INDIVIDUAL LEVEL DETERMINANTS MODEL FOR BENEFIT USE OF BUSINESS INTELLIGENCE IN MALAYSIAN MANUFACTURING ORGANIZATIONS

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ABSTRACT

Over the past few years, there has been an uplifting trend in the usage of Business Intelligence (BI) in the manufacturing sector. The implementation of BI in the industry has helped many manufacturing organizations improve their business processes, by solving manufacturing issues and ensuring high efficiency. Despite the predominant implementation of BI in manufacturing organizations, there were still failures reported in the implementation of it, in which it could be due to the lack of readiness for the BI implementation and processing itself. The lack of readiness can be attributed not only to the technical aspects of the BI, but also to the social aspects of it, such as those related to humans and change management. Many studies were conducted on Critical Success Factors (CSF) of BI in manufacturing organizations; however, there were less studies conducted on the individual determinants for benefit use of BI in manufacturing organizations. The research of determinants for benefit utilization of BI that incorporate individual aspects is still underexplored in Malaysian manufacturing organizations. Therefore, this research aims to understand the potential factors that influence the benefit use of BI in Malaysian manufacturing industry. This study developed a model by integrating Unified Theory of Acceptance and Use Technology (UTAUT) and DeLone and McLean's (D&M) model to explore individual factors that affect benefit use of BI. A set of constructs and their interrelationships were formulated as the research hypotheses from the unification of theoretical backgrounds and interdisciplinary literatures related to BI in manufacturing. By surveying 477 employees of Malaysian manufacturing firms, a quantitative approach was utilized to test twelve hypotheses of the proposed model. All the survey data were analyzed utilizing IBM SPSS Statistics 24 and SmartPLS 3.0 based on Structural Equation Modelling (SEM). The results indicated that the following factors are the most significant determinants that influenced the benefit use of BI—training, top management's influence, performance expectancy, effort expectancy, social influence, facilitating condition, effective use and user satisfaction. In addition, this study also revealed that there is no significant relationship between training and facilitating condition, and between training and effective use. Theoretically, this study empirically proposed a new model based on UTAUT and D&M models in the context of developing countries for individual determinants that influence the benefit use of the system. Practically, this model presented a guideline encompassing user-related issues that practitioners and manufacturers might apply during the design and implementation of BI.

