

**DEVELOPMENT AND VALIDATION OF
INFORMATION TECHNOLOGY
FLEXIBILITY MATURITY MODEL**

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Development and Validation of Information Technology Flexibility Maturity Model

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Certificate

This is to certify that the thesis entitled '**Development and Validation of Information Technology Flexibility Maturity Model**' being submitted by Mr. Kamal Karnatak to the Indian Institute of Technology Delhi for the award of the degree of Doctor of Philosophy (Ph.D.), is a record of bona fide research work carried out by him. He has worked under my guidance and supervision and fulfilled the requirements for the submission of the thesis, which has attained the standard required for a Ph.D. degree of the Institute. The results presented in this thesis have not been submitted elsewhere for the award of any degree or diploma.

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Abstract

Today businesses are going through multiple challenges. There are challenges of globalization, where companies need to compete with counterparts of other countries, fluctuating customer demands and need of speed to serve customers. In these turbulent times, flexibility is emerging as a force for achieving business excellence, and the concept of the flexibility maturity model is shaping up to benchmark organizations on multiple maturity levels. Organizations are also relying on Information Technologies (IT) to meet the demand of various stakeholders in this challenging phase. In today's world, IT in any organization is becoming a strategic partner and a key to differentiation, but IT is also going through many rapid changes.

There are many research studies about organizations and Information Technology, where it is concluded that IT flexibility is the key in this rapidly changing and challenging business environment. New and emerging technologies are changing the traditional definitions of IT flexibility and how to achieve the desired IT flexibility in the volatile, uncertain, complex, and ambiguous world, is becoming a critical question. This research study is an attempt to answer these questions and give a roadmap for practitioners to make Information Technology flexible in the real world.

The primary objective of this research is to create an IT flexibility maturity model after identifying and validating IT flexibility parameters. This research sub-objectives are: To identify various IT flexibility parameters and to verify them in the Indian context; To understand the Indian technology landscape, discover which technology trends are affecting IT flexibility and develop & validate an IT flexibility maturity model; and To analyse how organizations are using Information Technology flexibility and how new digital projects are providing benefits to the organizations and impacting flexibility maturity model.

The study is completed in five phases. Phase one is the conceptualization phase and deals with defining the research problem and objectives of the study. In this phase, a detailed understanding of organization flexibility, Information Technology flexibility, Information Technology trends, the concept of models for enhancing organizational performance, and concept of Flexibility Maturity Models is developed. Phase two is

used for doing the exploratory study for the conceptualization of the IT flexibility parameters. Seven IT flexibility parameters are finalized along with two overarching IT parameters. Phase three deals with empirical validation of finalized IT flexibility parameters. For that, opinion-survey has been conducted. Different statistical tools like factor analysis, reliability analysis, and univariate analysis have been used in this phase. Interpretive model building techniques are used to develop TISM, and step-wise regression analysis has been done on the identified flexibility factors, and their interrelationships have been established. MICMAC analysis is also performed. Phase four is devoted to conducting technology surveys of organizations and case study research of fifteen digital projects of different organizations. A detailed analysis of ecosystem flexibility is done with the case of B2B exchange “autoDX.” Phase five is devoted to the synthesis of the results and learning from each phase. An IT flexibility maturity model, which can be used by the practitioners for the organizations' digital transformation, is proposed.

The significant contributions of this research study are: (a) identification of seven IT flexibility parameters and two overarching IT flexibility parameters and empirical validations of them; (b) identification of emerging flexible technologies, which are currently being used by organizations, and identification of emerging technologies, which organizations are planning to use shortly; (c) impact of IT flexibility parameters on the different levels of organization; (d) creation and validation of IT Flexibility Maturity Model; (e) analysis of fifteen digital projects with their placing on Flexibility Maturity Model; and (f) Detailed analysis of eco-system flexibility with a real-life case analysis of B2B exchange platform “autoDX.”

