the time required to accomplish users' tasks (Questions 21, 26, 27, 28, 29, and 30). Finally, the researcher measured PU by the degree to which users believe that utilizing BI tools allow for more collaborative decisions, improve knowledge and understanding of organization objectives, allow for

presenting more convincing arguments, and improve the quality of decisions made by organizations users (Questions 22, 23, 24, and 25).

Descriptive Statistics

The researcher received 115 responses from Survey Monkey, with seven of the surveys excluded from the analysis due to missing answers to one or multiple questions in the survey, which were identified by the researcher as key questions in the research. Altogether, 108 surveys were used for the analysis of this research, with 76 for the end-user group and 32 for the power-user group. The end-user group contained 19 participants between the ages of 20–30 years, 24 between the ages of 31–40, 29 between the ages of 41–50, and four over the age of 50 years. The power user group age distribution was two between the ages of 20–30 years, six between the ages of 31–40, 18 between the ages of 41–50, and six over the age of 50 years

The end-user group experience distribution was two participants with 1–3 years of experience, 45 with 4–7 years, and 29 with more than 7 years. The power-user group included two participants with 1–3 years, 11 with 4–7 years, and 19 with more than 7 years.

The researcher asked participants to provide answers for several questions in the survey to the best of their knowledge. Participants were asked about the percentage of employees who have access to BI tools in their organizations. The results indicated 44.4% believed that only 1–25% of employees have access to BI tools in their organizations. Participants provided approximate percentages for the employees who use BI tools without IT assistant, and the results indicated that 36.1% of respondents answered that 1–20% of employees use BI tools without an IT assistant. Finally, based on results of the survey, 30.6% of respondents indicated that when they have access to BI tools, they will use them with 61–80%.

Inferential Statistics

The researcher divided the research model into two parts. In the first part, the researcher tested three extraneous variables: information quality, age, and experience against PEOU (Hypothesis 1). In the second part, the researcher tested job relevance and social influences against PU (Hypothesis 2). Then, the researcher tested the relationship between PEOU and PU. Following that, the researcher tested PEOU and PU as independent variables against the dependent variable, utilization. Finally, the researcher tested all research variables as independent variables for the model dependent variable, utilization, in an attempt to explain more variance with a better prediction model. The remainder of this chapter includes explanation of and details regarding the inferential statistics.

The first Part of the Model: The researcher used multiple regressions to test the research hypotheses. For the first part of the research model, PEOU was the dependent variable for three extraneous variables: information quality, age, and experience. PEOU was the dependent variable, which is a composite variable of two questions (9 and 13). In Question 9, participants indicated their level of agreement on a scale from 1–5 with the statement that it is not easy to analyze current BI tools information. For Question 13, participants indicated their level of agreement with whether current BI tools provided them with the ease of analyses. Questions 39 and 40 served to measure the independent variables, age and experience.

Five dimensions were used for the independent variable, information quality. Question 7 was the degree to which current BI tools provide users with information that is up-to-date. Question 8 was the degree to which current BI tools provide information that is precise and contains less error. Question 10 was the degree to which information delivered by current BI tools is contradictory. Question 11 was the degree to which current BI tools information is not to the point. Finally, Question 12 was the degree to which processing current BI tools information requires time.

The researcher conducted a multiple regressions analysis to examine BI users' age, experience, and information quality as predictors of PEOU. Initial results indicated a statistically significant model.

The researcher ran further regressions, eliminating the following questions in order: age, Q12, Q10, experience, and Q7. The researcher was left with the final model $F(2,107) = 24.97$, $P < 0.001$ with questions 8 and 11 used as predictors for PEOU, $R^2 = 0.309$.

