ORIGINAL ARTICLE

BUSINESS INTELLIGENCE SYSTEM ADOPTION: A SYSTEMATIC LITERATURE REVIEW OF TWO DECADES

Chi Tin Wong[1*], Cheng Ling Tan[1] and Imran Mahmud[2]

[1]Graduate School of Business, Universiti Sains Malaysia, Penang, Malaysia
[2]Department of Information Technology & Management, Daffodil International University, Bangladesh

ABSTRACT – The rapid development of Artificial Intelligence (AI) in recent years has greatly improved humans' quality of life and promoted Information Systems (IS) development progress. Business Intelligence (BI) system is one of the tools in the field of IS which obtained benefits from the development of AI. The adoption of BI can enhance the competitive aspect of a business organization in today's high competitive business environment and play an important role in determining a business organization's success. However, literature shows that the adoption rate of BI system is low and it is predicted that the adoption rate will not increase a lot in near future. Prior research studies paid less attention in comprehensive study that review research articles related to BI system adoption in regard to discuss the issues and research gaps. There is an absence of a clear agenda or roadmap in the research area of BI adoption. Therefore, this study aims to synthesize and analyze research studies of BI adoption in the past two decades, identify the major theories that researchers have used to predict the adoption of BI, and summarize key antecedents that influence the adoption of BI. This study reviewed 44 research articles published on the adoption of BI between the year 2000 and the first quarter of 2020. The findings first indicate that the analysis of BI adoption literature is not comprehensive enough. Researchers in the past two decades commonly rely on TAM and its modifications to measure the adoption of BI. The finding also indicates that there are limited research studies on negative stimulus of BI adoption. This study proposes the agenda for continued research in the area of BI adoption that targets identified gaps in the literature.

INTRODUCTION

The rapid development of Artificial Intelligence (AI) in recent years has greatly improved humans' quality of life and promoted Information Systems (IS) development progress. Business Intelligence (BI) system is one of the tools in the field of IS which obtained benefits from the development of AI (Torres et al., 2018). It is equipped with different latest intelligence algorithms that allow decision-makers to convert data into useful information to support the decision made, make a decision in a short period of time, and enhance the correctness of the decision made when comparing to the old days (Popovič et al., 2019). Therefore, the adoption of BI can enhance the competitive aspect of a business organization in today's highly competitive business environment and it plays an important role in determining a business organization's success.

However, the literature shows that the adoption rate of the BI system is low and it is predicted that the adoption rate will not increase a lot in near future (Dresner Advisory Services, 2017; Dresner Advisory Services, 2018). Prior research studies paid less attention to a comprehensive study that review research articles related to BI system adoption in regard to discuss the issues and research gaps (Richards et al., 2019; Lautenbach et al., 2017; Foshay et al., 2014). There is an absence of a clear agenda or roadmap in the research area of BI adoption. Therefore, this study aims to synthesize and analyze research studies of BI adoption in the past two decades, identify the major theories that researchers have used to predict the adoption of BI, and summarize key antecedents that influence the adoption of BI.

REVIEW METHODOLOGY

This study reviewed the literature on the adoption of BI between the year 2000 and the first quarter of 2020 from various databases such as Science Direct, IEEE Xplore, Taylor & Francis Online, Emerald insight, EBSCOhost, JSTOR Archive, ProQuest, Web of Science, Wiley Online Library, Springer-Link and Sage Journal with the keywords "Business Intelligence", "Business Intelligence system", "BI", "Business Intelligence adoption", "use of Business Intelligence", "adoption intention" and "acceptance". Scopus and Google Scholar search engines were also adopted in order to ensure wide coverage of publications. Research studies related to BI adoption and adoption intention were both included because behavior intention and its predictors have an influence on the actual adoption, and the intention is one of the antecedents that influence adoption. This study considered different types of English language publications (working papers, conference papers, and peer-reviewed journal publications). There is a total of 96 articles related to the BI adoption

published between the year 2000 and the first quarter of 2020. The content of these articles was studied carefully to see whether it is relevant to BI adoption, and 52 articles were omitted because the research direction of these studies was not on BI adoption or focused on other enterprise systems. Finally, there is a total of 44 articles were selected for further analysis.