Finally, an IT flexibility maturity model is proposed along with the necessary steps of its implementation.

सार

आज व्यवसाय कई चुनौतियों से गुजर रहे हैं। वैश्वीकरण की चुनौतियां हैं, जहां कंपनियों को अन्य देशों के समकक्षों के साथ प्रतिस्पर्धा करने की जरूरत है, ग्राहकों की मांगों में उतार-चढ़ाव और ग्राहकों की सेवा के लिए गति की आवश्यकता है। इस अशांत समय में, “लचीलापन” व्यवसाय उत्कृष्टता प्राप्त करने के लिए एक प्रमुख बल के रूप में उभर रहा है, और “लचीलेपन परिपक्वता मॉडल” की अवधारणा संगठनों को विभिन्न परिपक्वता स्तरों के मानदंडों पर स्थापित कर रही है। संगठन इस चुनौतीपूर्ण समय में विभिन्न हितधारकों की मांग को पूरा करने के लिए सूचना प्रौद्योगिकी (आईटी) पर भी भरोसा कर रहे हैं। आज की दुनिया में, किसी भी संगठन में आईटी एक रणनीतिक भागीदार और स्वयं को अन्य से बेहतर करने की कुंजी बन रहा है, लेकिन आईटी में प्रौद्योगिकियां भी कई तीव्र परिवर्तनों से गुजर रही हैं।

संगठनों और सूचना प्रौद्योगिकी के बारे में कई शोध अध्ययन हैं, जहां यह निष्कर्ष निकाला गया है कि आईटी का लचीलापन इस तेजी से बदलते और चुनौतीपूर्ण व्यवसायिक माहौल में महत्वपूर्ण है। नई और उभरती प्रौद्योगिकियां आईटी लचीलेपन की पारंपरिक परिभाषाओं को बदल रही हैं और अस्थिर, अनिश्चित, जटिल और अस्पष्ट विश्व में वांछित आईटी लचीलेपन को कैसे प्राप्त किया जाए, यह एक महत्वपूर्ण सवाल बन रहा है। यह शोध अध्ययन इन सवालों के उत्तर देने और आईटी के पेशेवर लोगों को वास्तविक दुनिया में सूचना प्रौद्योगिकी को लचीला बनाने के लिए एक दिशानिर्देश देने का एक प्रयास है।

इस शोध का प्राथमिक उद्देश्य आईटी लचीलेपन मापदंडों को पहचानने और मान्य करने के बाद एक आईटी लचीलापन परिपक्वता मॉडल बनाना है। इस अनुसंधान के उप-उद्देश्य हैं: विभिन्न आईटी लचीलेपन मापदंडों की पहचान करना और उन्हें भारतीय संदर्भ में सत्यापित करना; भारतीय प्रौद्योगिकी परिदृश्य को समझना और इस बात का पता करना कि कौन से प्रौद्योगिकी रुझान आईटी लचीलेपन को प्रभावित कर रहे हैं और एक आईटी लचीलापन परिपक्वता मॉडल विकसित करना और उसे मान्य करना; साथ ही यह भी विश्लेषण करना कि कैसे संगठन सूचना प्रौद्योगिकी लचीलेपन का उपयोग कर रहे हैं तथा कैसे नई डिजिटल परियोजनाएं संगठनों को लाभ प्रदान कर रही हैं व लचीलापन परिपक्वता मॉडल को प्रभावित कर रही हैं।

यह अध्ययन पांच चरणों में पूरा हुआ। पहला चरण एक अवधारणा चरण है जो अध्ययन की शोध समस्या और उद्देश्यों को परिभाषित करने से संबंधित है। इस चरण में, संगठन के लचीलेपन, सूचना प्रौद्योगिकी के लचीलेपन, सूचना प्रौद्योगिकी के रुझान, संगठनात्मक प्रदर्शन को बढ़ाने के लिए मॉडल की अवधारणा और लचीलेपन की परिपक्वता मॉडल की अवधारणा को विकसित किया गया है। दूसरे चरण का उपयोग आईटी लचीलापन मापदंडों की अवधारणा के लिए खोजपूर्ण अध्ययन करने के लिए