ABSTRAK

Sejak beberapa tahun kebelakangan ini, terdapat trend yang menggalakkan dalam penggunaan Kepintaran Perniagaan (BI) dalam sektor pembuatan. Pelaksanaan kepintaran perniagaan dalam industri tersebut telah membantu banyak syarikat pembuatan untuk menambah baik proses-proses perniagaan mereka dengan menyelesaikan isu-isu yang berkaitan dengan pembuatan serta memastikan kecekapan yang tinggi. Walaupun kepintaran perniagaan telah banyak dilaksanakan di dalam syarikat pembuatan, masih ada kegagalan yang dilaporkan berkaitan dengan pelaksanaan tersebut. Ini disebabkan oleh ketidaksediaan dalam melaksana dan memproses kepintaran perniagaan tersebut. Ketidaksediaan tersebut boleh dikaitkan dengan bukan hanya daripada aspek teknikal tetapi juga daripada aspek sosial seperti yang berkaitan dengan manusia dan pengurusan pengubahan. Banyak kajian telah dijalankan terhadap faktor kritikal kejayaan kepintaran perniagaan dalam syarikat pembuatan; walaupun begitu, terdapat kurangnya kajian yang dijalankan ke atas faktor penentu yang berkaitan dengan perseorangan terhadap penggunaan kepintaran perniagaan secara berfaedah di dalam syarikat pembuatan. Di syarikat pembuatan di Malaysia, kajian ke atas faktor penentu yang berkaitan dengan perseorangan terhadap penggunaan berfaedah kepintaran perniagaan masih lagi kurang diterokai. Oleh yang demikian, kajian ini bertujuan untuk memahami faktor yang berpotensi untuk mempengaruhi penggunaan berfaedah kepintaran perniagaan dalam industri pembuatan di Malaysia. Kajian ini membangunkan model dengan menggabungkan Teori Penyatuan Penerimaan dan Penggunaan Teknologi (UTAUT) dan model Delone & McLean (D&M) untuk meneroka faktor perseorangan yang mempengaruhi penggunaan berfaedah kepintaran perniagaan. Satu set konstruk dan hubung kait di antara konstruk tersebut telah diformulasi sebagai hipotesis kajian berdasarkan penggabungan latar belakang teori-teori dan literatur antara disiplin yang berkaitan dengan kepintaran perniagaan dalam pembuatan. Pendekatan kuantitatif telah diaplikasikan dengan melakukan tinjauan ke atas 477 pekerja syarikat pembuatan di Malaysia bagi menguji dua belas hipotesis untuk model yang dicadangkan. Perisian IBM SPSS Statistics 24 dan SmartPLS 3.0 telah diguna pakai untuk menganalisis semua data tinjauan. Hasil kajian mendapati faktor penentu yang ketara yang mempengaruhi penggunaan berfaedah kepintaran perniagaan adalah seperti berikut—pengaruh pihak pengurusan atasan, jangkaan prestasi, jangkaan usaha, pengaruh sosial, keadaan memudahkan, penggunaan efektif, dan kepuasan pengguna. Di samping itu, kajian ini juga menunjukkan bahawa tiada hubung kait yang ketara di antara latihan dan keadaan memudahkan, dan di antara latihan dan penggunaan efektif. Secara teorinya, dapatan kajian mencadangkan model yang baru berdasarkan UTAUT dan model D&M di dalam konteks negara membangun untuk faktor penentu berkaitan perseorangan yang mempengaruhi penggunaan berfaedah sistem tersebut. Secara praktikalnya, model ini mencadangkan garis panduan yang mengandungi isu-isu berkaitan dengan pengguna yang boleh digunakan oleh para pengamal dan pemilik syarikat pembuatan, semasa reka bentuk dan pelaksanaan kepintaran perniagaan.

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LIST OF ABBREVIATIONS

AMOS   -   Analysis of Moment Structure

ANOVA   -   Analysis of Variance

AVE   -   Average Variance Extracted

BI   -   Business Intelligence

BDPA   -   Big Data and Predictive Analytics

CB   -   Covariance-based

CEO   -   Chief Executive Officers

CIRP   -   International Conference on Production Engineering

CR   -   Composite Reliability

CRM   -   Customer Relationship Management

CSF   -   Critical Success Factors

D&M   -   Delone and McLean

ECM   -   Expectation-Confirmation Model

ECT   -   Expectation – Confirmation Theory

EE   -   Effort Expectancy

ERP   -   Enterprise Resource Planning

EPR   -   Electronic Patient Record

ES   -   Enterprise System

EE   -   Effective Use

FC   -   Facilitating Conditions

GDP   -   Gross Domestic Product

HIS   -   Healthcare Information Systems

HOT-Fit -   Human, Organization, and Technology-Fit

ICT   -   Information and Communications Technology

IPMA   -   Importance-Performance Map Analysis

IS   -   Information System

ISCM   -   Information System Continuance Model

IT   -   Information Technology

LISREL -   Linear Structural Relations

MNCs   -   Multinational Companies

NB	-	Net Benefits
PE	-	Performance Expectancy
PLS	-	Partial Least Square
R&D	-	Research and Development
RBV	-	Resource-Based View
ROB	-	Realization of Benefits
ROI	-	Return on Investment
S	-	User Satisfaction
SAP	-	Systems Applications and Products
SAS	-	Statistical Analysis System
SEM	-	Structural Equation Modelling
SMS	-	School Management System
SI	-	Social Influence
SPSS	-	Statistical Package for the Social Science
SQL	-	Structured Query Language
SSM	-	Suruhanjaya Syarikat Malaysia
TAM	-	Theory Acceptance Model
TOE	-	Technology-Organization-Environment
TMI	-	Top Management's Influence
TPB	-	Theory of Planned Behavior
TPC	-	Technology-to-Performance Chain
TR	-	Training
TRA	-	Theory of Reasoned Action
TTF	-	Task-Technology Fit
UniKL MIIT	-	Universiti Kuala Lumpur, Malaysian Institute of Information Technology
UniKL MITEC	-	Universiti Kuala Lumpur, Malaysian Institute of Industrial Technology
UTAUT	-	Unified Theory of Acceptance and Use Technology
UTM	-	Universiti Teknologi Malaysia
VIF	-	Variance Inflation Factor