FINDINGS AND DISCUSSION

Main theories

There are about 44 research studies in the past two decades related to BI adoption, and researchers suggested a lot of information technology adoption theories on the BI system. Table 1 illustrates the theories used in BI adoption in past decades such as Technology Acceptance Model (TAM) (34%) by Davis et al. (1989), Diffusion of Innovation theory (DOI) (22.7%) by Rogers (1962), Resource-based view (RBV) (9%) by Barney (1991), Unified Theory of Acceptance and Use of Technology (UTAUT) (6.8%) by Venkatesh et al. (2003) and Technology, Organization, Environment theory (TOE) (6.8%) by Tornatzky and Fleischer (1990). Apart from using a single theory to explain the BI adoption, researchers also tried to integrate multiple technology acceptance theories with theories from psychology, marketing, and social science domain such as Theory of Planned Behaviour (TPB), Social Exchange Theory (SET), Expectancy Theory (ET) and Theory of Reasoned Action (TRA).

Table 1. Articles included in the review

No	Author(s)	Theories	Factors	Countries and Sampling
1	Bach et al. (2016)	TAM	"Perceived Usefulness of BIS; Perceived Ease of Implementation of BIS; Technology-Driven Strategy; Information Quality; IT Project Management; Change Management; Knowledge Sharing"	USA (100)
2*	Brockmann et al. (2012)	TAM	"Perceived Value; Perceived Ease of Use; Trust; Perceived Ease of Adoption"	Germany (-)
3*	Chang et al. (2014)	TAM	"Perceived Ease of Use to Read; Perceived Usefulness; Perceived Ease of Use to Create"	China (118) Taiwan (153)
4	Foshay et al. (2014)	TAM	"Definitional Metadata Quality; Data Quality Metadata Quality; Navigational Metadata Quality; Lineage Metadata Quality; Perceived Usefulness; Perceived Ease of Use"	North American (499)
5	Gorla et al. (2003)	TAM	"Visualization; Summarization; Navigation; Query; Sophisticated Analysis; Dimensionality; Performance; Ease of Use; Usefulness"	Hong Kong (58)
6	Grublješič et al. (2014)	TAM UTAT	"Effort Perceptions; Performance Perceptions; Social Influence; Result Demonstrability; Facilitating Conditions; Focus on Customer"	EU (195)
7*	Hart et al. (2007)	TAM	"Job Relevance; Output Quality; Result Demonstrability; Anxiety; Facilitating Conditions; Perceived Usefulness; Perceived Ease of Use"	South Africa (53)
8	Hart and Porter (2004)	TAM	"Result Demonstrability; Output Quality; Job Relevance; Perceived Usefulness; Perceived Ease of Use"	South Africa (65)
9	Hong et al. (2006)	TAM	"Data Quality; Accessibility; Response Time; Support and Training; Perceived Usefulness; Perceived Ease of Use; Perceived Individual Impact"	Korea (115)
10	Hou (2013)	TAM TPB	"Perceived Usefulness; Perceived Ease of Use; Compatibility; Peers' Influence; Supervisors' Influence; Self-efficacy; Facilitating Condition"	Taiwan (339)
11	Hou (2015)	TAM ECMoIS	"Perceived Usefulness; Confirmation of Expectation; Perceived Ease of Use; Satisfaction"	Taiwan (330)