किया गया है। इस चरण में सात आईटी लचीलेपन मापदंडों को और दो अनिवार्य आईटी मापदंडों को स्थापित किया गया है। तीसरा चरण स्थापित किये गए सभी आईटी लचीले मापदंडों के आनुभविक सत्यापन को सिद्ध करने के लिए है। इस सत्यापन के लिए, राय-सर्वेक्षण आयोजित किया गया है। इस चरण में विभिन्न सांख्यिकीय तरीकों जैसे फैक्टर एनालिसिस, रिलायबिलिटी एनालिसिस और युनीवेरियेट एनालिसिस का उपयोग किया गया है। TISM को विकसित करने के लिए व्याख्यात्मक मॉडल निर्माण तकनीकों का उपयोग किया गया है, और पहचाने गए लचीलेपन कारकों पर चरणबद्ध तरीके से रिग्रेसन एनालिसिस किया गया है, और उनके अंतर्संबंध स्थापित किए गए हैं। MICMAC एनालिसिस भी किया गया है। चौथा चरण संगठनों के प्रौद्योगिकी सर्वेक्षण और विभिन्न संगठनों की पंद्रह डिजिटल परियोजनाओं के विस्तृत अध्ययन के अनुसंधान के लिए समर्पित है। पारिस्थितिकी तंत्र के लचीलेपन का एक विस्तृत विश्लेषण एक व्यवसायिक एक्सचेंज "ऑटोडेक्स" के अध्ययन के साथ किया गया है। चरण पांच परिणामों के संश्लेषण और प्रत्येक चरण से निकले परिणामों के एकीकरण के लिए समर्पित है। एक आईटी लचीलापन परिपक्वता मॉडल, जो संगठनों के डिजिटल परिवर्तन के लिए पेशेवर लोगों द्वारा उपयोग किया जा सकता है, प्रस्तावित है।

इस शोध अध्ययन के महत्वपूर्ण योगदान हैं: (क) सात आईटी लचीलेपन मापदंडों की पहचान और दो अनिवार्य आईटी लचीलापन मापदंडों का स्थापन और सत्यापन; (ख) उभरती हुई लचीली प्रौद्योगिकियों की पहचान, जो वर्तमान में संगठनों द्वारा उपयोग की जा रही हैं, और उन उभरती प्रौद्योगिकियों की पहचान, जो संगठन शीघ्र ही उपयोग करने की योजना बना रहे हैं; (ग) संगठन के विभिन्न स्तरों पर आईटी लचीलेपन मापदंडों का प्रभाव; (घ) आईटी लचीलापन परिपक्वता मॉडल का निर्माण और सत्यापन; (च) लचीलेपन की परिपक्वता मॉडल पर पंद्रह डिजिटल परियोजनाओं के प्रभाव का विश्लेषण; और (छ) व्यवसायिक एक्सचेंज प्लेटफॉर्म "ऑटोडेक्स" का विश्लेषण के साथ पारिस्थितिकी तंत्र लचीलेपन का विस्तृत विश्लेषण।

अंत में, एक आईटी लचीलापन परिपक्वता मॉडल इसके कार्यान्वयन के लिए चरणबद्ध आवश्यक दिशानिर्देशों के साथ प्रस्तावित है।

