UNIVERSITI PUTRA MALAYSIA

FACTORS AFFECTING SUCCESSFUL BIG DATA ANALYTICS IMPLEMENTATION IN PUBLIC SECTOR OF MALAYSIA

CECILIA ADRIAN

FSKTM 2020 5

FACTORS AFFECTING SUCCESSFUL BIG DATA ANALYTICS IMPLEMENTATION IN PUBLIC SECTOR OF MALAYSIA

By

CECILIA ADRIAN

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

October 2019

COPYRIGHT

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

FACTORS AFFECTING SUCCESSFUL BIG DATA ANALYTICS IMPLEMENTATION IN PUBLIC SECTOR OF MALAYSIA

By

CECILIA ADRIAN

October 2019

Chairman : Professor Rusli Abdullah, PhD
Faculty : Computer Science and Information Technology

Decision based big data analytics (BDA) has created countless opportunities and challenges for the Malaysian Public Sector. In order to be innovative, the government organizations need to adopt effective ways of decision-making. One such strategy is by understanding and recognizing the enabling factors that contribute to the success of BDA implementation. In this regard, this study explores the effects of organizational, talent and technology resources as the factors affecting successful BDA implementation. This study was developed based on Resource-Based View (RBV) and DeLone & McLean Information Systems Success Model (ISSM) theories. Systematic literature review was conducted to identify the factors affecting successful BDA implementation and to find the research gaps. In this study, a BDA implementation model named BDI model, is proposed. Existing literatures were synthesized and critically analysed which were then became the basis of the model development. A panel of experts was selected to verify the research model and questionnaire design. Data from the expert opinions was analysed by using I-CVI and Kappa analysis. To gain the reliability and validity of items from the revised questionnaires, a pilot study was conducted. Data collected from pilot study was analysed by using Rasch Measurement Model. An empirical study was then performed by administering the instrument to 140 big data practitioners in selected Malaysian Public Sectors through a drop-off survey method. SPSS software was used for descriptive analysis, while PLS-SEM was used for statistical analysis in which eleven hypothesis were tested empirically. The results indicate that resource commitment, analytics skills and managerial skills factors are not significant on BDA implementation, while the rest of the influencing factors such as big data strategy, analytics culture, top management support, data infrastructures, information processing and information quality are statistically significant. In addition, the relationship between analytics culture and BDA implementation is improved by introducing the moderating role of top management support. The revised BDI model was then validated further by the experts using a developed prototype. A usability test

with big data users was conducted to assess the feasibility and applicability of the prototype in the field. Based on the expert evaluation and usability testing, the prototype is believed to be able to assist decision-makers understand the key determinants and address the issue on the lack of resources that must be considered during BDA implementation. It is also believed that organizational decision making and future strategic planning can be improved by providing significant information on the strength and shortcomings of the affecting factors on successful BDA implementation.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

FAKTOR-FAKTOR YANG MEMPENGARUHI KEJAYAAN BAGI PELAKSANAAN ANALITIS DATA RAYA DI SEKTOR AWAM MALAYSIA

Oleh

CECILIA ADRIAN

Oktober 2019

Pengerusi : Profesor Rusli Abdullah, PhD
Fakulti : Sains Komputer dan Teknologi Maklumat

Keputusan berdasarkan analitis data raya (BDA) telah mewujudkan banyak peluang dan cabaran kepada Sektor Awam Malaysia. Untuk sentiasa inovatif, organisasi kerajaan perlu mengamalkan cara membuat keputusan yang berkesan. Salah satu strategi adalah memahami dan mengenal pasti faktor-faktor yang dapat menyumbang kepada kejayaan pelaksanaan BDA. Dalam hal ini, kajian ini menyiasat kesan sumber organisasi, bakat dan teknologi sebagai faktor-faktor yang mempengaruhi kepada kejayaan pelaksanaan BDA. Kajian ini menggunakan teori RBV dan ISSM. Kajian kesusasteraan secara sistematik dilakukan untuk mengenalpasti faktor-faktor yang mempengaruhi pelaksanaan BDA dan menyiasat jurang kajian. Kajian ini mencadangkan satu model pelaksanaan analitis data raya yang dinamakan model BDI. Soal selidik dibangunkan melalui sintesis dan analisa kajian lepas. Model kajian dan rekabentuk soal selidik disah oleh pakar. Data berkaitan pendapat pakar dianalisis menggunakan kaedah analisis I-CVI dan Kappa. Kajian rintis dilaksana menggunakan soal selidik bagi mengukur kebolehpercayaan dan kesahan item-item. Data kajian rintis dianalisis menggunakan *Rasch Measurement Model*. Seterusnya, tinjauan sebenar dilaksana melalui kaedah kaji selidik dengan mentadbir instrumen kepada 140 pengamal data raya dari agensi terpilih Sektor Awam Malaysia. Perisian SPSS digunakan untuk analisis deskriptif, manakala PLS-SEM digunakan untuk analisis statistik bagi menguji sebelas hipotesis secara empirikal. Hasil analisis mendapati bahawa faktor 'komitmen sumber', 'kemahiran analitis' dan 'kemahiran pengurusan' tidak signifikan pada pelaksanaan BDA, manakala faktor-faktor lain yang mempengaruhi seperti 'strategi data raya', 'budaya analitis', 'infrastruktur data', 'pemprosesan maklumat' dan 'kualiti maklumat' adalah signifikan secara statistik. Kesan penyederhanaan 'sokongan pengurusan atasan' ke atas hubungan antara budaya analitis dan pelaksanaan BDA juga didapati lebih kuat bagi ‘sokongan pengurusan atasan’ pada tahap rendah. Pakar mengesah model akhir BDI menggunakan perisian prototaip. Ujian kebolehgunaan oleh pengguna data raya dijalankan untuk menilai kebolehlaksanaan dan kebolehgunaan prototaip di lapangan. Berdasarkan penilaian

pakar dan pengujian kebolehgunaan, prototaip ini dapat membantu pembuat keputusan memahami penentu utama dan menangani masalah kekurangan sumber yang perlu dipertimbangkan semasa pelaksanaan BDA. Ia juga dipercayai bahawa pembuatan keputusan organisasi dan perancangan strategik dapat ditingkatkan pada masa depan dengan adanya maklumat berkaitan faktor-faktor kekuatan dan kekurangan sumber yang mempengaruhi kejayaan pelaksanaan BDA.

ACKNOWLEDGEMENTS

I would like to express my deepest appreciation to my supervisor, Professor Dr. Rusli Abdullah for his support, invaluable guidance, and continuous encouragement on keeping me working hard to complete this thesis. I would also like to extend my sincere thanks to my co-supervisors, Associate Professor Dr. Rodziah Atan and Associate Professor Dr. Yusmadi Yah Jusoh for their guidance, thoughtful questions and motivation. Their insightful views over numerous discussions have certainly facilitated me to complete this thesis.

My special gratitude goes to my husband, Grippin Akeng who was always at my side, during my ups and downs throughout the study and for his endless encouragement, inspiration, sacrifice and time. To my adorable children - Gordon, Gietrich and Genevieve who have been by my side, giving me motivation and strength in pursuing this challenging experience. My sincere appreciation also goes to my family members, particularly, my mother and mother-in-law for their endless support, patience and prayers.

Special thanks to all my friends and colleagues who have assisted me in their different ways for intellectual discussions, support and encouragement over the years. My sincere gratitude also goes to the Malaysian Public Service Department for giving me the opportunity and providing me with the financial support.

This thesis was submitted to the Senate of the Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

Rusli Abdullah, PhD
Professor
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
(Chairman)

Rodziah Atan, PhD
Associate Professor
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
(Member)

Yusmadi Yah Jusoh, PhD
Associate Professor
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
(Member)

ZALILAH MOHD SHARIFF, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

Declaration by graduate student

I hereby confirm that:

- this thesis is my original work;
- quotations, illustrations and citations have been duly referenced;
- this thesis has not been submitted previously or concurrently for any other degree at any institutions;
- intellectual property from the thesis and copyright of thesis are fully-owned by Universiti Putra Malaysia, as according to the Universiti Putra Malaysia (Research) Rules 2012;
- written permission must be obtained from supervisor and the office of Deputy Vice-Chancellor (Research and innovation) before thesis is published (in the form of written, printed or in electronic form) including books, journals, modules, proceedings, popular writings, seminar papers, manuscripts, posters, reports, lecture notes, learning modules or any other materials as stated in the Universiti Putra Malaysia (Research) Rules 2012;
- there is no plagiarism or data falsification/fabrication in the thesis, and scholarly integrity is upheld as according to the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) and the Universiti Putra Malaysia (Research) Rules 2012. The thesis has undergone plagiarism detection software

Signature:_____ Date:_____

Name and Matric No.: Cecilia Adrian GS44555

Declaration by Members of Supervisory Committee

This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) were adhered to.

