Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

Strategic Factors in Agile Software Development Method Adaptation: A Study of Market-Driven Organisations

A thesis presented in partial of the
requirements for the degree of

DOCTOR OF PHILOSOPY
in Information Technology
at Massey University, Albany campus, New Zealand

Ramesh Lal
2011

Strategic Factors in Agile Software Development Method Adaptation: A Study of Market-Driven Organisations

Abstract

Agile methods now provide an alternative to the structured approach for software development. Since their early adoption in the mid-1990s, there has been a growing acceptance of agile methods as a legitimate development approach amongst the information systems development community. Amongst some of the talked about agile benefits in comparison to the structured approach are improvements in delivery and quality standards, productivity levels and knowledge transfer within the organisation, and customer satisfaction through collaboration and frequent delivery of implemented features. The agile philosophy of a team approach and ownership for product development creates a feel-good and motivational factor for engineers. Regardless, the inventors of the agile approach strongly emphasize adaptation to achieve continuous product development success. As a result, an understanding of the adoption of agile methods cannot be separated from an understanding of its adaptation by development teams.

Using a theoretical framework relating to software development process adaptation, developed by Fitzgerald (1998), and through two case studies (agile adopters) qualitative data in relation to agile adaptation was gathered and analysed to determine the nature of agile adaptation. This revealed that adaptation is a critical feature of agile approaches. These adaptations enhance the strategic nature of the organisational factors and the chosen agile approach to develop market differential products. The main contribution of the thesis is that it presents an adapted agile adaptation framework showing that at a conceptual level the main structures (the organisational and methodology factors) that influence software development remain consistent when moving to agile development. However, the underlying elements of these factors are comprehensively adapted, transforming an organisation into an agile organisation in a market-driven environment. Further, in this environment the organisational and development structures will keep evolving due to the emerging market factors and improvements in product development technologies.

Acknowledgment

This thesis would not have been possible without the help of many wonderful people who have in one way or another helped me for my Ph D study. Firstly, I would like to thank my main supervisor, Dr David Parsons, for all the guidance and support throughout this challenging journey. I am truly grateful for your commitment, especially your assistance in facilitating the case study organisations and for your instant feedback on the successive drafts of Chapters. I would also like to thank my second supervisor, Dr Rosemary Stockdale who has given tremendous input on my thesis despite moving overseas. I sincerely thank both of you for the time and help given to me.

Next, I would like to thank the two organisations featured in this study for their kindness in giving me their precious time. I truly would like to thank all the individuals whom I had interviewed to collect data. To protect their anonymity, the company and individual details cannot be disclosed.

Thanks to Paul Hughes and Manfred Lange for all the cooperation and support given to me, without you two this thesis would not have been possible. My appreciation is extended to Sam Alexandra, Lornie Enggong, and Guy Kloss for all the help and advice.

I would also like to acknowledge Massey University for the doctoral scholarship and for the part-time employment, the Agile Alliance for providing me with funding, and Software Education Associates Limited for allowing me to attend the Agile 2005 Conference.

Finally, my deep appreciation goes to my wife and daughter for their patience and never ending support. To my wife, Nancy, without your belief in me and encouragement this journey would not have been possible.

TABLE OF CONTENTS

Abstract…… ii
Acknowledgement…… iii
Table of contents…… iv
List of tables…… viii
List of figures…… ix