Contents

Table of Contents

Certificate	i
Acknowledgments.....	iii
Abstract	v
सार.....	vii
Contents	ix
List of Figures	xv
List of Tables	xix
List of Appendices	xxv
Nomenclature	xxvii
1. Chapter 1: Introduction to the Study.....	1
1.1 General Background	1
1.2 Need and Motivation for the Study	3
1.3 Key Research Questions	4
1.4 Research Objectives	5
1.5 The Significance of the Research	7
1.6 The Scope of the Study.....	8
1.7 Overall Methodology of the Study	8
1.8 Organization of the Thesis	9
1.9 Concluding Remarks.....	12
2. Chapter 2: Literature Review	13
2.1 Introduction	13
2.2 Literature Review on Flexibility.....	13

2.3	Literature Review on Information Technology Flexibility	20
2.3.1	Definitions of IT Flexibility	27
2.4	Information Technology Trends.....	28
2.4.1	Cloud Computing	32
2.5	Maturity Models to Enhance Organizational Performance	33
2.5.1	Capability Maturity Model	34
2.5.2	Capability Maturity Model for CPM	36
2.6	The Concept of Flexibility Maturity Model	37
2.7	Learning from Literature and Research Gaps	40
2.7.1	Research Gaps.....	41
2.8	Concluding Remarks.....	42
3.	Chapter 3: Research Design and Methodology.....	43
3.1	Introduction	43
3.2	Conceptual Research Framework.....	43
3.3	Research Propositions	46
3.4	Research Hypotheses.....	47
3.5	Research Methodology	47
3.5.1	Research Methodology for the Exploratory Study	51
3.5.2	Research Methodology for the Empirical Testing	52
3.5.3	Research Methodology for the Case Studies	54
3.6	Justification of Methodology Chosen.....	56
3.7	Roadmap of the Study	58
3.8	Concluding Remarks.....	58
4.	Chapter 4: Exploratory Study	61
4.1	Introduction	61
4.2	The Objective of the Exploratory Study.....	62

4.3	Research Methodology for Exploratory Study	62
4.4	Exploratory Study for Identification of Flexibility Parameters.....	62
4.4.1	Identification of Parameters through Systematic Literature Review	63
4.4.2	Identification and Selection of Parameters with Expert Inputs	73
4.5	Concluding Remarks.....	82
5.	Chapter 5: Opinion Survey of CIOs and IT Decision Makers	83
5.1	Introduction	83
5.2	The Methodology of Empirical Study.....	84
5.3	Design of the Questionnaire.....	85
5.3.1	Questionnaire Development and Validation.....	85
5.4	Data Collection.....	88
5.5	Data Analysis of Survey	88
5.5.1	Exploratory Factor Analysis for Flexibility Parameters.....	90
5.5.2	Reliability Analysis.....	93
5.5.3	Univariate Analysis for Micro Variables	94
5.6	TISM Development	98
5.6.1	Interpreting TISM for IT Flexibility	101
5.7	MICMAC Analysis	103
5.7.1	Findings from MICMAC Analysis.....	104
5.8	Concluding Remarks.....	105
6.	Chapter 6: TISM Validation and Maturity Model Creation	107
6.1	Introduction	107
6.2	Nature of Survey Data.....	107
6.3	Regression Analysis.....	108
6.3.1	Connectivity as a Dependent Variable.....	109
6.3.2	Collaboration as a Dependent Variable	111

6.3.3	Eco-system Flexibility as a Dependent Variable	113
6.3.4	IT Personnel Competency Flexibility as a Dependent Variable	114
6.3.5	Application Flexibility as a Dependent Variable	116
6.3.6	Modularity as a Dependent Variable.....	116
6.3.7	Overall Discussion of Regression Analysis.....	118
6.4	Validated IT Flexibility Maturity Model for Large Organizations.....	119
6.5	Validated Hypotheses	122
6.6	Discussion and Maturity Model Creation	123
6.7	Concluding Remarks.....	124
7.	Chapter 7: Technology Surveys of Organizations	125
7.1	Introduction	125
7.2	Linking of Various Surveys.....	125
7.3	Technology Survey of Organizations	127
7.2.1	Discussion on Technological Survey	134
7.3	ERP in Organizations: An Analysis	142
7.4	Cloud Computing: Benefits and Challenges.....	144
7.4.1	Results of Discussion	146
7.4.2	Benefits of Cloud Computing	146
7.4.3	Mind Set Survey Results	153
7.5	Discussion on Cloud Mindset Survey.....	157
7.6	Concluding Remarks.....	157
8.	Chapter 8: Case Study Analysis	159
8.1	Introduction	159
8.2	The Methodology of the Case Study	160
8.3	Selection of the Case Organizations	161
8.4	Instrument Development	163