Signature: _____
Name of Chairman of Supervisory Committee: Professor Dr. Rusli Abdullah

Signature: _____
Name of Member of Supervisory Committee: Associate Professor Dr. Rodziah Atan

Signature: _____
Name of Member of Supervisory Committee: Associate Professor Dr. Yusmadi Yah Jusoh

TABLE OF CONTENTS

		Page
ABSTRACT		i
ABSTRAK		iii
ACKNOWLEDGEMENTS		v
APPROVAL		vi
DECLARATION		viii
LIST OF TABLES		xiv
LIST OF FIGURES		xvi
LIST OF ABBREVIATIONS		xviii
CHAPTER		
1	**INTRODUCTION**	1
	1.1 Research Background	1
	1.2 Problem Statement	3
	1.3 Research Questions	4
	1.4 Research Objectives	4
	1.5 Scope of Research	4
	1.6 Significance of Research	5
	1.6.1 Theoretical Contribution	5
	1.6.2 Practical Contribution	5
	1.7 Thesis Organization	5
2	**LITERATURE REVIEW**	8
	2.1 Introduction	8
	2.2 Big Data Analytics	8
	2.3 Big Data Analytics Implementation	9
	2.4 Big Data Analytics Implementation in Malaysian Public Sector	10
	2.5 The Evaluation of Successful BDA Implementation	13
	2.6 Organizational Decision-Making	14
	2.7 Related Big Data Analytics Implementation Theories and Models	14
	2.7.1 Resourced-Based View Theory	15
	2.7.1.1 Big Data Analytics Resources	16
	2.7.1.2 Big Data Analytics Capabilities	18
	2.7.2 Information Systems Success Model	19
	2.7.2.1 Big Data Analytics Quality	21
	2.7.3 Technology-Organization-Environment Framework	21
	2.7.4 Grounded Theory	23
	2.8 Prior Studies on the Implementation of Big Data Analytics	24
	2.9 Related Studies on Determinants of the Big Data Analytics Implementation	31
	2.9.1 Big Data Strategy	33
	2.9.2 Resource Commitment	33
	2.9.3 Analytics Culture	34
	2.9.4 Top Management Support	35

2.9.5 Analytics Skills 35
2.9.6 Managerial Skills 36
2.9.7 Data Infrastructures 36
2.9.8 Information Processing 37
2.9.9 Information Quality 38
2.9.10 Moderating Analysis 39
2.10 Gap Analysis 39
2.11 Summary 40

3 RESEARCH METHODOLOGY 41
3.1 Introduction 41
3.2 Research Philosophy 41
3.3 Operational Research Framework 42
3.4 Phase 1 – Literature Review 44
3.5 Phase 2 – Model Development 45
3.5.1 Determine the Constructs and Design Model 45
3.5.2 Develop the Constructs Definition 46
3.5.3 Develop Items to Represent the Construct 46
3.5.4 Measurement Scale Decision 47
3.5.5 Conduct Expert Review 48
3.5.6 Selection of Experts 48
3.5.6.1 Expert Demographic 49
3.5.7 Validity 49
3.5.7.1 Face Validity 49
3.5.7.2 Content Validity 50
3.5.7.3 Content Validity Index 50
3.5.7.4 Kappa Analysis 51
3.6 Phase 3 – Data Collection 55
3.6.1 Population 55
3.6.2 Unit of Analysis 55
3.6.3 Sample Size 56
3.6.4 Sampling Technique 56
3.6.5 Data Collection for Pilot Study 57
3.6.5.1 Descriptive Statistic of Demographic Background in Pilot Study 58
3.7 Phase 4 – Analysis 60
3.7.1 Data Analysis for Pilot Study 60
3.7.1.1 Person and Item Reliability 61
3.7.1.2 Person-Item Distribution Map 62
3.7.1.3 Item Fit 63
3.7.1.4 Unidimensionality 69
3.7.1.5 Scale Calibration 69
3.7.1.6 Discussion for Rasch Analysis 71
3.7.1.7 Summary 74
3.7.1.8 Data Analysis for Empirical Study using Structural Equation Modeling 82
3.7.1.9 Measurement Model Analysis using PLS-SEM 83
3.7.1.10 Structural Model Analysis using PLS-SEM 85

3.8 Phase 5 – Prototype Development 86
3.8.1 Prototype Development Process 87
3.8.2 Prototype Execution 87
3.8.3 Prototype Evaluation 88
3.9 Phase 6 – Report Writing 88
3.10 Summary 89

4 MODEL DEVELOPMENT 90
4.1 Introduction 90
4.2 Initial Model Development 90
4.3 Hypotheses Development 93
4.3.1 Big Data Strategy 93
4.3.2 Resource Commitment 94
4.3.3 Analytics Culture 95
4.3.4 Top Management Support 95
4.3.5 Analytics Skills 96
4.3.6 Managerial Skills 97
4.3.7 Data Infrastructures 98
4.3.8 Information Processing 98
4.3.9 Information Quality 99
4.3.10 Big Data Analytics Implementation and Organizational Decision-Making 100
4.4 Summary 101

5 EMPIRICAL STUDY 102
5.1 Introduction 102
5.2 Empirical Study 102
5.2.1 Initial Preparation 103
5.2.1.1 Response Rate Analysis 103
5.2.1.2 Non-Response Bias Test 104
5.2.1.3 Consideration for Common Method Bias 104
5.2.1.4 Normality Test 105
5.2.2 Descriptive Statistic of Demographic Background in Actual Study 105
5.3 Model Evaluation 108
5.3.1 Assessment of Measurement Model 109
5.3.1.1 Internal Consistency Reliability 109
5.3.1.2 Convergent Validity 111
5.3.1.3 Discriminant Validity 111
5.3.2 Assessment of Structural Model 115
5.3.2.1 Collinearity Assessment 115
5.3.2.2 Path Coefficient Analysis 116
5.3.2.3 Coefficient of Determination (R^2) 118
5.3.2.4 Assessment of Effect Size (f^2) 119
5.3.2.5 Assessment of Predictive (Q^2) Relevance 120
5.3.3 Moderator Analysis 120
5.3.4 Hypothesized Model 124
5.4 Summary 125

6 PROTOTYPE DEVELOPMENT AND IMPLEMENTATION OF THE PROPOSED MODEL 127
6.1 Introduction 127
6.2 Prototype Design 127
6.2.1 Prototype Process Flow 127
6.2.2 Use Case Diagram 128
6.2.3 User Roles 129
6.3 System Architecture 130
6.3.1 External Interface 130
6.3.1.1 Screen Layout for BDA Manager 131
6.3.1.2 Screen Layout for Team Member 132
6.3.1.3 Screen Layout for Decision Maker 132
6.3.1.4 Screen Layout for System Administrator 133
6.4 Module Development 133
6.4.1 Input Modules 133
6.4.2 Repositories 134
6.4.3 Application Modules 134
6.4.4 Output Modules 137
6.5 Requirement 137
6.6 Prototype User Interfaces 138
6.7 Implementation Framework for Model Validation 142
6.7.1 BDA Implementation Model 143
6.7.2 BDA Implementation Evaluation Processes 143
6.7.3 Expert Review Validation 149
6.8 Summary 149

7 RESULTS AND DISCUSSIONS 150
7.1 Introduction 150
7.2 Model Validation using Prototype Tools 150
7.2.1 Validation on the BDI Model 150
7.2.2 Test Instrument by Respondents 151
7.2.3 Usability Test Survey 152
7.3 Discussion 156
7.4 Summary 160

8 CONCLUSIONS AND FUTURE WORK 161
8.1 Introduction 161
8.2 Research Summary 161
8.3 Research Contributions 162
8.3.1 Theoretical Contribution 162
8.3.2 Practical Contribution 163
8.4 Research Limitation 163
8.5 Recommendations for Future Work 164
8.6 Summary 164

REFERENCES 165
APPENDICES 177
BIODATA OF STUDENT 211
LIST OF PUBLICATIONS 212

LIST OF TABLES

Table		Page
2.1	Tangible Resources, Intangible Resources and Talent Resources	17
2.2	Factors and Variables of Big Data Analytics Capabilities	18
2.3	Factors and Variables of Big Data Analytics Quality	21
2.4	Summary of Big Data Analytics Implementation Factors from Previous Studies	32
3.1	The Structure of Questionnaire	47
3.2	Expert Reviewers Profile	49
3.3	I-CVI and Kappa Threshold Values	51
3.4	Item Content Validity Index (I-CVI), Kappa (K) and Interpretations for Expert Review	53
3.5	G*Power Analysis for Sample Size	57
3.6	Demographic Profiles of the Respondents in Pilot Study (n=32)	59
3.7	Person Reliability of 32 Respondents	61
3.8	Item Reliability of 59 Items	62
3.9	Item Fit	64
3.10	Standardized Residual Variance (in Eigenvalue Units)	69
3.11	Scaling Categories	70
3.12	Number of Items Remains and Removed After Data Analysis	73
3.13	The Reliability of Each Item in the Pilot Study (n=32)	75
3.14	Revised Questionnaires Based on Expert Reviewed and Pilot Study	77
3.15	Summary of Indices for Measurement Model Assessment using PLS-SEM	83
3.16	Summary of Indices for Structural Model Assessment using PLS-SEM	85
3.17	Usability Testing Questionnaire Items using PSSUQ	88
4.1	Operational Definitions of Constructs	92
5.1	Harman's Single-factor Test Result	104