No	Author(s)	Theories	Factors	Countries and Sampling
12*	Jiang (2009)	TAM MT DOI	"Perceived Usefulness; Perceived Ease of Use; Social Influence; External Controls; User Predisposition"	Taiwan (-)
13*	Kohnke (2011)	TAM	"Quality of Information; System Performance; User Information; User Training; Top Management Support; Subjective Norm; Perceived Usefulness; Perceived Ease of Use"	Brazil (258)
14	Ramamurthy et al. (2008)	TAM DOI	"Relative Advantages; Complexity; Organizational Commitment; Absorptive Capacity; Organizational Size; Organizational Scope; Organizational Data Environment"	USA (198)
15	Zhao et al. (2012)	TAM	"Organizational Use Satisfaction; Organizational Needs; Organizational Readiness; Organizational Variables; Provider Variables; System Variables; Project Variables"	USA (-)
16	Ahmad et al. (2016)	DOI	"Relative Advantage; Complexity; Compatibility; Triability; Observability"	Malaysia (310)
17	Boonsiritomachai et al. (2016)	DOI	"Relative Advantages; Complexity; Compatibility; Absorptive Capacity; Organisational Resource Availability; Competitive Pressure; Vendor Selection; Owner-manager's Innovativeness; Owner-manager's IT Knowledge"	Thai (427)
18	Jaklič et al. (2018)	DOI RBV UTAT	"Performance Perceptions; Compatibility; Result Demonstrability; Social Influence"	EU (195)
19	Lautenbach et al. (2017)	DOI TOE	"Data Infrastructure Capabilities; Data Management Challenges; Top Management Support; Talent Management Challenges; External Market Influence; Regulatory Compliance"	South Africa (72)
20	Popovič et al. (2019)	DOI	"Impact on Marketing and Sales; Impact on Management and Internal Operations; Impact in Firm Procurement; Impact on Firm Performance"	Portugal (181)
21	Puklavec et al. (2014)	DOI TOE	"Expected Benefits; Perception of Strategic Value; Cost; BIS is a part of ERP; Management Support; Organizational Culture; Project Champion; Organizational Data Environment; Organizational Readiness; Size; External Support"	Slovenia (-)
22	Puklavec et al. (2017)	DOI TOE	"Expected Benefits; Perception of Strategic Value; Cost; BIS is a part of ERP; Management Support; Rational Decision Making Culture; Project Champion; Organizational Data Environment; Organizational Readiness; External Support"	Slovenia (181)
23*	Yoon et al. (2014)	DOI TPB MT	"Relative Advantages; Complexity; Compatibility; Intrinsic Motivation; Extrinsic Motivation; Supervisor Support; Co-worker Support; Requisite Skills & Resources; Organizational Learning Climate"	USA (47)
24	Arefin et al. (2015)	RBV ISCM	"Organizational Strategy; Organizational Structure; Organizational Process; Organizational Culture; System	Bangladesh (225)

No	Author(s)	Theories	Factors	Countries and Sampling
			Effectiveness; Organizational Effectiveness"	
25*	Fink et al. (2017)	RBV	"Exploitation; Exploration; BI Team; BI infrastructure; Operational BI Capabilities; Strategic BI Capabilities; Operational Business Value; Strategic Business Value"	Israel (159)
26*	Torres et al. (2018)	RBV IPT	"Infrastructure Quality; Management Capability; Personnel Expertise"	UK (137)
27	Hou (2014)	UTAT	"Performance Expectancy; Effort Expectancy; Social Influence; Facilitating Conditions; Gender; Age; Experience; Voluntariness of Use"	Taiwan (330)
28*	Li et al. (2013)	MT	"Perceived Usefulness; Intrinsic Motivation toward Accomplishment; Intrinsic Motivation to Know; Intrinsic Motivation to Experience Stimulation; Personal Innovativeness with IT"	China (193)
29*	Richards et al. (2019)	IPT IMoITV	"BIS Effectiveness; Business Analytics Effectiveness; Planning Effectiveness; Measurement Effectiveness; Process Effectiveness"	Canada (337)
30*	Han et al. (2016)	ECMoIS	"Confirmation; Perceived Usefulness; Satisfaction; Habit; Psychological Empowerment; Structural Empowerment"	Taiwan (117)
31*	Chang et al. (2017)	BDB	"Conscientiousness; Emotional Stability; Agreeableness; Extraversion; Openness to Experience"	China &Taiwan (354)
32*	Chang et al. (2015)	BDB ET SET	"Tangible Rewards; Intangible Rewards; Organization Rewards; Reputation Reciprocity"	China (271)
33	Arnott et al. (2017)	GSM	"Operational Control; Management Control; Strategic Planning"	Australia (-)
34*	Işık et al. (2013)	GSM	"Data Quality; Integration with other System; User Access; Flexibility; Risk Management Support; Decision Types; Information Processing Needs"	USA (92)
35*	Kositanurit et al. (2011)	TPC	"System Quality; Information Quality; Utilization; Performance"	USA (349) Thai (304)
36*	Hou (2012)	NNM	"Content; Accuracy; Format; Ease of Use; Timeliness"	Taiwan (330)
37*	Trieu (2013)	TEU WWF	"Data Integration; BI Interaction Transparency; BI Representational Fidelity; Informed Decision; Decision-Making Effectiveness; Decision-Making Efficiency"	Australia (-)
38*	Elbashir et al. (2008)	VCAFP	"Customers Intelligence; Supplier Relations; Internal Efficiency; Business Process Performance; Organizational Performance"	Australia (419)
39*	Ramakrishnan et al. (2012)	IT	"Institutional Isomorphism; Competitive Pressure"	USA (63)
40	Mathew (2012)	TaM	"Size; Management; Access; Affordability; Decision Support; Task Complexity; Technology Familiarity; Quantitative Skills"	India (-)
41	Dawson and Van Belle (2013)	TRA	"Management Support; Champion; Resources; User Participation; Data Quality"	South Africa (-)
42*	Han and Farn (2013)	TEU	"Perceived Usefulness; Confirmation; Satisfaction; Habit; Structural	Taiwan (117)