8.5	Case Study Details.....	164
8.5.1	Overview of the Companies.....	165
8.5.2	Analysis of Organizational Data Collected.....	166
8.5.3	Case Summaries	173
8.5.4	Analysis of Case Project's Data.....	213
8.5.5	Impact of Digital Projects on Flexibility Maturity Model	217
8.6	A Case Study on Eco-System Flexibility	219
8.7	Cases of Other Capability Maturity Models	222
8.8	Concluding Remarks.....	223
9.	Chapter 9: Synthesis and Conclusion.....	225
9.1	Introduction	225
9.2	Summary of Research Findings	226
9.3	Revisiting the Objectives and Research Propositions	229
9.4	Synthesized Information Technology Flexibility Maturity Model (ITFMM) .	232
9.4.1	Discussion on the Model.....	232
9.5	Recommended Steps for Implementation of ITFMM.....	237
9.6	Major Recommendations and Implications	238
9.7	Significant Research Contributions	239
9.8	Limitations of the Study.....	240
9.9	Scope for Future Research	241
9.10	Concluding Remarks.....	241
	References	243
	Appendices	A1-A49

List of Figures

Figure No.	Name	Page No.
1.1	Organisation of the Thesis	11
2.1	Comparison of Tech Trends 2013 and 2014	30
2.2	A Typical Flexibility Maturity Model	39
3.1	Phase wise Research Plan	49
3.2	Research Flowchart	50
3.3	Diagrammatic Representation of Approach for Exploratory Research	51
3.4	Research Roadmap	59
4.1	Exploratory Study for Identification	63
5.1	Designation-Wise Breakup of Respondents	89
5.2	City-Wise Breakup	90
5.3	Mean Values of Macro Variables (N=288)	98
5.4	Digraph with Direct and Transitive Links	99
5.5	TISM for IT Flexibility Factors (Conceptual Hierarchy model)	102
5.6	MICMAC Analysis of IT Flexibility Factors	104
6.1	Regression Model for Connectivity (Large Organizations)	110
6.2	Regression Model for Collaboration (Large Organizations)	112
6.3	Regression Model for Eco-system Flexibility (Large Organizations)	114
6.4	Regression Model for IT Personnel Competency Flexibility (Large Organizations)	115
6.5	Regression Model for Modularity (Large Organizations)	117
6.6	Validated IT Flexibility Model for Large Organizations with Beta Values and Maturity Levels	121

Figure No.	Name	Page No.
7.1	Designation-Wise Break-Up of Respondents in the Chart form	129
7.2	City Wise Break-Up of Respondents in the Chart Form	130
7.3	Industry Segment Wise Details	132
7.4	Size-Wise Representation	134
7.5	Disaster Recovery Plans	135
7.6	Cybersecurity in Graphical Form	138
7.7	Security and Continuity in the Organization	139
7.8	Top Technologies in the Graphical Form	140
7.9	Top Future Technologies	141
7.10	Technologies with no Immediate Plans	142
7.11	ERP-Wise Breakup of Organizations	143
7.12	Benefits as Rated by CIOs	152
7.13	Cloud Readiness	153
7.14	Cloud Usage of Organizations	154
7.15	Security Risks in Cloud	154
7.16	Database on the Cloud	155
7.17	Challenges in Keeping the Database on the Cloud	155
7.18	Factors for Security Risks	156
7.19	Usage of Cloud	156
8.1	Sector-Wise Selected Organizations	162
8.2	Selection and Response of Case Companies	163
8.3	Top Technologies Influencing Business in Graphical Form	166
8.4	Enterprise Risk Assessment Status	171
8.5	Components of autoDX System	220