5.2	Demographic Profiles of the Respondents in Actual Study (n=140)	107
5.3	Cronbach's Alpha for Constructs	108
5.4	Internal Consistency and Convergent Validity of Research Model	110
5.5	Cross Loading of Constructs for Discriminant Validity Assessment	112
5.6	Fornell-Larcker Criterion for Discriminant Validity Assessment	114
5.7	Heterotrait Monotrait (HTMT) Criteria for Discriminant Validity Assessment	115
5.8	Inner Variance Inflation Factor (VIF) Values	116
5.9	Path Coefficient	117
5.10	R Square Values of Endogenous Constructs	118
5.11	F Square Assessment Results	119
5.12	Result of Predictive Relevance (Q^2)	120
5.13	Analysis of Direct Path Coefficient and Significant Value Before Interaction Effect of the Moderator	120
5.14	Analysis of Effect Size (f^2) for BDI construct	121
5.15	Result of the Interaction Effect Analysis	121
5.16	The Summary of Path Coefficient	122
5.17	Hypotheses Testing Results	123
6.1	User Roles for e-BiGIS Application	129
6.2	Definition of AHP Variable Names	136
6.3	Random Consistency Indices	137
6.4	Software Requirements	137
6.5	Menu and Sub-Menu	138
6.6	Summary of Risk Level for Assessment Result	144
7.1	Demographic of Participants (n=10)	152
7.2	Summary of Agreement Level for Post-Survey Usability Testing	153

LIST OF FIGURES

Figure		Page
2.1	The Malaysian Big Data Analytics Framework at National Level	11
2.2	The Malaysian Public Sector of Big Data Analytics Framework	12
2.3	NAHRIM Big Data Framework	12
2.4	D&M IS Success Model	19
2.5	Update D&M IS Success Model	20
2.6	The Technology-Organization-Environment Framework	22
2.7	Big Data Theory Model	24
3.1	The Research 'Onion'	42
3.2	Operational Research Framework	43
3.3	The Systematic Review Stages and Processes	44
3.4	Survey Instrument Development Process	45
3.5	Wright Map for Pilot Study	63
3.6	The Probability of Curve of Rating Categories	71
4.1	Proposed Big Data Analytics Implementation (BDI) Model	91
4.2	Proposed BDI Model with Hypotheses	100
5.1	Actual Study Analysis Process	103
5.2	Result of Skewness and Kurtosis of Survey Data	105
5.3	Measurement Model	109
5.4	Results of the Structural Model for Direct Path Coefficient Testing	118
5.5	Moderating and Direct Links of AC and BDI	122
5.6	Plotting Graph of Interaction Term of AC*TS	122
5.7	Structural Model Testing Results	124
5.8	Revised BDI Model	125
6.1	Prototype Process Flow	128

6.2	Use Case Diagram for Users Interaction	129
6.3	3-Tier System Architecture of e-BiGIS	130
6.4	External Interface Requirement	131
6.5	BDA Manager Screen Layout	131
6.6	Team Member Screen Layout	132
6.7	Decision Maker Screen Layout	132
6.8	System Administrator Screen Layout	133
6.9	Schematic Diagram of Modules Components	134
6.10	Four Steps of AHP Analysis Process	135
6.11	Hierarchical Structure of BDA Implementation	135
6.12	Introduction Page	139
6.13	List of Assessment	139
6.14	Create New Assessment	140
6.15	Criteria and Items Selection for Assessment	140
6.16	Member's Selection List	141
6.17	New Assignment List for Team Member Introduction Page	141
6.18	Assessment in Progress	142
6.19	Implementation Framework for Validation	143
6.20	Sub-Criteria Dashboard	145
6.21	Overall Calculation Dashboard	146
6.22	The Rank and Graph Dashboard	147
6.23	Printable Evaluation Report	148
7.1	Results of Participants' Feedback on Prototype	156

LIST OF ABBREVIATIONS

AC	Analytics Culture
aDRSA	Malaysian Public Sector Big Data Analytics Framework
AHP	Analytical Hierarchical Process
AIS	Association of Information Systems
AS	Analytics Skills
AVE	Average Variance Extracted
BDA	Big Data Analytics
BI	Big Data Analytics Implementation
BDI	Big Data Analytics Implementation
BS	Big Data Strategy
BV	Business Value
CEO	Chief Executive Officer
CFO	Chief Financial Officer
CI	Consistency Index
CIO	Chief Information Officer
CM	Consistency Measure
COO	Chief Operating Officer
CR	Composite Reliability
CVI	Content Validity Index
DF	Data Infrastructures
DI	Data Infrastructures
DE	Organizational Decision-Making
D&M	DeLone and McLean
e-BiGIS	Online Big Data Implementation Assessment System

GLCs	Government Linked Companies
ICT	Information and Communication Technology
I-CVI	Item Level Content Validity Index
IF	Implementation Framework
IP	Information Processing
IQ	Information Quality
IS	Information System
ISSM	Information Systems Success Model
IT	Information Technology
K	Kappa or Modified Kappa
MAMPU	Malaysian Administrative Modernisation and Management Planning Unit
MDeC	Malaysia Digital Economy Corporation
MS	Managerial Skills
MNSQ	Outfit Mean Square
NAHRIM	National Hydraulic Research Institute of Malaysia
NC	No Changes
OLS	Ordinary Least Squares
PIDM	Person-Item Distribution Map
PODC	Process-Oriented Dynamic Capabilities
PSSUQ	Post-Study System Usability Questionnaire
PLS	Partial least squares
PLS-SEM	Partial Least Squares-Structural Equation Modelling
PTMCorr	Point-Measure Correlation
RBV	Resourced-based View Theory
RC	Resource Commitment

RI	Random Consistency Index
SEM	Structural Equation Modelling
SME	Subject Matter Expert
SPSS	Statistical Package for Social Science
UK	United Kingdom
USA	United States of America
TS	Top Management Support
TOE	Technology-Organization-Environment Framework
VRI	Value, Rarity and Inimitability
VRIN	Valuable, Rare, Imperfectly inimitable and Non-substitutability
ZSTD	Outfit Standardized Mean Square

CHAPTER 1

INTRODUCTION

1.1 Research Background

Big data analytics (BDA) has a pivotal role in organizations to support accurate decision-making and to boost economic performance (Cao & Duan, 2014; Kamioka & Tapanainen, 2014). At present, BDA has been broadly implemented in organizations to support several activities, such as data visualisation analysis, managerial decision making, and organizational performance measurement. These BDA applications facilitate organizations to acquire, store, process, transform and analyse massive amounts and various types of data, which eventually deliver meaningful information that allows them to discover new insights for decision-making, apart from gaining competitive advantage of the firm (Thirathon et al., 2017).

The BDA implementation refers to the process of managing BDA resources, inclusive of technologies, people, and analytic processes (Koronios et al., 2014). The goal is to transform big data into valuable and meaningful information (Watson, 2014) through the use of analytic applications in gaining insights for effective decision-making and enhancing organizational performance (Akter et al., 2016a; Wamba et al., 2015). The analytic outcomes, which have been applied by business leaders and decision makers, have improved the quality of decision-making and captured business opportunities that facilitate better planning in management and operational activities (Wang et al., 2017). The BDA implementation contributes to strategic long-term planning to support business growth and value creation, which can enhance organizational performance (Popovič et al., 2016; Wang et al., 2017).

To date, organizations have invested in BDA to accomplish many analytical tasks, wherein BDA can be classified into various domains-specific, including supply chain management (Chen et al., 2015; Waller & Fawcett, 2013), manufacturing (Cao & Duan, 2014; Dutta & Bose, 2015; Popovič et al., 2016), retail (Wamba et al., 2017), financial (Huang et al., 2018), and healthcare (Wang & Byrd, 2017; Zainudin & Shamsuddin, 2016). As the application of big data has been successfully implemented across industrial organizations, the public sectors also seek the implementation of big data to effectively improve service delivery (Gamage, 2016).

Upon reckoning the impact of BDA applications, governments worldwide have begun investing heavily in big data initiatives, as big data have been applied effectively by a range of public sector entities in developed nations, including the USA, Australia, Japan, France, and Mexico, as well as developing nations, such as India, Malaysia, Bahrain, Chile, Brazil, and Kenya (Gamage, 2016). Gartner carried out a survey and revealed that analytics was ranked second in technologies that is crucial for investment to meet the mission of the public sector (Gamage, 2016). Meanwhile, heavy investment in BDA increases the impact of information technology (IT) on the

competitive capability of organizations, which has shifted the focus and attention on the need for effective big data implementation (Garmaki et al., 2016).