LIST OF SYMBOLS

f^2	-	Effect size
α	-	Alpha (probability of error)
Q^2	-	Predictive relevance
R^2	-	Coefficient of determination
β	-	Path coefficient
p	-	Significance level or error probability level
t	-	Size of the difference relative to the variation in data

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CHAPTER 1

INTRODUCTION

1.1   Introduction

This chapter provides the overview of the research. Firstly, the background of the research problem is presented. The problem background section describes the existing problems that lead to the emergent of the research. This is followed by the problem statement section. Then, the research questions are developed, that lead to the next section which is the research objectives. The research objectives describe the research goals. Next, research scope is presented which explains the extent of the research. After that, the significance of the study section outlines the research contributions both to the theoretical and industrial practitioners' standpoints. Finally, organization of the thesis section describes the structure and synopsis for each chapter of the thesis.

1.2   Overview of Business Intelligence in Organizations

The ability of the Business Intelligence (BI) technology to gather and analyze considerable volume of data into information that enables businesses to operate, accomplish their objectives and elevate their performance has made it a valuable technological tool for organizations (Fourati-Jamoussia and Niambab, 2016). As every organization retains the record of their data which is obtained from various transactions, the role of BI that turned the data into knowledge to facilitate users and aid the decision making process makes the system well recognized by organizations (Wall, 2017). Imagine a supermarket having lots of receipts with multiple lines inside the receipts every day. Those are in fact valuable data that will be able to be extracted by BI and processed accordingly, to provide users with useful information which in turn will assist the organizations to discover their needs intelligently. The data can be

used to learn and predict customers' trend in buying goods. This eventually can assist the company to plan diligently in the future to increase its sales. Hence, the benefits of implementing BI in organizations are not only in the internal business process, but in forecasting sales and attracting future customers as well.

The Business Intelligence (BI) term is coined since 1958 by Luhn and is defined as "an automatic system that is being developed to disseminate information to the various sections of any industrial, scientific or government organization" (Grossmann and Rinderle-Ma, 2015). At that time, Luhn's BI system is used to extract and summarize documents and deliver the information for actions to be taken. There are different definitions of BI took place since then. One of them was by Negash (2004) who stated the important aspects of BI which are "business intelligence systems provide actionable information delivered at the right time, at the right location, and in the right form to assist decision makers." On the other hand, the BI term is expected to gradually change and perhaps will be replaced by other terminology. Thus, in this research, BI is defined as the information acquired from existing data, with the purpose to assist the decision making process of an organization, which is presented visually.

Taking into account the numerous capabilities and benefits offered by BI, more and more organizations had begun to implement the system. There are various industries that implemented BI covering the public and private sectors (Nasab, 2016). The industries are ranging from healthcare, banking, retail, manufacturing, supply chain, software, service and even tourism (Attaran and Attaran, 2018; Chianese and Piccialli, 2018; Karageorgou, 2018; Owuor and Njeru, 2018; Mishra, 2016; Moniruzzaman et al., 2015). Studies also revealed that banking or financial services, manufacturing, software and retail are among the fields that are having the highest users of BI (Attaran and Attaran, 2018). Thus, BI is popular among wide range of organizations, both public and private sectors. The role of BI in translating organizational data into actionable information has made it prevalently used in various industries, including manufacturing.