Chapter one: Introduction …….. 1
1.1 Agile methods for software development …… 1
1.1.1 The evlotion of sofware development ……. 1
1.1.2 Agile practices…….. 2
1.2 Background …….. 3
1.2.1 Definition of process and methodology …….. 3
1.2.2 Agile approach to software development …… 4
1.2.3 Agility ……. 4
1.2.4 Undocumented agile approach …… 4
1.2.5 Agile methods ……. 6
1.3 Method adaptation ……..…..… 6
1.3.1 Adaptation definition …….. 7
1.3.2 Research problem …… 8
1.4 Research into agile adaptation …… 8
1.4.1 Research questions …….. 9
1.5 Research contributions …… 10
1.6 The study roadmap …….. 11
Chapter two: Literature review…….. 15
2.1 Theoretical basis for the research ……... 15
2.1.1 The components of the Fitzgerald's adaptation framework …… 16
2.1.2 Other adaptation frameworks …….. 20
2.2 Profile of the development environment ……. 22
2.2.1 Agile organisation ……... 22
2.2.2 General software development issues ……. 39
2.3 Overt factors …… 44
2.3.1 Agile methods ……. 44
2.4 Covert factors ……. 63
2.4.1 Agile methods ……. 64
2.5 Methodology-in-action …… 67
2.5.1 Method adaptation ……... 67
2.6 Summary …….. 74
Chapter three: Research methodology ……. 75
3.1 Research paradigm …….. 75
3.2 The role of the researcher …… 76
3.3 Method selection ……. 77
3.4 Research design ……... 81
3.5 Case study selection & context …… 90
3.6 Generalising using two case studies …… 93
3.7 Data collection skills ……... 94
3.8 Study protocol ……. 95
3.9 Unit of analysis …… 100
3.10 Data analysis …….. 101
3.11 Quotation and description policy ……... 105
3.12 Study confidentiality …… 106
3.13 Case study report ……... 106
3.14 The study (methodology) model ……... 106
3.15 Summary …… 107
Chapter four: Akldevelopment case study …… 109
4.1 Overview …… 109
4.1.1 Company background …… 109
4.1.2 Product development ……... 111

4.1.3 Culture for improvement ……. 116
4.2 Methodology adaptation …….. 118
4.2.1 Original formalised methodology vs. Methodology-in-action …… 118
4.2.1.1 Method-in-action ……... 118
4.2.1.2 Ratinale for adaptation ……..... 119
4.2.1.3 Adaptation process …… 120
4.2.1.4 Adaptation responsibility ……... 121
4.3 Profile of the development environment …… 121
4.3.1 In-house development ……. 122
4.3.1.1 Team approach …….. 123
4.3.1.2 Technical expertise …… 135
4.3.1.3 Domain knowledge …… 140
4.3.2 Size of IS department …….. 143
4.3.2.1 Functional setup ……. 143
4.3.2.2 Informal engineering roles ……..…… 147
4.3.3 Short project duration …….. 152
4.3.3.1 Incremental and iteractive approach …….. 153
4.3.4 Legacy systems development …….. 154
4.3.4.1 Business value projects …….. 154
4.3.5 Responsible autonomy …… 155
4.3.5.1 Engineer autonomy …… 156
4.3.6 Productivity and rigour trade-off ……. 157
4.3.6.1 Productivity ……... 158
4.3.6.2 Rigour with development process ……. 161
4.4 Overt factors …… 164
4.4.1 Project management …… 164
4.4.1.1 Improved visibility …… 164
4.4.1.2 Reduced risk …….. 167
4.4.2 Reduction of variety and complexity …….. 169
4.4.3 Economic: division of labour and skill specialisation ……. 171
4.4.3.1 Division of labour …….. 172
4.4..3.2 Skill specialisation …… 173
4.4.4 Epistemological role of methodology ……. 174
4.4.5 Facilitation of intercommunication among developers ……... 177
4.5 Covert factors ……..…... 179
4.5.1 Comfort factor ……. 179
4.5.2 Legitimacy factor …… 181
4.5.3 Aura of professionalism …….. 181
4.5.4 Confidence factor …… 182
4.5.5 Audit trail …… 183
4.5.6 Raise the profile of IS department ……... 184
4.6 Summary …….. 185
Chapter five: Meldevelopment case study …… 187
5.1 Overview ……. 187
5.1.1 Company background ……. 187
5.1.2 Product development ……... 189
5.1.3 Culture for improvement ……. 194
5.2 Methodology adaptation …….. 196
5.2.1 Original formalised methodology vs. Methodology-in-action …… 196
5.2.1.1 Method-in-action ……... 196
5.2.1.2 Ratinale for adaptation ……..…... 197
5.2.1.3 Adaptation process …… 197
5.2.1.4 Adaptation responsibility ……... 198
5.3 Profile of the development environment …… 199
5.3.1 In-house development ……. 199
5.3.1.1 Team approach …….. 200
5.3.1.2 Technical expertise …… 213
5.3.1.3 Domain knowledge …… 218
5.3.2 Size of IS department …….. 220
5.3.2.1 Functional setup ……. 221