Big data is a new frontier for the public sector in the context of Malaysia. Daily operations in the public sector accumulate massive, rapid, and various types of datasets from a range of database sources. The advent of information in digital format has created vast opportunities, advantages, and potential value to public sector entities, as well as several governmental bodies, in terms of functional areas, such as health, defence, public safety, social services, transportation, disaster management, and tax (Gamage, 2016). Unlike the private domain, the implementation of big data across public sector entities mainly addresses several major national challenges associated with citizens, economy, employment opportunities, natural disasters, and terrorism (Anna & Nikolay, 2015). In this regard, many organizations, particularly the public sectors, have benefited from BDA implementation in a number of ways, such as cost reduction, enhanced service delivery, increased transparency, and improved decision making (Anna & Nikolay, 2015). With the status as a developing nation, Malaysia upholds that BDA initiatives can transform the delivery of public sector services. In steering the direction and strategic planning of successful BDA implementation, a BDA framework was built in light of the national and public sectors (Abdullah et al., 2017a).

Despite successful BDA implementation, there are few challenges that organizations have faced in relation to unfit capabilities, resources, and commitment of BDA technologies, such as insufficient analytics infrastructures (Janssen et al., 2017). These challenges have resulted in extended time for analyses, poor data quality, and lack of complete information (Kwon et al., 2014; Ji-fan Ren et al., 2016), which eventually affects the output presentation and incomplete analytic reports (LaValle et al., 2011). Poor data quality has led to low data utilisation efficiency and has even caused grave decision-making errors (Halaweh & El Massry, 2015; Cai & Zhu, 2015). Hence, big data users have been disappointed with the outcomes of the analytics due to incomplete analytic reports that somewhat affect the organizational decision and performance in an adverse manner (Abbas & Aggarwal, 2010). Furthermore, big data users have become concerned regarding the incompetent skills to critically analyse complex and unstructured data (Gamage, 2016; Gupta & George, 2016). Due to lack of analytical skills and experiences, they have failed to provide relevant analytic presentations and prepared incomplete reports for decision making (Kwon et al., 2014; Ji-fan Ren et al., 2016; Wamba et al., 2017). These issues exert a negative impact on corporate image and reputation, thus affecting the quality of decision-making and future business prospects. As a result, a number of organizations have begun to realise that the deployment of BDA does not entirely bring positive impact in decision-making for both private and public domains (Abbas & Aggarwal, 2010).

There is also a concern in relation to the increasing of operational budgets for future planning and financial investment in maximising the value of BDA implementation, which has drawn great challenges to decision makers. In ensuring the success of BDA implementation, McAfee and his colleague (McAfee & Brynjolfsson, 2012) have put

forward five management challenges and capabilities that are critical in big data environment, namely, leadership, talent management, technology infrastructure, decision-making, and company culture. Indeed, it is useful for the organization to further investigate the factors affecting successful BDA implementation in addressing new issues and uprising challenges (LaValle et al., 2011).

1.2 Problem Statement

In the Malaysian Public Sector, although earlier BDA initiatives have been successfully implemented in 2015, the successful rate by the government organizations has been growing very slow even after almost five years operations (Gamage, 2016). A number of issues have been highlighted in BDA implementation especially in the Malaysian organizations: the understanding of big data definition related to its V's characteristic, the role of information technology in BDA implementation, and the dispersion of data and the relevancy of BDA (Abdullah et al., 2017a). Even though the government organizations are keen to implement BDA, the various constraints of government as compared to private sector in terms of expert, financial and technological resources, could lead to complex and expensive BDA project that might affect their operations (Gupta & George, 2016; Halaweh & El Massry, 2015). Generally, the implementation of big data is not merely a technical issue, but linked with people and organizational resources issues (Huang et al., 2018), as some public sector entities have failed to succeed in BDA implementation. In fact, there were a few disaster stories in BDA implementation projects including insufficient resources in term of technology, employees, operational and financial, due to the lack of solid management tools for monitoring and evaluation on the success of BDA implementation process (Abbasi et al., 2016). This highlights the importance for big data users to know the pre-requisite factors since the implementation of BDA projects involves high level of implementation risks and investment to the organizations. Understanding the strengths and shortcomings of BDA affecting factors enhance the ability of the organizations to plan and develop their application strategy.

BDA implementation success has evolved, and the contributing factors are still under discussion. Several conceptual models derived from prior studies, which investigated the influence of big data capabilities on organizational performance, have been developed in light of the industrial stance (Akter et al., 2016). Current practical big data models have been largely based on the experience of income based companies which are rather different from that in public sectors (Akter et al., 2016; Huang et al., 2018; Jeble et al., 2018). Gupta and colleague (Gupta & George, 2016) determined the BDA capabilities for organizational performance: a cluster of data, basic resources and technology, managerial skills, technical skills, data-driven culture and the intensity of organizations learning. Their model, however, lacks of important factors such as organizational resources, information procession and information quality. Ji-fan et al. (2016) determined that information and data quality were among the few factors for achieving a great firm performance. In a similar study conducted in the United Kingdom (Cao & Duan, 2014), it was found out that information processing capability was among the important factors in achieving competitive advantage. On the contrary, Joshi and his colleague (Joshi & Biswas, 2018) recently determined that

the top management support and organizational commitment were among the important factors for achieving the success of big data adoption. Therefore, the prior studies, which were grouped with specific themes, did not measure the overall resources relationship between factors affecting successful BDA implementation. BDA organization requires multidimensional factors to ensure success in its implementation. Thus, a specific BDA implementation model focusing on government organization is essential to establish the solution for this theoretical bridge.

Based on the above reasons, a pressing need presently is to conduct studies on BDA implementation in the Malaysian Public Sector, on the affecting factors that contribute to the successful of BDA implementation so that the findings can improve the success rate of BDA implementation in the government organizations, as well as to address the uprising issues.

1.3 Research Questions

The research questions of this study are designed to guide the operational of this research, which include the following:

(i) What are the factors affecting the success of BDA implementation?
(ii) How does the integration of factors from organizational resources, technology resources and human resources able to affect successful BDA implementation?
(iii) How does the BDA implementation model be functional and suitable for big data organizations in Malaysian Public Sector?

1.4 Research Objectives

The objectives of this present study are described as the following:

(i) To investigate the factors affecting successful BDA implementation in the Malaysian Public Sector.
(ii) To propose and evaluate a new approach of the BDA implementation model for Malaysian Public Sector.
(iii) To validate the BDA implementation model using a prototype tool.

1.5 Scope of Research

The study focuses on investigating the factors that affect the successful of BDA implementation in the Malaysian Public Sector. This study analyses the primary data gathered from the government organizations that have involved in the First and Second Phases of the Malaysian Public Sector Big Data Analytics pilot studies listed

and monitored by Malaysian Administrative Modernisation and Management Planning Unit (MAMPU). The multi-group level of BDA team members in the government organizations in Klang Valley and Putrajaya, Malaysia, have been set as the respondents for the data collection. In the end, this study managed to gather data from a sample of 140 respondents. As the foundation to this study, resource-based view (RBV) and the updated DeLone & McLean Information Systems Success Model (ISSM) theories have been used as the supporting theories to support the research model.

1.6 Significance of Research

This section deliberates the significance of the study from theoretical and practical perspectives.

1.6.1 Theoretical Contribution

The main contribution of the study is that it provides a conceptual model for the big data analytics implementation by identifying the big data resource factors that affect the successfulness of BDA implementation in the Malaysian Public Sector. The relationships between the determinants, i.e. from organizational, talent and technology resources, contribute to the body of knowledge in big data environment.

1.6.2 Practical Contribution

The findings of this study will benefit both scholars and big data practitioners. The study also provides insights for organizational management, particularly top management, to maximise the BDA value for the organizational decision-making by evaluating the strengths and weaknesses of BDA resources that affecting its implementation. The findings from this study are useful in addressing the uprising BDA implementation issues and beneficial for future strategic investment decisions.

1.7 Thesis Organization

This thesis comprises of eight (8) chapters namely introduction, literature review, research methodology, model development, empirical study, prototype development and implementation of the proposed model, results and discussions, and finally, conclusions and future work. A brief description of each chapter is presented as follows:

Chapter 1: Introduction

The first chapter presents the overview and background of the research including the problem statement, research objectives, research scope and significance of the study. Thesis organization of the study is the end of chapter one.

Chapter 2: Literature Review

This chapter details out the literature review undertaken for the purpose of the research. Discussions regarding determinants in BDA implementation followed by the theory of the study are included. Past literatures are reviewed and discussed together with the variables related to the BDA implementation model, and consequently, the research gaps are highlighted.

Chapter 3: Research Methodology

This chapter explains the research methodology and statistical techniques adopted and used in the study. This chapter established the positivism research approach, quantitative method and survey design that includes research design, the procedure of the sample, data collection methods and research instrument. This section presents in-depth analysis of the expert opinion and the empirical evaluation of theoretical model. The research activity continues with a pilot study. Based on the data collected in the pilot study, the chapter discusses the validity and reliability of the survey instrument used before it can be used in the actual study. The research then continues with the development of the prototype, the implementation of the proposed model and the validation of the model by experts and BDA users.

Chapter 4: Model Development

This section discusses the development of the hypothesized model and the eleven research hypothesis.