Over the recent decades, manufacturers have continued to improve the quality of their products and services as well as optimize their processes, in order to withstand the competitive environment to meet the market demand (Lee *et al.*, 2015). The focus of the manufacturers is of course in the production of physical goods that encompasses various processes across the manufacturing plant itself (Sangar, 2014). Consequently, manufacturing organizations must ensure that all the processes and activities are carried out in accordance with the business objectives as well as remain visible to the related employees working in the area, including the decision makers. In relation to that, the use of innovative technologies is considered to be applied, to solve manufacturing issues and ensuring high efficiency (Petrillo *et al.*, 2018). BI is one of the technologies that is able to accomplish those needs and eventually as a tool for sturdier decision making process supporting the growth of the business. This is important to ensure the competitiveness of the organizations in the manufacturing sector which is dynamic and of a fast pace working environment.

There are various business divisions and departments in manufacturing organization that use BI. They are materials planning and management, capacity planning, and shop floor control departments (Koupaei, Mohammadi and Naderi, 2016). The shop floor control can be further categorized into order management, maintenance and repair, and staffing decisions. The focus of the manufacturing division in this research is on the order management decision making, since the use of BI in this division is crucial in determining how fast the manufactured product can reach customer. Therefore, the potential context for such investigation to be carried out is the order management division of manufacturing organizations.

According to the Economic Report 2017/18 (2018), Malaysian manufacturing sector, inclusive of small to medium and large enterprise contributed to sales amounted to RM500.2 billion in the first six months of 2017 which is having the rise of up to 15.6% from 2016. Whereas on the supply aspect of Malaysian economy, the manufacturing and services sectors remain as the main driver for the growth, which indicated a strong performance. Moreover, high number of work opportunities are offered by the manufacturing sector in Malaysia (Azami, Ungku and Choi, 2016), and it is an important sector in Malaysia (Sangar, 2014). All the evidence indicate that the

manufacturing sector has played an important role in fostering growth, employment, income, and has been an integral to the Malaysian economy.

In Malaysian manufacturing organizations, the rate of BI adoption is increasing (Azman *et al*., 2019; Kharuddin *et al*., 2015). Employing BI in manufacturing organizations is an important project. However, there is insufficient evidence that highlighted the success stories of BI implementation in Malaysian manufacturing organizations, both in small to medium and large enterprises. In other words, many BI projects in Malaysian manufacturing organizations have failed, due to the lack of pushing factors that influence users to utilize the system while realizing the benefits given by the system (Abai, Yahaya and Deraman, 2016; Hatta *et al*., 2015). Additionally, Rahaman (2017) also mentioned in her study that only few instances of BI implementation in Malaysia are being reported and studied. This means that despite the prevailing capabilities and benefits offered by BI, there are still failures in its implementation projects in Malaysian manufacturing organizations.

Apart from the literature, an interview result with a project manager of BI system implementation in one of Malaysian manufacturing organizations revealed that the capabilities of BI in supporting the decision making are always not being realized by the employees in the order management division. This leads to issues, challenges and subsequently to failure of implementing the system in the organizations. Most of the time, the failure leads to ROI and additional cost involved, which need to be avoided by the management of any manufacturing organization.

1.3   Background of the Problem

According to Boyton *et al.* (2015), the failure for BI projects is in meeting the faster decision making process in organizations. This is also supported by Mudzana and Maharaj (2015) who asserted that the failure of BI implementation in organizations is on the inability of the system to assist users to produce better decision making. Mudzana and Maharaj (2015) also outlined other form of failure for BI implementation which is failing to meet the expectation of stakeholders. Other than that, unclear

implementation goals of BI among the top management (Hasan *et al.*, 2016), and failure to realize the benefits offered by BI (Lautenbach and Johnston, 2017) are also among the disappointments of BI. All the letdowns are also contributing to the low usage rate of BI within organizations. In a nutshell, BI implementation failures are related to not only the technical aspects, but also to the social aspects of it, which is beyond the technological, such as those related with humans, change management and individual.