The researcher ran a second multiple regression analysis to examine the variables age, experience, and information quality as predictors for users' utilization of BI tools, which was represented in the analysis by a composite variable (COPM 31_32). In Question 31, participants provided a percentage for the people who utilize BI tools in their organizations. For Question 32, participants indicated the percentage of their actual utilization of BI tools. The following tables show the initial results of the regressions, which indicate a statistically significant model, where $F(7,107) = 3.566$, $P<0.001$, $R^2=0.144$.

The researcher conducted further regressions on the model, removing the non-significant predictors, which indicated that the model is statistically significant, where $F(3,107) = 7.936$, $P<0.001$, $R^2=0.163$. Tables 14, 15, and 16 show the previous results.

The researcher ran a third regression to examine the relationship between PEOU (COMP 9_13) and utilization (COMP 31_32). The results of the analysis are as follows: $F(1,107) = 0.248$, $R^2 = -0.007$.

The second part of the model: The dependent variable, perceived usefulness (PU), is a composite variable (COMP 22_25); independent variables used as predictors are questions 20, 21, 26, 27, 28, 29, and 30.

Conducting regressions using the previous variables resulted in an initial statistically significant model, where $F(7,107) = 21.153$, $P< 0.001$, $R^2=0.569$.

The researcher conducted three further regressions analyses; each time the researcher removed the question with the highest non-significance value and tested the model again to see if more variance would be explained. The researcher removed Questions 29, 21, and 27 by order. The final model served to explain more variance ($R^2= 0.570$), $F(4,107) = 36.411$, and $P < 0.001$.

The researcher conducted further regression analyses to examine the relationship between all the items of the two independent variables (social influences and job relevance) and the COMP31_32 variable, which represents users' utilization in the research model. The researcher obtained the following results from the test: $F(7,107) = 5.197$, $R^2=0.215$, $P < 0.001$. Additionally, the researcher conducted further regression analyses by removing non-significant items from the model. Items were removed in the order of Q21, Q29, Q30, and the results of the improved model are $F(4,107) = 8.497$, $R^2= 0.219$, $P <0.001$.

Testing the Relationship between PEOU and PU: the researcher examined the relationship between PEOU and PU in two different ways: first the researcher conducted a regression analysis using (COMP 9_13) as the independent variable for (COMP 22_25). The results indicated that F (1,107) = 6.290, R^2= 0.047, P <0.001

The researcher conducted the second test by using all the variables in PEOU as independent variables (predictors) for PU as a dependent composite variable. F (7,107) = 6.290, R^2= 0.311

The researcher conducted further analyses on the previous regressions by removing the following items: age, Q12, Q11, experience, and Q7. The resulting model has R^2 = 0.296, F (2, 107) = 23.494

Testing PEOU and PU against users' Utilization: In this part of research model analysis, the researcher predicted users' utilization of BI tools using two predictors (COMP 9_13 and COMP 22_25); then predicted users' utilization of BI tools using all the items in PEOU and PU variables. When the researcher conducted the test using the composite variables, the results were as follows: F (2,107) = 7.793, R^2 = 0.113. Further analysis, which included removing COMP 9_13, indicated that R^2 = 0.120, F (1,107) = 15.539

After removing the non-significant variables from the model, which were removed in the following order: Q21, Q10, Q25, Q13, Q20, Q11, age, Q9, Q23, Q22, Q27, experience, Q8, and Q12; the significant questions were Q7, Q24, Q26, Q28, Q29, Q30. The results of the final regression indicated R^2= 0.257, F (6,107) = 7.18, P < 0.001

DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

Hypothesis One

Hypothesis one was that users' perception of ease of use of BI tools impacts users' utilization of these tools. Three extraneous variables—information quality, age, and experience—were hypothesized to have an impact on perceived ease-of-use (PEOU). The researcher conducted multiple regression analyses in three different ways, as the results section in the previous chapter showed. The first test showed that age and experience were significant in predicting PEOU, R^2= 0.144. In the second test, the researcher used information quality, age, and experience to predict utilization, and the results showed that age was not significant, R^2= 0.163. In the third test, the researcher used PEOU, a composite variable, as a predictor for users' utilization, and results showed R^2= 0.007.