Chapter 5: Empirical Study

This section presents the assessment of measurement and structural model using the Partial Least Square of Structural Equation Modelling (PLS-SEM) approach. This chapter presents detailed discussion on the findings of this study that include the significance of the relationship among the proposed constructs.

Chapter 6: Prototype Development and Implementation of the Proposed Model

This chapter illustrates the prototype design of the detailed steps involved in the development process, which include the prototype design, system architecture, module development, software requirement, and the prototype user interface design. It also presents the findings of the implementation framework for validating the

proposed model alongside evaluating the BDA implementation in the field of study. The implementation framework consists of the integration of the determinant from the revised model in Chapter 5, and then it continues with the evaluation process of the factors affecting the successful BDA implementation, which encompasses task assignment, assessment, AHP analysis, and finally the presentation of the assessment results.

Chapter 7: Results and Discussions

This chapter describes the results and findings of the implementation framework based on the verification and validation of the proposed model by the experts, followed by the evaluation involved during the testing of the prototype using the system usability scaling. This chapter concludes the discussion of the overall research.

Chapter 8: Conclusions and Future Work

This chapter presents the conclusion, theoretical and practical contribution of this research. It also presents the limitations and future directions of the study.

REFERENCES

Abbas, Q., & Aggarwal, A. (2010). Development of a Structured Framework To Achieve Quality Data. *International Journal of Advanced Engineering & Application*, 193–196.

Abbasi, A., Sarker, S., & Chiang, R. (2016). Big Data Research in Information Systems: Toward an Inclusive Research Agenda. *Journal of the Association for Information Systems*, *17*(2), i–xxxii.

Abdullah, M. F., Ibrahim, M., & Zulkifli, H. (2017a). Big Data Analytics Framework for Natural Disaster Management in Malaysia. In *The 2nd International Conference on Internet of Things, Big Data and Security (IoTBDS)*, 406–411.

Abdullah, M. F., Zulkifli, H., & Ibrahim, M. (2017b). Big Data Technology Implementation in Managing Water Related Disaster: NAHRIM's Experience. In *The 37th IAHR World Congress*, 1–8.

Akter, S., & Wamba, S. F. (2016a). Big data analytics in E-commerce: a systematic review and agenda for future research. *Electronic Markets*, *26*(2), 173–194.

Akter, S., Wamba, S. F., Gunasekaran, A., Dubey, R., & Childe, S. J. (2016b). How to improve firm performance using big data analytics capability and business strategy alignment? *International Journal of Production Economics*, *182*, 113–131.

Andrich, D. (1978). A rating formulation for ordered response categories. *Psychometrika*, *43*(4), 561–573.

Anna, K., & Nikolay, K. (2015). Survey on Big Data Analytics in Public Sector of Russian Federation. *Procedia Computer Science*, *55*(1), 905–911.

Aragón-Correa, J. A., & Sharma, S. (2003). A Contingent Resource-based View of Proactive Corporate Environmental Strategy. *Academy of Management Review*, 28(1), 71-88.

Armstrong, J. S., & Overton, T. (1977). Estimating Non-response Bias in Mail Surveys. *Journal of Marketing Research*, *14*(3), 396–402.

Autry, C. W., Griffis, S. E., Goldsby, T. J., & Bobbitt, L. M. (2005). Warehouse Management Systems: Resource Commitment, Capabilities, and Organizational Performance. *Journal of Business Logistics*, *26*(2), 165–183.

Aziz, A. A., Masodi, M. S., & Zaharim, A. (2013). *Asas Model Pengukuran Rasch: Pembentukan Skala dan Struktur Pengukuran*. Bangi: UKM.

Babu, P. M. S. P., & Sastry, S. H. (2014). Big Data and Predictive Analytics in ERP Systems for Automating Decision Making Process. In *2014 5th IEEE International Conference on Software Engineering and Service Science (ICSESS)* (pp. 259–262).

Baker, J. (2012). The Technology-Organization-Environment Framework. In *Information Systems Theory: Explaining and Predicting Our Digital Society, Vol. 1* (pp. 231–243). New York, NY.

Barclay, D., Higgins, C., & Thompson, R. (1995). The Partial Least Squares (PLS) Approach to Causal Modelling: Personal Computer Adoption and Use as an Illustration. *Technology Studies*, *2*(2), 285–309.

Barney, J. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management*, *17*(1), 99–120.

Bharadwaj, A. S. (2000). A Resource-Based Perspective on Information Technology Capability and Firm Performance: An Empirical Investigation. *MIS Quarterly*, *24*(1), 169–196.

Bond, T. & Fox, C. (2007). *Applying the Rasch Model: Fundamental Measurement in the Human Sciences (2nd Ed.)*. Mahweh, New Jersey: Lawrence Erlbaum.

Boudreau, M. C., Gefen, D., & Straub, D. W. (2001). Validation in Information Systems Research: A State-of-the-Art Assessment. *MIS Quarterly*, *25*(1), 1–16.

Brentari, E., Golia, S., & Manisera, M. (2007). Models for categorical data: a comparison between the Rasch model and Nonlinear Principal Component Analysis. *Statistics e Applicazioni*, *V*(1), 53–77.

Cai, L., & Zhu, Y. (2015). The Challenges of Data Quality and Data Quality Assessment in the Big Data Era. *Data Science Journal*, *14*(2), 1–10.

Cao, G., & Duan, Y. (2014). Gaining Competitive Advantage From Analytics Through The Mediation of Decision-Making Effectiveness : An Empirical Study of UK Manufacturing Companies. In *PACIS 2014 Proceedings* (p. 377).

Cao, G., Duan, Y., & Li, G. (2015). Linking Business Analytics to Decision Making Effectiveness : A Path Model Analysis. *IEEE Transactions on Engineering Management*, *62*(3), 384–395.

Carmines, E. G., & Zeller, R. A. (1979). *Reliability and Validity Assessment*. Beverly Hills, CA: SAGE Publication.

Castellan, C. M. (2010). Quantitative and Qualitative Research: A View for Clarity. *International Journal of Education*, *2*(2), 1-14.

Chatterjee, D., Grewal, R., & Sambamurthy, V. (2002). Shaping up for e-commerce: Institutional enablers of the organizational assimilation of web technologies. *MIS Quarterly*, *26*(2), 65–89.

Chen, D. Q., Preston, D. S., & Swink, M. (2015). How the Use of Big Data Analytics Affects Value Creation in Supply Chain Management. *Journal of Management Information Systems*, *32*(4), 4–39.

Chen, H., Chiang, R. H. L., & Storey, V. C. (2012). Business Intelligence and Analytics: From Big Data to Big Impact. *MIS Quarterly*, *36*(4), 1165–1188.

Chin, W. W. (1998). The Partial Least Squares Approach to Structural Equation Modeling. In *Modern Methods for Business Research* (pp. 295–336). Mahwah, New Jersey: Lawrence Erlbaum Associates.

Cicchetti, D. V., & Sparrow, S. A. (1981). Developing criteria for establishing interrater reliability of specific items: Application to assessment of adaptive behavior. *American Journal of Mental Deficiency*, *86*, 127–137.

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. Lawrence Erlbaum, Mahwah, NJ.

Collis, J., & Hussey, R. (2013). *Business Research: A Practical Guide for Undergraduate and Postgraduate Students (3rd Edition)*. New York: Palgrave Macmillan.

Cooper, D. R., & Schindler, P. S. (2011). *Business Research Methods Eleventh Edition* (McGraw-Hil). New York.

Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. SAGE Publication, Inc.

Davis, L. L. (1992). Instrument review: Getting the most from a panel of experts. *Applied Nursing Research*, *5*(4), 194–197.

DeLone, W. H., & McLean, E. R. (1992). Information System Success: The Quest for the Dependent Variable. *Information System Research*, *3*(1), 60–95.

DeLone, W. H., & McLean, E. R. (2003). The DeLone and McLean Model of Information Systems Success : A Ten-Year Update. *Journal of Management Information Systems*, *19*(4), 9–30.

DeLone, W. H., & McLean, E. R. (2016). *Information Systems Success Measurement*. *Foundations and Trends in Information Systems* (Vol. 2).

Demchenko, Y., De Laat, C., & Membrey, P. (2014a). Defining Architecture Components of the Big Data Ecosystem. In *2014 International Conference on Collaboration Technologies and Systems (CTS)*, 104–112.

Demchenko, Y., Gruengard, E., & Klous, S. (2014b). Instructional Model for Building Effective Big Data Curricula for Online and Campus Education. In *2014 IEEE 6th International Conference on Cloud Computing Technology and Science* (pp. 935–941). IEEE Computer Society.

Deshpande, R. (1983). "Paradigms Lost": On Theory and Method in Research in Marketing. *Journal of Marketing*, 47(4), 101-110.

Devece, C., Palacios, D., & Martinez-Simarro, D. (2016). Effect of information management capability on organizational performance. *Service Business*, 1–18.

Dutta, D., & Bose, I. (2015). Managing a Big Data project: The case of Ramco Cements Limited. *International Journal of Production Economics*, *165*, 293–306.