No	Author(s)	Theories	Factors	Countries and Sampling
43*	Grublješič and Jaklič (2015)	STROBE	Empowerment; Psychological Empowerment" "Individual Characteristics; BIS Quality Characteristics; Organizational Factors; Macro-Environmental Characteristics; Performance Perceptions; Result Demonstrability; Effort Perceptions; Social Influence; Facilitating Conditions"	Slovenia (-)
44*	Visinescu et al. (2017)	BJSDCM	"Problem Space Complexity; Information Quality; Perceived Decision Quality"	USA (60)

* means studies were conducted with individual of analysis (no * means studies were conducted with organizational unit of analysis)

Notes (Theories): Bagozzi, Dholakia and Basuroy model (BDB); Burton et al. dimensions Clark's model (BJSDCM); Diffusion of innovation theory (DOI); Expectation-confirmation Model of IS (ECMoIS); Expectancy Theory (ET); Gorry et al. Morton MIS framework (GSM); Integrative Model of IT Value (IMoITV); Information processing theory (IPT); Institution theory (IT); IS continuance model (ISCM); Motivational theory (MT); Nomological net model (NNM); Resource based view (RBV); Social exchange theory (SET); Strategic orientation of business enterprise framework (STROBE); Technology Acceptance Model (TAM); Technology adoption model (TaM); Theory of effective use (TEU); Theory of effective use (TES); Technology, Organization, Environment (TOE); Theory of Planned Behavior (TPB); Technology to Performance Chain model (TPC); Theory of Reasoned action (TRA); Unified Theory of acceptance and use of technology (UTAT); Value-chain activities framework by Porter(VCAFP); Wixom & Waston framework (WWF)

Visible from Table 1, researchers in the past two decades highly relied on TAM to measure the BI adoption and largely ignored other ideas. Of the 44 studies, 15 (34%) used the TAM and its modification as their theoretical framework. Kim et al. (2007) suggested that TAM is too old and not sufficient enough to explain the adoption of new information and communication technology such as AI and BI. Therefore, researchers can try not to rely on TAM to measure the adoption of BI because using a single point of view is unable to reflect the view more comprehensively. Researchers can make use of TAM as a foundation to further explore and develop technology acceptance theories in the next decade.