Conclusion One

The result of the third regressions, which showed R^2= 0.007, where PEOU was used to predict utilization is not an indication of weakness in the research model. As shown in the first regressions, when information quality, age, and experience were used as predictors for PEOU, the resulting R^2 was 0.144. In addition, as shown in the second regressions, when information quality, age, and experience were used to predict utilization, the resulting R^2 was 0.163. Based on these analyses, the researcher concluded that survey questions related to information quality must be revised in future research and more precise questions have to be asked in addition to the two significant questions that were found to be effective.

The age and the experience variables were not significant in the current research results. This is a logical conclusion, because the researcher used a population that contained two groups of users: power- and end-users. Age and experience may be found to be significant in the model if the research question is a comparison question between two groups. In this case, the sample must be divided into two groups and the analyses must be done on each group separately.

Hypothesis Two

Hypothesis two was that perceived usefulness (PU) impacts users' utilization of BI tools. Two extraneous variables—social influences and job relevance—were hypothesized to have impact on PU. The findings of hypothesis two indicated that PU was significantly impacted by the two factors: social influences and job relevance. The resultant final model had R^2=0.570 at 95% confidence interval with P<0.001. The factors that were found to be significant are as follows:

Q20: The degree to which utilizing BI tools make the user seem as a more valuable member in the organization.

Q26: The degree to which BI tools provide users with analytical tools that can be used to accomplish their jobs.

Q28: The degree to which utilizing BI tools allows users to think of more possible solutions.

Q30: The degree to which utilizing BI tools help users in making relevant business predictions.

The final model for Hypothesis 2 was,

PU= 1.32 + 0.266*Q20 + 0.262*Q26 +0.287*Q28 + 0.206*Q30.

Predicting users' utilization of BI tools, using social influence and job relevance as independent variables for utilization, yielded R^2= 0.219. Several dimensions had to be removed from the dimensions to arrive at the previous result. The final model for predicting users' utilization using social influences and job relevance was as follows:

Utilization= -0.739+ 0.193*Q20 – 0.222*Q26+ 0.289*Q27+ 0.308*Q28

Conclusion Two

The results of the regressions on the second part of the research model, when social influences and job relevance were the predictors for PU, indicated a strong model with R^2= 0.570. Predicting users' utilization of BI tools, using the two dimensions job relevance and social influences, yielded R^2= 0.219. Noting that four out of the proposed 10 questions were significant in two previous final models. The researcher concluded that adding more questions to the significant dimensions may lead to a better prediction model for users' utilization of BI tools.

Hypothesis Three: PEOU Impact on PU

The third hypothesis was that perceived ease of use impacts perceived usefulness, as indicated by TAM. In examining the relationship between PEOU and PU, the researcher investigated the impact of PEOU factors on PU. The resultant model indicated that PEOU impacts PU. In specific, two factors were found to be significant with R^2= 0.296. The two factors were

Q8: The degree to which BI tools provide information that is precise and contains less errors

Q10: The degree to which BI information is less contradictory.

Age and experience were not significant at 95% confidence interval. The resultant final model was as follows:

PU= 3.591 + 0.401*Q8 – 0.358*Q10.

Conclusion Three: PEOU Impact on PU

Explaining the 0.296 of variance in predicting PU from PEOU dimensions with two significant questions led the researcher to confirm the first conclusion of the research. More questions that are relevant have to be added to information quality dimension in future work to achieve a better prediction model.

Hypothesis Three: PEOU & PU as Predictors of Utilization

The researcher used PEOU and PU to predict users' utilization of BI tools, and the resultant model had R^2= 0.12 at 95% confidence interval and P<0.001. When all extraneous factors were used to predict users' utilization of BI tools, the model improved and the result was R^2= 0.257 at 95% confidence interval and P<0.001. The factors that the researcher found significant in predicting users' utilization of BI tools were as follows:

Q7: The degree to which BI tools provide users with up-to-date information.