Emani, C. K., Cullot, N., & Nicolle, C. (2015). Understandable Big Data: A survey. *Computer Science Review*, *17*, 70–81.

Eyitayo, O. (2015). Improving ERP Implementation Through Knowledge Gained From End Users. *The European Conference on Information Systems Management*, 85-92.

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical Power Analyses using G*Power 3.1: Tests for Correlation and Regression Analyses. *Behavior Research Methods*, *41*, 1149–1160.

Fisher, W. P. J. (2007). Rating Scale Instrument Quality Criteria. *Rasch Measurement Transactions*, *21*(1).

Fleiss, J. L. (1981). *Statistical Methods for Rates and Proportions (2nd Ed.)*. New York: John Wiley.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equations models with unobservable variables and measurement error. *Journal of Marketing Research*, *18*(1), 39–50.

Fraenkel, J. R., & Wallen, N. E. (2009). *How to design and evaluate research in education (7th ed.)*. New York, NY: McGraw-Hill.

Gamage, P. (2016). New development: Leveraging 'big data' analytics in the public sector. *Public Money & Management*, *36*(5), 385–390.

Garmaki, M., Boughzala, I., & Wamba, S. F. (2016). The Effect of Big Data Analytics Capability on Firm Performance. *Pacific Asia Conference on Information Systems (PACIS)*.

Garrison, G., Wakefield, R. L., & Kim, S. (2015). The effects of IT capabilities and delivery model on cloud computing success and firm performance for cloud supported processes and operations. *International Journal of Information Management*, *35*(4), 377–393.

Gefen, D., Straub, D. W., & Boudreau, M.-C. (2000). Structural Equation Modeling and Regression: Guidelines for Research Practice. *Communications of the Association for Information Systems*, *4*(7), 1–70.

Geisser, S. (1974). A predictive approachto the random effects model. *Biometrika*, *61*, 101–107.

Glaser, B. G., & Strauss, A. L. (1967). *The Discovery of Grounded Theory: Strategies for Qualitative Research*. Chicago, IL: Aldine.

Gliem, J. A., & Gliem, R. R. (2003). Calculating , Interpreting , and Reporting Cronbach ' s Alpha Reliability Coefficient for Likert-Type Scales. In *Midwest Research to Practice Conference in Adult, Continuing, and Community Education* (pp. 82–88).

Gnanasundaram, C., & Vallieswaran, V. (2007). Determining Software Development Strategies. In *The 3rd Malaysian Software Engineering Conference*.

Gold, A. H., Malhotra, A., & Segars, A. H. (2001). Knowledge Management: An Organizational Capabilities Perspective. *Journal of Management Information Systems*, *18*(1), 185–214.

Gorla, N., Somers, T. M., & Wong, B. (2010). Organizational impact of system quality, information quality, and service quality. *Journal of Strategic Information Systems*, *19*(3), 207–228.

Grant, J. S., & Davis, L. L. (1997). Selection and Use of Content Experts for Instrument Development. *Research in Nursing & Health*, *20*(3), 269-274.

Gupta, M., & George, J. F. (2016). Toward the Development of a Big Data Analytics Capability. *Information & Management*, *53*(8), 1046–1064.

Hair, J. J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2017). *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM) 2nd Edition*. USA: SAGE Publication, Inc.

Halaweh, M., & El Massry, A. (2015). Conceptual Model for Successful Implementation of Big Data in Organizations. *Journal of International Technology and Information Management*, *24*(2), 21–29.

Haneem, F., Kama, N., Taskin, N., Pauleen, D. & Abu Bakar, N. A. (2019). Determinants of Master Data Management Adoption by Local Government Organizations: An Empirical Study. *International Journal of Information Management*, 45, 25-43.

Hartmann, D. P. (1977). Considerations in the choice of interobserver reliability measures. *Journal of Applied Behavior Analysis*, *10*(1), 103–116.

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, *43*(1), 115–135.

Hertzog, M. A. (2008). Considerations in Determining Sample Size for Pilot Studies. *Research in Nursing & Health*, *31*, 180–191.

Hu, H., Wen, Y., Chua, T.-S., & Li, X. (2014). Toward Scalable Systems for Big Data Analytics: A Technology Tutorial. *IEEE Access*, *2*, 652–687.

Huang, C., Wang, T., & Huang, T.-Y. (2018). Initial Evidence on the Impact of Big Data Implementation on Firm Performance. *Information Systems Frontiers*, 1–13.

Hunter, M. G. (2012). Conducting Information Systems Research Using Narrative Inquiry. In *Information Systems Theory: Explaining and Predicting Our Digital Society, Vol. 2* (pp. 349–365). New York, NY: Springer Science+Business Media.

Janssen, M., Van Der Voort, H., & Wahyudi, A. (2017). Factors influencing big data decision-making quality. *Journal of Business Research*, *70*, 338–345.

Jeble, S., Dubey, R., Childe, S. J., Papadopoulos, T., Roubaud, D., & Prakash, A. (2018). Impact of big data and predictive analytics capability on supply chain sustainability. *International Journal of Logistics Management*, *29*(2), 513–538.

Ji-fan Ren, S., Fosso Wamba, S., Akter, S., Dubey, R., & Childe, S. J. (2016). Modelling quality dynamics, business value and firm performance in a big data analytics environment. *International Journal of Production Research*, 1–16.

Johnson, D. R., & Bachan, L. K. (2013). What can we learn from studies based on small sample sizes? Comment on Regan, Lakhanpal, and Anguiano (2012). *Psychological Reports*, *113*, 221–224.

Joshi, M., & Biswas, P. (2018). An Empirical Investigation of Impact of Organizational Factors on Big Data Adoption. In *Proceedings of First International Conference on Smart System, Innovations and Computing* (pp. 809–824). Springer, Singapore.

Kabir, N., & Carayannis, E. (2013). Big Data , Tacit Knowledge and Organizational Competitiveness. *Journal of Intelligence Studies in Business*, *3*, 54–62.

Kamioka, T., & Tapanainen, T. (2014). Organizational Use of Big Data and Competitive Advantage – Exploration of Antecedents. *PACIS 2014 Proceedings*, *Paper 372*, 372.

Kim, M.-K., & Park, J.-H. (2016). Identifying and prioritizing critical factors for promoting the implementation and usage of big data in healthcare. *Information Development*, 1–13.

Kiron, D. (2013). Organizational Alignment is Key to Big Data Success. *MIT Sloan Management Review*, *54*(3).

Kitchenham, B., & Charters, S. (2007). Guidelines for performing Systematic Literature Reviews in Software Engineering. EBSE Technical Report (EBSE-2007-01) (Vol. 2).

Koronios, A., Gao, J., & Selle, S. (2014). Big Data Project Success - A Meta Analysis. In *18th Pacific Asia Conference on Information Systems, PACIS* (pp. 376–390).

Kowalczyk, M., & Buxmann, P. (2015). An ambidextrous perspective on business intelligence and analytics support in decision processes: Insights from a multiple case study. *Decision Support Systems*, *80*, 1–13.

Krueger, R. A., & Casey, M. A. (2000). *Focus Groups: A Practical Guide for Applied Research*. California: Thousand Oaks Sage.

Kulkarni, U. R., Robles-Flores, J. A., & Popovič, A. (2017). Business Intelligence Capability: The Effect of Top Management and the Mediating Roles of User Participation and Analytical Decision Making Orientation. *Journal of Association for Information Systems*, *18*(7), 516–541.

Kung, L., Jones-farmer, A., & Wang, Y. (2015). Managing Big Data for Firm Performance : A Configurational Approach. *Twenty-First Americas Conference on Information Systems*, 1–9.

Kwon, O., Lee, N., & Shin, B. (2014). Data Quality Management, Data Usage Experience and Acquisition Intention of Big Data Analytics. *International Journal of Information Management*, *34*, 387–394.

Lai, F., Li, D., Wang, Q., & Zhao, X. (2008). The Information Technology Capability of Third-Party Logistics Providers: A Resource-Based View and Empirical Evidence From China. *Journal of Supply Chain Management*, *44*(3), 22-38.

LaValle, S., Lesser, E., Shockley, R., Hopkins, M. S., & Kruschwitz, N. (2011). Big Data, Analytics and the Path from Insights to Value. *MIT Sloan Management Review*, *52*(2), 21–34.

Lewis, J. R. (1995). IBM Computer Usability Satisfaction Questionnaires: Psychometric Evaluation and Instructions for Use. *International Journal of Human-Computer Interaction*, *7*(1), 57–78.

Linacre, J. M. (2007). A User's Guide to WINSTEPS/MINISTEP Rasch-Model Computer Programs. Chicago: MESA Press.

Linying, D. (2001). Modeling top management influence on ES implementation. *Business Process Management Journal*, *7*(3), 243.

Lynn, M. R. (1986). Determination and quantification of content validity. Nursing Research.

Mach-Król, M. (2015). A Survey and Assessment of Maturity Models for Big Data Adoption. In *11th International Conference on Strategic Management and Its Support by Information Systems (SMSIS)* (pp. 391–399).