5.3.2.2 Informal engineering roles ……...……. 230
5.3.3 Short project duration …….. 232
5.3.3.1 Incremental and iteractive approach …….. 232
5.3.4 Legacy systems development …….. 234
5.3.4.1 Business value projects …….. 234
5.3.5 Responsible autonomy …… 236
5.3.5.1 Engineer autonomy …… 236
5.3.6 Productivity and rigour trade-off ……. 239
5.3.6.1 Productivity ……... 240
5.3.6.2 Rigour with development process ……. 243
5.4 Overt factors …… 248
5.4.1 Project management …… 248
5.4.1.1 Improved visibility ……...……. 249
5.4.1.2 Reduced risk …….. 252
5.4.2 Reduction of variety and complexity …….. 254
5.4.3 Economic: division of labour and skill specialisation ……. 256
5.4.3.1 Division of labour …….. 256
5.4..3.2 Skill specialisation …… 258
5.4.4 Epistemological role of methodology ……. 261
5.4.5 Facilitation of intercommunication among developers ……... 264
5.5 Covert factors ……...……... 266
5.5.1 Comfort factor ……. 266
5.5.2 Legitimacy factor …… 267
5.5.3 Aura of professionalism …….. 267
5.5.4 Confidence factor …… 268
5.5.5 Audit trail …… 270
5.5.6 Raise the profile of IS department ……... 270
5.6 Summary …….. 271
Chapter six: Case study analysis …… 273
6.1 Backgroundand comparison of the two cases ……. 274
6.1.1 Similarities in development structures and related adaptation …… 274
6.1.2 Differences in development structures and related agile adaptation ……... 279
6.2 Originalformalised methodology vs. methodlogy-in-action ……... 282
6.3 Profile of the development environment ……. 287
6.3.1 In-house development ……. 287
6.3.1.1Team approach ……... 288
6.3.1.2 Technical expertise …… 295
6.3.1.3 Domain knowledge …… 298
6.3.2 Size of IS department …….. 300
6.3.2.1 Functional setup ……. 300
6.3.2.2 Informal engineering roles …… 304
6.3.3 Short project duration …….. 306
6.3.3.1 Short development cycle …….. 306
6.3.4 Legacy systems development …….. 309
6.3.4.1 Business value projects …….. 309
6.3.5 Responsible autonomy …… 310
6.3.5.1 Full empowerment ……. 310
6.3.6 Productivity and rigour trade-off ……. 312
6.3.6.1Productivity …… 313
6.3.6.2 Rigour: quality ……... 314
6.4 Overt factors …… 316
6.4.1 Project management …… 316
6.4.1.1 Improved visibility ……...……. 316
6.4.1.2 Reduced risk …….. 319
6.4.2 Reduction of variety and complexity …….. 321
6.4.3 Economic: division of labour and skill specialisation ……. 323
6.4.3.1 Economic: division of labour ……...…. 323
6.4.3.2 Economic: skills specialisation …….. 325
6.4.4 Epistemological role of methodology ……. 326
6.4.4.1 Adapting the learning practice for transfer of knowledge ……. 326