Q24: The degree to which BI tools allow users to present their arguments more convincingly.

Q26: The degree to which BI tools provide users with great analytical tools that can be used to accomplish their jobs.

Q28: The degree to which BI tools allow users to think about more possible solutions.

Q29: The degree to which utilizing BI tools reduces the time required to accomplish one's task.

Q30: The degree to which BI tools help in making relative business predictions.

Two of the extraneous variables that the researcher integrated to the model—age and experience—were found to be non-significant, and the researcher found three of the extraneous variables—information quality, job relevance, and social influences—to be significant at 95% confidence interval and P< 0.001. The final model had R^2=0.257, and was as follows:

BI Utilization = -0.912 + 0.196*Q7 + 0.306*Q24 – 0.226*Q26 + 0.301*Q28 + 0.318*Q29 – 0.294*Q30.

Conclusion Three: PEOU & PU as Predictors of Utilization

The researcher found six dimensions to be significant in predicting users' utilization of BI tools from PEOU and PU. The researcher concluded that survey questions must be refined by removing all non-significant questions and adding more relevant questions.

Summary of Statistical Results

The study included 115 IS/IT participants. Seven surveys were excluded from the analysis due to missing answers to some of the key questions in the survey. The researcher conducted the analysis on 108 participants. Descriptive statistics showed that 76 participants were end users and 32 were power users. The age distribution for end users was 25% between the ages of 20–30 years, 31.6% between 31–40 years, 38.2% between 41–50 years, and 5.3% over the age of 50 years. The age distribution of power users was

6.3% between the ages of 20–30 years, 18.8% between 31–40 years, 56.3% between 41–50 years, and 18.8% over the age of 50 years.

End users' experience included two users with 1–3 years of experience, 45 with 4–7 years, and 29 had more than 7 years of experience. The power users' experience included two users with 1–3 years of experience, 11 with 4–7 years, and 19 had more than 7 years of experience. Other descriptive statistics showed that 44.4% of participants believed that the percentage of employees who have access to BI tools in their organization was between 1–25%. The percentage of employees who use BI tools without an IT assistant was between 1–20%, according to 36.1% of participants, and only 30.6% of participants indicated that they would use BI tools if they have access to them by 61–80%.

The researcher conducted inferential statistics using multiple regression statistical tests, and conducted a total of eight tests on the research hypotheses.

Results of Multiple Regression Tests

Test	D.V.	I.V.'s	Significant questions	R^2
1	PEOU	Information quality, age, experience	Q8, Q11	0.391
2	BI Utilization	Information quality, age, experience	Q7, Q12, experience	0.163
3	BI Utilization	PEOU (Com9_13)	Comp (9_13)	0.007
4	PU	Social influence, job relevance	Q20, Q26, Q28, Q30	0.570
5	BI Utilization	Social influence, job relevance	Q20, Q26, Q27, Q28	0.219
6	PU	Information quality, age, experience	Q8, Q10	0.296
7	BI Utilization	PEOU and PU	PU	0.12
8	BI Utilization	Questions (7-13 and 20-30)	Questions 7, 24, 26, 28, 29, 30	0.257

Future Research Recommendations

This study was an examination of the impact of perceived ease-of-use (PEOU) and perceived usefulness (PU) in predicting users' utilization of BI tools based on the impact of five extraneous factors, suggested

in the literature to have impact on PEOU and PU. The researcher utilized multiple regressions as the statistical method to test the research hypotheses. For future research, the researcher recommends duplicating the study using path analysis as a statistical method to test the research hypotheses and compare the results of the two methods. Another interesting topic will be studying the impact of the five extraneous variables used in this research with two groups of users to compare which are the most significant factors that impact each group's utilization of BI tools and if there are any differences between these factors. A final recommendation is conducting the study in countries other than U.S.

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