Mackenzie, S. B., Podsakoff, P. M., & Podsakoff, N. P. (2011). Construct Measurement and Validation Procedures in MIS and Behavioral Research: Integrating New and Existing Techniques. *MIS Quarterly*, *35*(2), 293–334.

Makadok, R. (1999). Interfirm Differences in Scale Economies and the Evolution of Market Shares. *Strategic Management Journal*, *20*(10), 935–952.

MAMPU. (2017). *Pelaksanaan Analitis Data Raya Sektor Awam (aDRSA)*. *Pekeliling Transformasi Pentadbiran Awam* (Vol. 1).

Mao, H., Liu, S., Zhang, J., & Deng, Z. (2016). Information technology resource, knowledge management capability, and competitive advantage: The moderating role of resource commitment. *International Journal of Information Management*, *36*(6), 1062–1074.

Mason, R. O. (1978). Measuring information output: A communication systems approach. *Information & Management*, *1*(5), 219–234.

McAfee, A., & Brynjolfsson, E. (2012). Big Data: The Management Revolution. *Harvard Business Review*, *90*(10), 60–68.

Memon, M. A., Ting, H., Ramayah, T., Chuah, F., & Cheah, J.-H. (2017). A Review of the Methodological Misconceptions and Guidelines to the Application of Structural Equation Modeling: A Malaysian Scenario. *Journal of Applied Structural Equation Modeling*, *1*(1), i-xiii.

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric Theory (3rd Ed.)* (Third). New York, NY: McGraw-Hill, Inc.

Okoli, C., & Schabram, K. (2010). A Guide to Conducting a Systematic Literature Review of Information Systems Research. *Sprouts: Working Papers on Information Systems*, 10(26), 1–51.

Pääkkönen, P., & Pakkala, D. (2015). Reference Architecture and Classification of Technologies, Products and Services for Big Data Systems. *Big Data Research*, *1*.

Phillips-Wren, G., & Hoskisson, A. (2015). An analytical journey towards big data. *Journal of Decision Systems*, *0125*(June), 1–16.

Pinsonneault, A., & Kraemer, K. (1993). Survey Research Methodology in Management Information Systems: An Assessment. *Journal of Management Information Systems*, *10*(2), 75–105.

Pitt, L. F., Watson, R. T., & Kavan, C. B. (1995). Service Quality: A Measure of Information Systems Effectiveness. *MIS Quarterly*, *19*(2), 173–187.

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies. *Journal of Applied Psychology*, *88*(5), 879–903.

Podsakoff, P. M., & Organ, D. W. (1986). Self-Reports in Organizational Research: Problems and Prospects. *Journal of Management*, *12*(1), 531–544.

Polit, D. F., Beck, C. T., & Owen, S. V. (2007). Is the CVI an acceptable indicator of content validity? *Research in Nursing & Health*, *31*, 341–354.

Popovič, A., Hackney, R., Coelho, P. S., & Jaklič, J. (2012). Towards business intelligence systems success: Effects of maturity and culture on analytical decision making. *Decision Support Systems*, *54*(1), 729–739.

Popovič, A., Hackney, R., Tassabehji, R., & Castelli, M. (2016). The Impact of Big Data Analytics on Firms' High Value Business Performance. *Information Systems Frontiers*, 1–14.

Pospiech, M., & Felden, C. (2015). Towards a Big Data Theory Model. In *2015 IEEE International Conference on Big Data* (pp. 2082–2090).

Pospiech, M., & Felden, C. (2016). Big Data – A Theory Model. In *49th Hawaii International Conference on System Sciences* (pp. 5012–5021). IEEE.

Pratt, D. (1980). *Curriculum, Design, and Development*. Wadsworth Pub Co.

Premkumar, A. G., Ramamurthy, K., & Saunders, C. S. (2012). View of Information Processing An Exploratory Organizations : of of Fit in the Context Examination Relationships Interorganizational. *Journal of Management*, *22*(1), 257–294.

Proctor, E., Silmere, H., Raghavan, R., Hovmand, P., Aarons, G., Bunger, A., Griffey, R. & Hensley, M. (2011). Outcomes for implementation research: Conceptual distinctions, measurement challenges, and research agenda. *Administration and Policy in Mental Health and Mental Health Services Research*, *38*(2), 65–76.

Raguseo, E. (2018). Big data technologies: An empirical investigation on their adoption, benefits and risks for companies. *International Journal of Information Management*, *38*(1), 187–195.

Raguseo, E., & Vitari, C. (2018). Investments in big data analytics and firm performance: an empirical investigation of direct and mediating effects. *International Journal of Production Research*, *7543*, 1–16.

Rahrovani, Y., Kermanshah, A., & Pinsonneault, A. (2014). Aligning IT for Future Business Value : Conceptualizing IT Project Portfolio Alignment. *The DATA BASE for Advanced in Information Systems*, *45*(3), 30–53.

Ramayah, T., Cheah, J., Chuah, F., Ting, H., & Memon, M. A. (2018). *Partial Least Squares Structural Equation Modeling (PLS-SEM) using SmartPLS 3.0 : An Updated and Practical Guide to Statistical Analysis*. Kuala Lumpur, Malaysia: Pearson.

Rasch, G. (1960). *Probabilistic Models for Some Intelligence and Attainment Test*. Copenhagen: Danish Institute for Educational Research.

Richey, R. G., Genchev, S. E., & Daugherty, P. J. (2005). *The role of resource commitment and innovation in reverse logistics performance*. *International Journal of Physical Distribution and Logistics Management* (Vol. 35).

Ross, J. W., Beath, C. M., Goodhue, D. L. (1996). Develop Long-term Competitiveness Through IT Assets. *Sloan Management Review,* 38 (1), 31-42.

Saaty, T. L. (1980). *The Analytic Hierarchy Process*. New York, NY: McGraw-Hill.

Saaty, T. L. (2008). Decision making with the analytic hierarchy process. *International Journal of Services Sciencies*, *1*(1), 83–98.

Saggi, M. K., & Jain, S. (2018). A survey towards an integration of big data analytics to big insights for value-creation. *Information Processing and Management*, *54*(5), 758–790.

Saunders, M., Philip, L., & Thornhill, A. (2009). *Research Methods for Business Students Fifth Edition*. Pearson.

Schumm, W. R., Pratt, K. K., Hartenstein, J. L., Jenkins, B. A., & Johnson, G. A. (2013). Determining statistical significance (alpha) and reporting statistical trends: controversies, issues, and facts. *Comprehensive Psychology*, *2*(10), 1–6.

Sekaran, U., & Bougie, R. (2010). *Research Methods for Business: A Skill-Building Approach* (5th ed.). New York, USA: John Wiley & Sons.

Shannon, C. E., & Weaver, W. (1949). *The Mathematical Theory of Communication*. Urbana IL: University of Illinois Press.

Sharma, R., Mithas, S., & Kankanhalli, A. (2014). Transforming decision-making processes: a research agenda for understanding the impact of business analytics on organisations. *European Journal of Information Systems*, *23*(4), 433–441.

Shim, J. P., French, A. M., Guo, C., & Jablonski, J. (2015). Big Data and Analytics: Issues, Solutions, and ROI. *Communications of the Association for Information Systems*, *37*(39), 797–810.

Singleton, R. A., & Straits, B. C. (2005). *Approaches to Social Research*. New York: Oxford University Press.

Sommerville, I. (2011). *Software Engineering (9th ed.)*. Boston: Addison-Wesley.

Stemler, S. E. (2004). A Comparison of Consensus, Consistency, and Measurement Approaches to Estimating Interrater Reliability. *Pratical Assessment Research & Evaluation*, *9*(4), 1–19.

Stone, M. (1974). Cross-validatory choice and assessment of statistical predictions. *Journal of Royal Statistical Society*, *36*, 111–147.

Straub, D., Boudreau, M. C., & Gefen, D. (2004). Validation Guidelines for IS Positivist Research. *Communications of the Association for Information Systems*, *13*(24), 380–427. https://doi.org/Article

Sung, S. Y., & Choi, J. N. (2014). Do organizations spend wisely on employees? Effects of training and development investments on learning and innovation in organizations. *Journal of Organizational Behavior*, *35*(3), 393–412.

Tabachnick, B.G., & Fidell, L.S. (2007). *Using Multivariate Statistics (6th Edition)*. Pearson.

Taher, M. (2012). Resource-based View Theory. In *Information Systems Theory: Explaining and Predicting Our Digital Society, Vol. 1* (pp. 151–163). New York, NY: Springer Science Business Media.

Teijlingen Van, E. R., Rennie, A. M., Hundley, V., & Graham, W. (2001). The importance of conducting and reporting pilot studies: the example of the Scottish Births Survey. *Journal of Advanced Nursing*, *34*(3), 289–295.

Teo, T. S. H., Srivastava, S. C., & Jiang, L. (2008). Trust and Electronic Government Success: An Empirical Study. *Journal of Management Information Systems*, *25*(3), 99–132.