6.4.4.2 Adapting template for inexperienced developers …….. 327
6.4.4.3 Adapting the practice to learn from past projects……... 327
6.4.5 Facilitation of intercommunication among developers ……... 328
6.5 Covert factors ……..... 330
6.5.1 Comfort factor ……. 330
6.5.2 Legitimacy factor …… 331
6.5.3 Aura of professionalism …….. 333
6.5.4 Confidence factor …… 335
6.5.5 Audit trail …… 337
6.5.6 Raise the profile of IS department ……... 338
6.6 Summary …….. 340
Chapter seven: Conclusions and future research ……. 343
7.1 Introduction ……. 343
7.2 Adaptation factors of the agile approach ……. 344
7.3 Research contributions and implications ……. 345
7.3.1 Contributions ……... 345
7.3.2 Implications for theory …… 345
7.3.3 Implications for practice …….. 346
7.3.4 Adapted agile adaptation framework …….. 350
7.4 Limitations ……... 355
7.5 Future research ……..... 356

References ……. 359
Glossory ……. 397

LIST OF TABLES

Table 1 Agile Values and Principles as listed in the Agile Manifesto…..……..... 5
Table 2 Agile Methods …….... 6
Table 3 Adopted qualitative inquiry themes…….... 78
Table 4 Validation strategy……..… 84
Table 5 Data collection methods……..... 89
Table 6 List of participants from case study one (Akldevelopment)..……..… 96
Table 7 List of participants from case study two (Meldevelopment)……...……...… 96
Table 8 Number of interviews per participants at case study 1 (Akldevelopment) 99
Table 9 Number of interviews per participants at case study 2 (Meldevelopment) 99
Table 10 Test for completeness…… 105
Table 11 Case study background (similarities) prior to agile adoption…….. 274
Table 12 Agility features (similarities) of two case studies prior to agile adoption……..…. 279
Table 13 Case study background (differences) prior to agile adoption ……. 279

LIST OF FIGURES

Figure 1 The study roadmap……...…… 12
Figure 2 Framework for IS Development Process……..…... 17
Figure 3 Research design - based on Maxwell's (2005) model……..... 83
Figure 4 The main categories used to organise and analyse case study data……..... 103
Figure 5 The data analysis approach based on Creswell (1998)……..…... 104
Figure 6 The study model showing research methodology……...…. 108
Figure 7 The executive management structure of Akldevelopment …… 110
Figure 8 In-house development – Akldevelopment……... 122
Figure 9 Team approach as part of in-house development – Akldevelopment……..… 123
Figure 10 Team approach in-relation to high-level planning – Akldevelopment…….. 124
Figure 11 Team approach in-relation to development and testing – Akldevelopment…….…… 131
Figure 12 In-house development in relation to technical expertise – Akldevelopment……..…… 136
Figure 13 In-house development in relation to domain knowledge – Akldevelopment……..… 140
Figure 14 Size of IS department – Akldevelopment…….. 143
Figure 15 Development function in relation to size of IS department – Akldevelopment……..… 144
Figure 16 Documentation function in relation to size of IS department – Akldevelopment……..… 146
Figure 17 Informal engineering role in relation to the size of IS department – Akldevelopment…….…. 147
Figure 18 Incremental and iterative approach in relation to short project duration……... 153
Figure 19 Business value projects in relation to legacy systems development…….. 155
Figure 20 Developer autonomy…….…… 156
Figure 21 Productivity in relation to productivity-rigor trade-off – Akldevelopment…….…. 157
Figure 22 Rigor with development in relation to productivity-rigor trade-off – Akldevelopment…….…. 161
Figure 23 Improved visibility in relation to project management –Akldevelopment…… 165
Figure 24 Reduced risks in relation to project management – Akldevelopment……..... 168
Figure 25 Reduction of variety and complexity factor – Akldevelopment……..... 169
Figure 26 Economic division of labour – Akldevelopment……... 172
Figure 27 Economic; skills specialisation – Akldevelopment……... 173
Figure 28 Transfer of knowledge in relation to epistemological role of methodology – Akldevelopment…….. 175
Figure 29 Template for inexperienced developers in relation to epistemological role of methodology – Akldevelopment…… 176
Figure 30 Learning from past projects in relation to epistemological role of methodology – Akldevelopment…….. 177
Figure 31 Facilitation of intercommunication among developers – Akldevelopment……..… 178
Figure 32 Comfort factor – Akldevelopment…….…. 180
Figure 33 Legitimacy factor – Akldevelopment……..…….. 181
Figure 34 Aura of professionalism – Akldevelopment…….…. 181
Figure 35 Confidence factor – Akldevelopment……..... 182
Figure 36 Audit trail – Akldevelopment…….…. 183
Figure 37 Raise the profile of IS department – Akldevelopment……... 184
Figure 38 The executive management structure of Meldevelopment……... 188
Figure 39 Profile of development environment – Meldevelopment……... 199
Figure 40 In-house development – Meldevelopment…….…….... 200
Figure 41 Team approach in-relation to high-level planning – Meldevelopment…….. 202
Figure 42 Team approach in-relation to development and testing – Meldevelopment…… 209
Figure 43 In-house development in relation to technical expertise –