Main antecedents

Researchers suggested a lot of information technology adoption theories on BI system adoption such as TAM, UTAUT, and DOI. Although these frequently used theories are reliable enough and have been adopted by many information system researchers, it only focusses on the positive impacts of technology use exclusively. This study classified key antecedents from literature related to BI adoption in the past two decades into two types: positive stimulus and negative stimulus. Figure 1 illustrates the classification results. There are about 30 positive stimuli and 1 negative stimulus from the literature related to BI adoption. It was found that prior research studies frequently focused on the influence of positive stimulus in BI adoption research, while there were very limited studies focused on the impact of negative stimulus in BI adoption. Therefore, investigation of negative stimulus in BI adoption is necessary in order to understand the adoption of BI comprehensively. Researchers can consider more negative factors in future studies related to BI adoption.
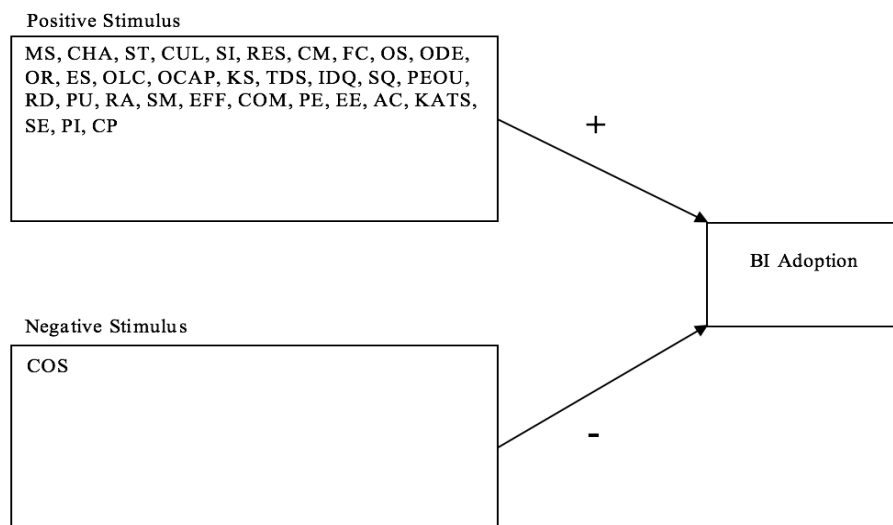

Figure 1. Classification of key antecedents to influence the adoption of BI

Note: Management support (MS), Champion (CHA), Support and training (ST), Cost (COS), Culture (CUL), Social influence (SI), Resources (RES), Change management (CM), Facilitating Conditions (FC), Organization size (OS), Competitive pressure (CP), Organizational data environment (ODE),

Organizational readiness (OR), external support (ES), Organizational BI capabilities (OCAP), Organizational learning climate (OLC), Knowledge sharing (KS), Technology driven strategy (TDS), Information/ Data Quality (IDQ), System quality (SQ), Perceived ease of use (PEOU), Result demonstrability (RD), Perceived Usefulness (PU), Relative advantages (RA), BI system maturity (SM), BIS effectiveness (EFF), Compatibility (COM), Performance expectancy (PE), effort expectancy (EE), Absorptive capacity (AC), Team IT knowledge and technical skills (KATS), Self-efficacy (SE), Personal innovativeness (PI)

CONCLUSION

This study reviewed 44 research articles published on the adoption of BI between the year 2000 and the first quarter of 2020. The findings first indicate that the analysis of BI adoption literature is not comprehensive enough. Researchers in the past two decades commonly relied on TAM and its modifications to measure the adoption of BI. The finding also indicates that there are limited research studies on the negative stimulus of BI adoption.

For the theoretical significance, this study proposes the agenda for continued research in the area of BI adoption that targets identified gaps in the literature: (1) Investigation of negative stimulus in BI adoption is necessary in order to understand the BI adoption comprehensively. Researchers can consider more negative factors in future studies related to BI adoption. (2) Researchers can try not to rely on TAM to measure the adoption of BI because using a single point of view is unable to reflect the view more comprehensively. Also, TAM is too old and not sufficient enough to explain the adoption of new information and communication technology such as AI and BI. Researchers can make use of TAM as a foundation to further explore and develop technology acceptance theories in the next decade. For practical significance, BI vendors can understand the barriers and factors influencing BI adoption in an organization and try to adjust their BI products in order to attract more organizations to adopt BI in near future.

There are some limitations of this study and it offers opportunities for additional research. Firstly, the searching process of this study focused on BI adoption or acceptance, where some relevant and important research articles might be excluded. Secondly, the core of this study is to review the acceptance or adoption of BI in the past two decades, in which the factors in the post-adoption stage were excluded.

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AUTHOR'S BIOGRAPHY

WONG Chi Tin is a PhD student in the Graduate School of Business (GSB) of Universiti Sains Malaysia. His current research focuses on Business Intelligence system and Technology Management.

Dr Cheng Ling Tan is an associate professor and deputy dean of the Graduate School of Business at the Universiti Sains Malaysia. She provides lectures on operations management and supervises postgraduate students in the field of innovations and operations management. Her research has been cited in many international journals.

Dr. Imran Mahmud is currently working as Head and Associate Professor at Department of Information Technology & Management at Daffodil International University, Bangladesh. Previously, Dr. Imran worked as a senior lecturer at Graduate School of Business in Universiti Sains Malaysia.