Figure No.	Name	Page No.
8.6	B2B Network with Current and Proposed Integrations	221
9.1	IT Flexibility Maturity Model	231

List of Tables

Table No.	Name	Page No.
2.1	Select Definitions of Flexibility	17
2.2	Select Definitions of IT Flexibility	26
2.3	Various Information Technology Trends	31
3.1	Linkages between Research Gaps and Research Questions	45
3.2	Linkages between Research Objectives and Research Methods	46
3.3	Process Building Theory from Case Study Research	55
3.4	Research Methodology Used in Research Phases	57
4.1	Components and Definitions of IT Infrastructure Flexibility	66
4.2	Components and Definitions of IT Infrastructure Flexibility and Other Constructs	67
4.3	IT Flexibility Parameters as per Literature	69
4.4	Renaming and Merging of Flexibility Parameters	73
4.5	Selection of Unique IT Flexibility Parameters	77
4.6	Finalized IT Flexibility Parameters from Literature	80
4.7	Connectivity Details and their Flexibility Impact	81
4.8	Finalized Flexibility Parameters	82
5.1	Macro and Micro IT Flexibility Variables	86
5.2	IT Flexibility Parameters and Questions	87
5.3	Designation-Wise Breakup of Respondents	88
5.4	City-Wise Breakup of Respondents	89
5.5	KMO and Bartlett's Test	90
5.6	Total Variance through Eigenvalues	91
5.7	Rotated Component Matrix with Varimax Rotation	92

Table No.	Name	Page No.
5.8	Factors after Factor Analysis and their Loading	93
5.9	Cronbach's Alpha Values for Constructs	94
5.10	Univariate Statistical Analysis for Macro Variables (N=288)	95
5.11	Univariate Statistical Analysis for Micro Variables (N=288)	95
5.12	Univariate Analysis for Micro Variables of Large Companies (N=60)	96
5.13	IT Flexibility Factors	99
5.14	Reachability Matrix (With Transitivity) of IT Flexibility Factors	100
5.15	Level Matrix - IT Flexibility Factors	100
5.16	Hypotheses for the study based on TISM	101
5.17	Position Coordinates of Identified IT Flexibility Factors	103
6.1	Stepwise Regression Process (N=60)	108
6.2	Model Summary of Connectivity as a Dependent Variable	109
6.3	Coefficients Summary of Regression Analysis for Connectivity as a Dependent Variable	110
6.4	Model Summary of Collaboration as a Dependent Variable	111
6.5	Coefficients Summary of Regression Analysis for Collaboration as a Dependent Variable	111
6.6	Model Summary of Eco-System Flexibility as a Dependent Variable	113
6.7	Coefficients Summary of Regression Analysis for Eco-system Flexibility as a Dependent Variable	113
6.8	Model Summary of IT Personnel Competency Flexibility as a Dependent Variable	115
6.9	Coefficients Summary of Regression Analysis for IT Personnel Competency Flexibility as a Dependent Variable	115