Meldevelopment……..… 213
Figure 44 In-house development in relation to domain knowledge – Meldevelopment……..…… 218
Figure 45 Size of IS department – Meldevelopment……..… 220
Figure 46 Development setup in relation to size of IS department – Meldevelopment……..… 221
Figure 47 Quality Assurance setup in relation to size of IS department – Meldevelopment…….…… 225
Figure 48 Documentation setup in relation to size of IS department – Meldevelopment……..…… 227
Figure 49 Engineering role adaptation – Meldevelopment……..…….. 230
Figure 50 Short project duration – Meldevelopment……..…… 232
Figure 51 Legacy systems development – Meldevelopment……..... 234
Figure 52 Developer autonomy – Meldevelopment……... 237
Figure 53 Productivity in relation to productivity-rigor trade-off – Meldevelopment …….. 240
Figure 54 Rigor in relation to productivity-rigor trade – Meldevelopment……... 243
Figure 55 Improved visibility (project management) – Meldevelopment……..… 249
Figure 56 Reduced risks (project management) – Meldevelopment……..…… 252
Figure 57 Reduction of variety and complexity – Meldevelopment…….. 254
Figure 58 Division of labour – Meldevelopment……..... 256
Figure 59 Skills specialisation – Meldevelopment…….…… 258
Figure 60 Transfer of knowledge – Meldevelopment……..... 261
Figure 61 Template for inexperienced developers – Meldevelopment…….…. 262
Figure 62 Learning from past projects – Meldevelopment……. 263
Figure 63 Facilitation of intercommunication among developers – Meldevelopment……..…. 264
Figure 64 Comfort factor – Meldevelopment…..……..…… 266
Figure 65 Legitimacy factor – Meldevelopment……...…….. 267
Figure 66 Aura of professionalism – Meldevelopment……..…… 268
Figure 67 Confidence factor – Meldevelopment……..... 268
Figure 68 Audit trail – Meldevelopment……..…... 270
Figure 69 Raise profile of IS department – Meldevelopment……..... 270
Figure 70 Enhanced method users component of adaptation framework……..…. 277
Figure 71 Influences for method-in-action…….…… 287
Figure 72 Sub-factors for in-house development...…….…... 300
Figure 73 Sub-factors for size of IS department…….…… 306
Figure 74 Sub-factor for short project duration…….…. 308
Figure 75 Sub-factor for legacy systems development……..…. 310
Figure 76 Sub-factor for responsible autonomy…….…… 312
Figure 77 Sub-factors for productivity and rigour ……..…. 316
Figure 78 Sub-factors for project management……... 321
Figure 79 Sub-factors for reduction of variety and complexity……..…… 323
Figure 80 Sub-factors for economic: skill specialisation and division of labour……... 326
Figure 81 Sub-factors for facilitation of intercommunication among developers…….. 329
Figure 82 Sub-factor for comfort factor……..… 331
Figure 83 Sub-factors for legitimacy factor……..... 333
Figure 84 Sub-factors for aura of professionalism…….…… 335
Figure 85 Sub-factors for confidence factor……... 337
Figure 86 Sub-factors for audit trail……..... 338
Figure 87 Sub-factors for raise the profile of IS department factor……..... 340
Figure 88 Adapted agile adaptation framework for market driven development……... 349