The attention of scholars towards the social aspects of BI is in due consideration of the barriers and failures on the implementation of BI. The failures are related to not only the technology as the key role, but to other non-technological factors as well, such as individuals, processes, management and also the organizational culture (Mesároš, Čarnický and Mandičák, 2015). The current arguments among the scholars are, the issues and obstacles towards the implementation of BI that could possibly contributing to the failures of it are not merely related to the technical aspect, but there were many cases reportedly related to the social aspects too (Grublješič, Coelho and Jaklič, 2019; Weiler, Matt and Hess, 2019; Mesároš, Čarnický and Mandičák, 2015). The factors classified in the social aspect include corporate policy, corporate culture, and communication, which can be further narrowed down into elements that are the people, individual or human.

In the context of social aspect related to the implementation of a technology in an organization, an individual is the employee or worker of the organization that uses a particular technology (Karimika, 2017). Individuals that used an information system (IS) over a period of time after their first time use would result to the successful implementation of the IS (Hou, 2018; Al-Sharafi, Arshah and Abu-Shanab, 2017). This is mainly due to seldom and ineffective use of IS could lead to unforeseen expenses and useless effort in developing the IS, which could further lead to unattainable business benefits. However, less studies have been given attention by researchers on the benefit use of software systems as compared to the effect upon the initial adoption of the systems (Fitzgerald and Stol, 2017; Gebauer, Söllner and Leimeister, 2013). There were few studies on the intention of using IS grounded based on common matured theories such as Technological Acceptance Model (TAM),

Theory of Reasoned Action (TRA), Theory of Planned Behavior (TPB) and Unified Theory of Acceptance and Usage of Technology (UTAUT). These theoretical foundations are used to explain IS adoption at the initial stage. To discuss on the benefit use of a system and the underlying theories for this study, it cannot be presumed right after the initial judgment to use the system but most importantly, it should be discussed after the benefit use of the system and on the perspective of economic remuneration or the benefits that the system provides, rather than after the initial use of the system (Fitzgerald and Stol, 2017). It must be understood that the influence of BI and the benefits that the system offers could not be seen in a short period of time, i.e. after the initial acceptance (Weaver, 2016). Therefore, this leads to a theoretical gap between the initial use of an IS and the benefit use of it. It is crucial to explore the long-term effect of BI usage in organizations.

A comprehensive literature review revealed that there are few studies exploring the benefit use of BI in manufacturing organizations. For instance, Hou (2015) adopted matured theories like Technological Acceptance Model (TAM) by (Davis, Bagozzi and Warshaw, 1989) and Expectation-Confirmation Model (ECM) by Bhattacherjee (2001), to study on the benefit use of BI by individuals from the perspective of organizational decision making capability at the post-adoption stage. More recently, Cheng (2018) studied on the users benefit use of cloud ERP, which is also one the BI systems. The study utilized the Expectation-Confirmation Model (ECM) by Bhattacherjee (2001), DeLone and McLean (D&M) Information System Success Model by DeLone and McLean (2003) and Task-Technology Fit (TTF) by Goodhue and Thompson (1995). Although all these theories are appropriate and had been utilized in technology acceptance studies, the theories were originated based on the age where users were relatively new to the digital world (Fitzgerald and Stol, 2017). In addition, those theories do not incorporate individual aspects that ultimately lead to benefit use. Furthermore, most of the research used the term 'intention' all the while where the word is not suitable to be used in BI system context, since 'intention' is more appropriate to be used in voluntary setting of an IS (Gewald and Gewald, 2020). BI is used as a mandatory system for the decision making in the order management division of manufacturing organizations. Therefore, the benefit use agenda of a BI system in manufacturing organizations is still under question and need to undergo

further research that encompasses a holistic view, especially on the user or individual aspects.