Table No.	Name	Page No.
6.10	Model Summary of Application Flexibility as a Dependent Variable	116
6.11	Coefficients Summary of Regression Analysis for Application Flexibility as a Dependent Variable	116
6.12	Model Summary of Modularity as a Dependent Variable	117
6.13	Coefficients Summary of Regression Analysis for Modularity as a Dependent Variable	117
6.14	Placement of IT Flexibility Factors on Flexibility Maturity Model	119
6.15	Hypotheses Status after Analysis	122
6.16	Micro IT Flexibility Variables	123
6.17	Placement of IT Flexibility Micro Variables with Maturity Levels	124
7.1	Summary of Surveys	126
7.2	Technologies Selected and their Nature	127
7.3	Designation-Wise Break-Up of Respondents	128
7.4	City-Wise Break-Up of Respondents	130
7.5	Industry Segment Wise Representation of Respondents	130
7.6	Classification of Organizations	133
7.7	Size-Wise Representation of Companies	133
7.8	Disaster Recovery plans of Organizations	135
7.9	Classification-Wise Breakup of Disaster Recovery	136
7.10	Cybersecurity for Organizations	137
7.11	Cybersecurity in Different Types of Organization	138
7.12	"Security" and "Continuity" in Technology Survey	139
7.13	Top Technologies in Organizations	140
7.14	Top Futuristic Technologies in Organizations	141

Table No.	Name	Page No.
7.15	Technologies with no Immediate Plans	142
7.16	Application-Wise Breakup of Organizations	143
7.17	Cloud Computing in Organizations	144
7.18	Organization Type Wise Break-Up of Cloud Computing	145
7.19	Benefits of Cloud Computing and Implications on IT Maturity	152
8.1	Industry Verticals of Selected Case Organization	161
8.2	The Response Rate of Case Study Research	163
8.3	Organization Details of Case Companies	164
8.4	Vertical-Wise Number of Employees in Case Organizations	165
8.5	Top Technologies Influencing Competitiveness	166
8.6	Challenges which Consume Most of the IT Team's Time	167
8.7	Strategies for Meeting Data Center Resource Demands	168
8.8	Data Center Evolution Time Horizon	168
8.9	Vertical Wise Data Center Evolution Time Horizon	169
8.10	Status of Server Virtualization	169
8.11	Status of Private Cloud Use	170
8.12	Status of the Disaster Recovery Plans	170
8.13	Enterprise Risk Assessment Status	170
8.14	Current Data Sizes of Case Organizations	171
8.15	Placement on Flexibility Maturity Model (FMM) by Case-1	174
8.16	Placement on Flexibility Maturity Model (FMM) by Case-2	176
8.17	Placement on Flexibility Maturity Model (FMM) by Case-3	178
8.18	Placement on Flexibility Maturity Model (FMM) by Case-4	180

Table No.	Name	Page No.
8.19	Placement on Flexibility Maturity Model (FMM) by Case-5	183
8.20	Placement on Flexibility Maturity Model (FMM) by Case-6	185
8.21	Placement on Flexibility Maturity Model (FMM) by Case-7	188
8.22	Placement on Flexibility Maturity Model (FMM) by Case-8	193
8.23	Placement on Flexibility Maturity Model (FMM) by Case-9	196
8.24	Placement on Flexibility Maturity Model (FMM) by Case-10	198
8.25	Placement on Flexibility Maturity Model (FMM) by Case-11	200
8.26	Placement on Flexibility Maturity Model (FMM) by Case-12	202
8.27	Placement on Flexibility Maturity Model (FMM) by Case-13	206
8.28	Placement on Flexibility Maturity Model (FMM) by Case-14	208
8.29	Placement on Flexibility Maturity Model (FMM) by Case-15	211
8.30	Case Titles and Areas of Innovation	212
8.31	Primary Business Functions Benefitted	213
8.32	Various Impacts of Digital Projects	213
8.33	Technologies Used in Digital projects	214
8.34	Case Wise One-Time Cost	215
8.35	Summary of Impacts of Case Project on Flexibility Maturity Model	216
8.36	Summary of Projects after Scoring	216
8.37	Ranking of Cases Based on FMM Impact	217
9.1	Impact of IT Flexibility on Flexibility Maturity Model	232