Thirathon, U., Wieder, B., Matolcsy, Z., & Ossimitz, M. L. (2017). Big Data, Analytic Culture and Analytic-Based Decision Making Evidence from Australia. In *Procedia Computer Science* (Vol. 121, pp. 775–783). Elsevier.

Thirathon, U., Wieder, B., & Ossimitz, M. L. (2018). Determinants of analytics-based managerial decision-making. *International Journal of Information Systems and Project Management*, *6*(1), 27–40.

Tornatzky, L. G., & Fleischer, M. (1990). *The Processes of Technological Innovation*. *Lexington Books*.

Tseng, S. (2017). How information quality leads to operational capabilities and corporate performance. *International Journal of Innovative Science, Engineering & Technology*, *4*(1), 26–34.

Turner, C., James, R., & Nielsen, J. (2006). Determining Usability Test Sample Size. *International Excyclopedia of Ergonomics and Human Factors*, *3*.

Urbach, N., & Ahlemann, F. (2010). Structural Equation Modeling in Information Systems Research using Partial Least Squares. *JITTA: Journal of Information Technology Theory And Application*, *11*(2), 5–40.

Verma, S. (2017). The Adoption of Big Data Services by Manufacturing Firms: An Empirical Investigation in India. *Journal of Information Systems and Technology Management*, *14*(1), 39–68.

Wade, M., & Hulland, J. (2004). Review: The Resource-Based View and Information Systems Research: Review, Extension, and Suggestions for Future Research. *MIS Quarterly*, *28*(1), 107–142.

Waller, M. A., & Fawcett, S. E. (2013). Data science, predictive analytics, and big data: A revolution that will transform supply chain design and management. *Journal of Business Logistics*, *34*(2), 77–84.

Wamba, F. S., Akter, S., Edwards, A., Chopin, G., & Gnanzou, D. (2015). How 'big data' can make big impact: Findings from a systematic review and a longitudinal case study. *International Journal of Production Economics*, *165*, 234–246.

Wamba, S. F., Gunasekaran, A., Akter, S., Ren, S. J., Dubey, R., & Childe, S. J. (2017). Big data analytics and firm performance: Effects of dynamic capabilities. *Journal of Business Research*, *70*, 356–365.

Wang, H., Xu, Z., Fujita, H., & Liu, S. (2016). Towards felicitous decision making: An overview on challenges and trends of Big Data. *Information Sciences*, *367–368*, 747–765.

Wang, Y., & Byrd, T. (2017). Business Analytics-Enabled Decision Making Effectiveness through Knowledge Absorptive Capacity in Health Care. *Journal of Knowledge Management*, *21*(3), 517–539.

Wang, Y., Kung, L., & Byrd, T. A. (2018). Big Data Analytics: Understanding Its Capabilities and Potential Benefits for Healthcare Organizations. *Technological Forecasting and Social Change*, *126*, 3–13.

Wang, Y., Kung, L., Wang, W. Y. C., & Cegielski, C. G. (2017). An Integrated Big Data Analytics-enabled Transformation Model: Application to Health Care. *Information & Management*, (April), 1–16.

Watson, H. J. (2014). Tutorial: Big Data Analytics: Concepts, Technologies, and Applications. *Communications of the Association for Information Systems*, *34*(65), 1247–1268.

Wernerfelt, B. (1984). A Resource-Based View of the Firm. *Strategic Management Journal*, *5*, 171–180.

Wiersma, W., & Jurs, S. G. (2005). *Research Methods in Education: An Introduction (8th Edition)*. Pearson.

Wilson, J. (2010). *Essentials of Business Research: A Guide to Doing Your Research Project*. SAGE Publications.

Wong, K. K. (2013). Partial Least Squares Structural Equation Modeling (PLS-SEM) Techniques Using SmartPLS. *Marketing Bulletin*, *24*(1), 1–32.

Wright, B. D., & Masters, G. N. (1982). *Rating Scale Analysis: Rasch Measurement*. Chicago: Mesa Press.

Wynd, C. A., Schmidt, B., & Schaefer, M. A. (2003). Two quantitative approaches for estimating content validity. *Western Journal of Nursing Research*, *25*(5), 508–518.

Zainudin, Z., & Shamsuddin, S. M. (2016). Predictive Analytics in Malaysian Dengue Data from 2010 until 2015 using BigML. *International Journal of Advances in Soft Computing and Its Applications*, *8*(3), 18–30.

Zhang, Z., & Yuan, K.-H. (2018). *Statistical Power Analysis Using Webpower and R*. Granger, IN: ISDSA Press.

Zhu, Y., Li, Y., Wang, W., & Chen, J. (2010). What leads to post-implementation success of ERP? An empirical study of the Chinese retail industry. *International Journal of Information Management*, *30*(3), 265–276.

BIODATA OF STUDENT

Cecilia Adrian pursued her studies in Diploma Computer Science in Universiti Putra Malaysia, Main Campus Serdang, Selangor in 1994 for a year. In 1995, she was promoted from Diploma to Bachelor programme and graduated in Bachelor Engineering (Electronic and Computer) in 1998. She pursued her master's degree at Newcastle University, United Kingdom and graduated with MSc. in Computer Security and Resilience in 2008. She has served the Federal Government of Malaysia for 20 years. She has worked in MAMPU Prime Minister's Department, Polytechnic Malaysia in Semambu Campus, Pahang, Ministry of Defence, Ministry of Health, The Headquarters of Department of Veterinary Services, Division of Housing Loan for Public Sector at Ministry of Finance, and Department of Statistics Malaysia.

LIST OF PUBLICATIONS

Cecilia Adrian, Rusli Abdullah, Rodziah Atan and Yusmadi Yah Jusoh (2018). Expert Review on Big Data Analytics Implementation Model in Data-driven Decision-Making, In 4th International Conference on Information Retrieval and Knowledge Management (CAMP), IEEEXplore, pp. 13-17.

Cecilia Adrian, Rusli Abdullah, Rodziah Atan and Yusmadi Yah Jusoh (2018). Conceptual Model Development of Big Data Analytics Implementation Assessment effect on Decision-Making, International Journal of Interactive Multimedia and Artificial Intelligence (IJIMAI), 5(1), pp. 101-106.

Cecilia Adrian, Rusli Abdullah, Rodziah Atan and Yusmadi Yah Jusoh (2018). Theoretical Application Analysis in Assessing Big Data Analytics Implementation, Acta Mechanica Malaysia (AMM), 2(1), pp. 16-17.

Cecilia Adrian, Rusli Abdullah, Rodziah Atan and Yusmadi Yah Jusoh (2017). Factors Influencing to the Implementation Success of Big Data Analytics: A Systematic Literature Review. In 5th International Conference on Research and Innovation in Information Systems (ICRIIS), IEEE, pp. 1-6.

Cecilia Adrian, Rusli Abdullah, Rodziah Atan and Yusmadi Yah Jusoh (2016). Towards Developing Strategic Assessment Model for Big Data Implementation: A Systematic Literature Review. International Journal of Advances in Soft Computing and its Application (IJASCA), 8(3), pp. 173–192.

Cecilia Adrian, Fatimah Sidi, Rusli Abdullah, Iskandar Ishak, Lilly Suriani Affendey, and Marzanah A. Jabar (2016). Big Data Analytics Implementation for Value Discovery : A Systematic Literature Review. Journal of Theoretical and Applied Information Technology (JATIT), 93(2), pp. 385–393.

UNIVERSITI PUTRA MALAYSIA

STATUS CONFIRMATION FOR THESIS / PROJECT REPORT AND COPYRIGHT

ACADEMIC SESSION : First Semester 2019/2020

TITLE OF THESIS / PROJECT REPORT :

FACTORS AFFECTING SUCCESSFUL BIG DATA ANALYTICS IMPLEMENTATION IN PUBLIC SECTOR OF MALAYSIA

NAME OF STUDENT: CECILIA ADRIAN

I acknowledge that the copyright and other intellectual property in the thesis/project report belonged to Universiti Putra Malaysia and I agree to allow this thesis/project report to be placed at the library under the following terms:

1. This thesis/project report is the property of Universiti Putra Malaysia.
2. The library of Universiti Putra Malaysia has the right to make copies for educational purposes only.
3. The library of Universiti Putra Malaysia is allowed to make copies of this thesis for academic exchange.

I declare that this thesis is classified as :

*Please tick (√)

☐	**CONFIDENTIAL**	(Contain confidential information under Official Secret Act 1972).
☐	**RESTRICTED**	(Contains restricted information as specified by the organization/institution where research was done).
☐	**OPEN ACCESS**	I agree that my thesis/project report to be published as hard copy or online open access.

This thesis is submitted for :

☐ **PATENT** Embargo from _____ (date) until _____ (date)

Approved by:

_____
(Signature of Student)
New IC No/ Passport No.:

Date :

_____
(Signature of Chairman of Supervisory Committee)
Name:

Date :

[Note : If the thesis is CONFIDENTIAL or RESTRICTED, please attach with the letter from the organization/institution with period and reasons for confidentially or restricted.]