Moreover, there is almost no research done in Malaysian manufacturing organizations on modelling the benefit use of BI. Researches were previously done in different country like Taiwan, which focused on the intention of the users to use BI rather than the benefit use of BI in manufacturing organizations (Cheng, 2018; Hou, 2018). The research utilized theories like ECM, D&M and TTF. Although the theories are appropriate and had been used in technology acceptance studies, they do not incorporate individual characteristics that affect the benefit use of BI, which is the focus of this research. For these reasons, the gap in knowledge exists whereby there is a need to develop a comprehensive model to confer more understanding on individual determinants that affect the benefit use of BI in Malaysian manufacturing organizations. Furthermore, since Malaysia is witnessing a major change in IS used for decision making, therefore, Malaysian manufacturing sector, covering small to medium and large enterprises is an appropriate context to conduct a research on the benefit use of BI. In addition, the evidence upon interviewing the BI project manager as stated previously disclosed the importance of understanding the individual determinants that influence the benefit use of BI in Malaysian manufacturing organizations.

1.4 Problem Statement

Despite the predominant implementation of BI in manufacturing organizations, there were failures reported in relation with the implementation of it. Additionally, in Malaysia, although the implementation of BI in manufacturing industry is rising, there are still failures reported on the implementation of it, especially in the order management section of manufacturing organizations, ranging from small to medium and large enterprises. For this reason, many research were conducted to study pertaining to the issues. Those research developed models that were originated from various underlying theoretical models whose variables were evaluated using respective measurement method. However, the developed models did not incorporate individual

related factors in them as influential determinants among the users that eventually lead to the benefit use of BI. Therefore, the research problem for this study is to investigate and explore the determinants related to individual and how the determinants influence the benefit use of BI in Malaysian manufacturing sector. Consequently, in-depth study is required to model the individual determinants, to confer more understanding on the benefit use of BI in Malaysian manufacturing organizations.

1.5   Research Questions

The research questions to be attempted by this study have been identified as follows:

1. What are the determinants related to individual that influence the beneficial use of BI in manufacturing-based organizations?

2. How to develop a model of individual determinants that influences the benefit use of BI which identifies the relationship between the determinants?

3. How to evaluate a model of individual determinants that influence the benefit use of BI in manufacturing-based organizations.

1.6   Research Objectives

The main objective of this research is to develop a model of individual level determinants for BI that consequently affects the benefit use of the system in manufacturing organizations. The specific objectives of this research are as follows:

1.   To identify the individual determinants that influence the benefit use of BI in manufacturing-based organizations.

2. To develop a model of individual determinants that influences the benefit use of BI which identifies the relationship between the determinants.

3. To evaluate a model of individual determinants that influence the benefit use of BI in manufacturing-based organizations.

1.7 Research Scope

This study focuses on identifying the individual determinants that influence the benefit use in the context of BI system. Therefore, the scope of this study is only on the BI systems, including Baan Enterprise Resource Planning (ERP), Infor ERP, Systems Applications and Products (SAP), Statistical Analysis System (SAS), Oracle, IBM, and others that fall in the similar category (Kemboi, Wanyoike and Langat, 2019; Azeroual and Theel, 2018; Sneller, 2014).

The study targets Malaysian manufacturing organizations that have implemented BI, ranging from small to medium and large enterprises. The division involved was the order management of the manufacturing organizations. The target participants were the employees in the division that used BI in their work. The employees were of any levels until the top management, since the sample from users of diverse levels are required to see more comprehensive pattern on the results (Hou and Gao, 2018; Sönmez, 2018).

In gathering data from employees at each manufacturing organization, quantitative method was used. UTAUT and D&M model were used as the basis for gathering quantitative data. The Structural Equation Modelling (SEM) was used to perform empirical validation of the model proposed which includes the evaluation of measurement model and structural model. SmartPLS 3.0 was utilized in this research.

1.8   Significance of the Study

The result of this study can be used to support future research on BI system particularly in relations with individual determinants that leads to benefit use of the system. The contribution of this study can be categorized into theoretical and practical standpoints as outlined in the next sub sections.

1.8.1   Theoretical Contribution

The endeavour of this research is to identify the individual related determinants of BI in Malaysian manufacturing organizations, which consequently affects the benefit use of the system and the relationship between the determinants. Thus, for researchers and practitioners, this research provides in-depth understanding of the determinants from users' context that influence the benefit use of BI.