List of Appendices

Appendix I: Internet Growth.....	A-1
Appendix II: Opinion Survey Questionnaire.....	A-5
Appendix III: Factor Analysis.....	A-9
Appendix IV: Pairwise comparison.....	A-15
Appendix V: TISM Development.....	A-19
Appendix VI: Regression Analysis.....	A-21
Appendix VII: Technology Survey Questionnaire.....	A-29
Appendix VIII: Cloud Mind-set Survey.....	A-33
Appendix IX: Case Study Questionnaire.....	A-35
Appendix X: Case Study Coding.....	A-45

Nomenclature

3PL	Third-Party Logistics
AAI	Airport Authority Of India
ACDM	Airport Collaborative Decision Making
ACMA	Automotive Component Manufacturers Association
AD	Active Directory
AGM	Assistant General Manager
AI	Artificial Intelligence
AR	Augmented Reality
AVP	Assistant Vice President
BCP	Business Contingency Plan
BFSI	Banking / Finance / Accounting / Insurance
BI	Business Intelligence
BPR	Business Process Reengineering
BSE	Bombay Stock Exchange
BYOD	Bring Your Own Device
CAPEX	Capital Expenditures
CEO	Chief Executive Officer
CHRO	Chief Human Resources Officer
CIO	Chief Information Officer
CISF	Central Industrial Security Force

CISO	Chief Information Security Officer
CMM	Capability Maturity Model
CPM	Corporate Performance Management
COO	Chief Operating Officer
CRM	Customer Relationship Management
CSP	Cloud Service Providers
CSR	Corporate Social Responsibility
CTO	Chief Information Officer
DevOps	Development And Operations
DGM	Deputy General Manager
DLP	Data Loss Prevention
DMS	Distributer Management System
DR	Disaster Recovery
DRP	Disaster Recovery Plan
EDI	Electronic Data Interchange
EDIFACT	Electronic Data Interchange For Administration, Commerce And Transport
ERP	Enterprise Resource Planning.
F&D	Forwarding And Distribution
FMM	Flexibility Maturity Model
GB	Giga Byte
GDPR	General Data Protection Regulation

GM	General Manager
GPRS	General Packet Radio Service
HR	Human Resource
IB	Intelligence Bureau
ICT	Information And Communications Technology
ISO	International Organization For Standardization
IoT	Internet Of Things
IP	Internet Protocol
IS	Information System
IT	Information Technology
ITES	Information Technology Enabled Services
ITFMM	Information Technology Flexibility Maturity Model
JIT	Just In Time
LAN	Local Area Network
M2M	Machine To Machine
MAC	Media Access Control
MDM	Mobile Device Management
MIS	Management Information System
ML	Machine Learning
MRP	Maximum Retail Price
MSME	Micro Small & Medium Enterprises

MSMED	Micro Small & Medium Enterprises Development
NBFC	Non-Banking Financial Company
NCR	National Capital Region
NDA	Non-Disclosure Agreement
NGO	Non-Governmental Organization
NSE	National Stock Exchange
OEM	Original Equipment Manufacturer
OPEX	Operational Expenditure
PB	Peta Byte
P-CMM	People Capability Maturity Model
PEP	Patient Engagement Platform
PR	Public Relations
PWC	Price Waterhouse Coopers
R&D	Research And Development
ROI	Return On Investment
SCM	Supply Chain Management
SIAM	Society Of Indian Automobile Manufacturers
SKU	Stock Keeping Unit
SLA	Service-Level Agreement
SMAC	Social Media, Mobility, Analytics and Cloud
SME	Small and Medium Enterprises

SMS	Short Message Service
TB	Tera Byte
TCO	Total Cost Of Ownership
UFIS	Universal Flight Information System
UN	United Nations
USB	Universal Serial Bus
VDI	Virtual Desktop Infrastructure
VENA	Virtual Enterprise Network Architecture
VP	Vice President
VPN	Virtual Private Network
VR	Virtual Reality
VUCA	Volatile, Uncertain, Complex And Ambiguous (VUCA)
WAN	Wide Area Network
WiFi	Wireless Fidelity
WMS	Warehouse Management System