Another endeavour of this research is to develop a conceptual model of individual related determinants that influence the benefit use of the system. For that reason, this research integrates UTAUT and D&M model to provide another in-depth understanding towards the factors among the BI users that consequently determine the benefit use of BI. As a result, this study enriched the previous academic research on BI system implementation through developing a more comprehensive model for benefit use of BI, catering a contribution to knowledge.

Furthermore, this investigation embarks on the context of manufacturing companies in Malaysia where previous research attempts were done in other countries such as Thailand, Taiwan, South Africa, China, Australia, Turkey, Iran and USA. Therefore, this research highlights Malaysia as one of the developing countries that contributes to the world's economy and spotlights on the BI implementation, which contributes to knowledge.

1.8.2   Contribution to Practitioners and Manufacturing Industry

From practitioners and manufacturers standpoint, this research contributes to a valuable insights whereby whenever there is a plan to study, implement or provide services for consultancy for the BI system, they will be able to foresee any issues related to users of the system such as, can the system be acceptable by the users, what are the reasons for failures in accepting the system by the users, corrective actions to be taken whenever there are such cases, and how can the employees be stimulated to use the system. These considerations are important to ensure that the high investment and resources in implementing the BI is worth spending, which will eventually lead to improved business performance.

Other than that, the results of this research will be able to guide the practitioners and manufacturers on the current emerging trends of the BI system usage in the country and the culture of use of the system specific to users and employees in Malaysia context, to serve them a new platform in handling user-related issues. That is to say, the result will be able to increase their understanding on the current issues faced by manufacturing companies in Malaysia, considering the anomaly from other countries such as Thailand, Taiwan, South Africa, China, Australia, Turkey, Iran and USA.

1.9   Organization of the Thesis

This thesis is structured into six chapters. Every chapter begins with an overview of the purpose and objective of the chapter and ends with the summary of the chapter. The synopsis for each chapter is outlined as follows.

Chapter 1 Introduction: This chapter presents a detailed introduction of the study in terms of the background of the problem, problem statement, research questions, research objectives, research scope and significance of the study. At the end of the chapter, the thesis organization is described.

Chapter 2 Literature Review: This chapter scrutinizes over the previous relevant literatures related to overview of manufacturing industry, BI system, BI system used in manufacturing, and interdisciplinary research review on BI. Based on that, the chapter discusses on the determinants selected for the research, the relationships established between the determinants and the relevant theories and models for the research that lead to the establishment of the research model. Ultimately, research conceptual model and research hypotheses are proposed.

Chapter 3 Research Methodology: This chapter explains on the justification for the method and illustration of the design used in this study. Details on each step of the research design are presented. Phases of the research are explained correspondingly. The analysis techniques that are used in the research utilizing the SmartPLS software version 3 are described in this chapter. This chapter also displays the processes employed for the development of the research instrument, which is the survey.

Chapter 4 Data Analysis: This chapter examines the data analysis results. Firstly, the pilot study results are presented. This is followed by the demographic analysis results, and the results of the main data analysis related to the proposed model and hypotheses using the Structural Equation Modelling (SEM) approach with SmartPLS 3.0.

Chapter 5 Results and Discussion: This chapter discusses the key findings that evolved from the outcomes of data analysis. The validation of the data analysis and final model with the experts is presented in this chapter. At the end of the chapter, the discussion on important factors to be considered by industrial practitioners using IPMA analysis is acquainted.

Chapter 6 Conclusion: This chapter wraps up the study in terms of achievement of objectives, summary of the research and emphasis on the research contributions in theoretical and practical aspects. The chapter also defines the guideline for recommendation among researchers intended to conduct future study. Finally, this chapter recognizes limitations, recommendations, and challenges for future research.

1.10   Summary

This chapter introduced the research domain in terms of background of the research, followed by the discussion on the research gap that needs to be addressed. After that, research problem is determined. Then, the research questions and research objectives are outlined. Subsequently, the scope and significance of the research are presented. The last section of this chapter described the thesis structure. The subsequent chapter will review the relevant literatures as the foundation and justification for the research.

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