Agency Theory: 
An Extended Conceptualisation and Reformulation

Nurcan Temel Candemir

School of International Business

Principal Supervisor: Dr Mark McGovern
Associate Supervisor: Prof. Roger Willett

Bachelor of Business (International Business/Accountancy/Japanese)
Bachelor of Business (Honours) (International Business/Accountancy)

Doctor of Philosophy (International Business)

14 November 2005
The completion of this Dissertation would not have been possible without the assistance and dedication of special people.

I wish to express my sincere gratitude firstly to my principal supervisor Dr. Mark McGovern, and also my external supervisor Prof. Stephen Hill and my associate supervisor Prof. Roger Willett for their enthusiasm, dedication and understanding throughout the course. Their encouragement, guidance and assistance were greatly appreciated.

I wish to also thank all the relevant School of International Business Staff who assisted in the administrative tasks of writing this Dissertation.

I wish to also express my sincere gratitude to my husband Dr. Oben Candemir for his continual support and assistance throughout the writing of this Dissertation. I am indebted to him for his assistance in locating suitable software for the simulation developed. Thank-you Oben for your insightful comments, encouragement and emotional support.

Finally, I would like to sincerely thank my family as a whole. My father, mother and brother whose patience and assistance during hectic times have been greatly appreciated. My son Onur, who arrived in my life during the writing of this PhD has been an continuing inspiration in completing this Dissertation. Without their encouragement this Dissertation would not of been possible.

To all of the above people, I acknowledge and thank you sincerely for all the assistance and support that you have given me. Without you, this research would not have been possible.
Statement of Original Authorship

The work contained in this thesis has not been previously submitted for a degree or diploma at any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signed

______________________________

Date

______________________________
Abstract

The theory of Agency, specifically that developed by Jensen and Meckling (1976), will be the subject of examination. Agency theory has been the subject of extensive research since its introduction in modern form by Jensen and Meckling (1976). The generality of the theory of Agency appears unquestionable and it has been widely adopted. Surprisingly, however, the model correctly predicts particular phenomena under investigation in only the simplest of instances, and even in the simplest of instances there are cases where the simple agency model has limited success.

Possible reasons for this failure may lie in the assumed universalist foundation and in the common formulation regarding agent behaviour, that all agents are self-interested rationalists seeking to maximise their own utility to the disregard of their principal’s interest. While the hypothesis of self-interested rationalism may be apt in some contexts it may be misleading or inadequate in others. This is especially so when the narrow interpretations of self-interested rationalism are used. Human beings are more complex in their totality than can be represented in any parsimonious model. This is particularly a problem when model predictions are not empirically supported. Aspects omitted in a model may be a source of the misfit between prediction and observation.

An extended conceptualisation and reformulation of agent behaviour is presented. An approach is developed that addresses the context of agent behaviour, the socio-environment within which the agent interacts. The context particularly refers to the institutional affiliations and interactions that influence agent behaviour through their belief structure (i.e., their Belief-Desire-Intention, BDI, model of rational action). Through the use of an institutional framework contextual analysis is incorporated into the theory of agency and ultimately agent behaviour. This agent is termed a socio-environmental rationalist agent (SERA) which is contrasted with the self-interested rationalist (SIR) agent in the existing agency literature.
This research utilises an object-oriented approach to develop a simulation of the extended conceptualisation and reformulation of agent behaviour. Simulations investigate agent behaviours and outcomes at the micro (specifically through individualised SERA and SIR formulations) and macro (specifically through a multi-agent SERA community formulation in the context of the EU financial accounting harmonisation process) levels. Netlogo is the simulation tool through which this is attained.

The simulation demonstrates how alternative formulations of rationality lead to different outcomes and these differences are evident at both levels. Importantly the extended model has outputs that are more in tune with current empirical evidence. The analysis thus demonstrates the plausibility of the extended conceptualisation and reformulation and the need to incorporate the context of behaviour more fully within the analysis of the principal-agent relationship.

Through this extended examination of agent behaviour further theoretical and practical insights regarding the understanding of agent behaviour, the principal-agent problem and relationship, multi-agent communities, and of business and society in general may be attained. This dissertation provides one step in advancing our fundamental understanding of the principal-agent problem. The scope and power of agency analysis can be substantially extended using the approach and methods outlined, particularly beyond that present in existing Agency research.
Table of Contents

ACKNOWLEDGEMENTS ...................................................................................................... I
STATEMENT OF ORIGINAL AUTHORSHIP ...................................................................... II
ABSTRACT ........................................................................................................................... III
LIST OF FIGURES ............................................................................................................. X
LIST OF TABLES .................................................................................................................. XIII

1. INTRODUCTION ............................................................................................................ 1
   1.1 BACKGROUND TO THE AGENT RELATIONSHIPS AND AGENCY THEORY .......... 1
   1.2 RESEARCH PROBLEM AND JUSTIFICATION FOR THE RESEARCH ............... 3
   1.3 RESEARCH APPROACH AND QUESTION ...................................................... 5
   1.4 METHODOLOGY ................................................................................................. 8
   1.5 OUTLINE OF DISSERTATION ......................................................................... 10
   1.6 CONCLUSION ................................................................................................. 13

2. LITERATURE REVIEW – A REVIEW OF AGENCY THEORY ..................................... 15
   2.1 THE THEORY OF THE FIRM: WHY THEY EXIST ........................................... 15
      2.1.1 The Firm: The Theoretical Approaches ...................................................... 17
      2.1.2 Decision Rights, Alienability and the Conflict of Interest ......................... 19
      2.1.3 Theory of Agency and Transaction Cost Theory (TCT) ............................ 22
   2.2 AGENCY THEORY: A DESCRIPTION ................................................................ 24
      2.2.1 A Description of Principal Agent Problems and Agency ......................... 24
      2.2.2 Specific Formulations of the Principal Agent Model ................................. 26
      2.2.3 An Example of a Specific Formulation of Agency ..................................... 31
      2.2.4 Characteristics of the Specification ............................................................. 35
      2.2.4.1 Information Asymmetry and Conflicting Interests ................................. 35
      2.2.4.2 Agency Problems .................................................................................. 37
      2.2.5 Summary .................................................................................................... 38
   2.3 EXISTING RESEARCH IN THE THEORY OF AGENCY .................................... 39
      2.3.1 Theoretical Approaches to Agency ............................................................. 40
      2.3.2 Extension and Application of the Simple Principal-Agent Model ............. 41
      2.3.3 Self Interest: The Underlying Proposition of Agency ............................... 45
      2.3.4 Self-Interest and Management Compensation ......................................... 47
      2.3.5 Critique of Self-Interest & the Use of Management Compensation .......... 49
   2.4 PROBLEMS TO BE ADDRESSED ...................................................................... 51
   2.5 Initial Formulation: the Interplay of Institutions ................................................. 52
   2.6 CONCLUSION ....................................................................................................... 60
3. **AN EXTENDED CONCEPTUALISATION OF AGENT BEHAVIOUR** . 65

3.1 **THE DEVELOPMENT OF THEORY** .................................................. 66
3.2 **THE NOTIONS OF RATIONALITY** .................................................. 69
   3.2.1 **TYPES AND USES OF RATIONALITY** ............................................ 69
   3.2.2 Research Examining the Notions of Rationality .............................. 71
3.3 **RATIONAL MODELS WITHIN AGENCY** ........................................ 74
   3.3.1 **RATIONAL MODELS WITHIN AGENCY** ........................................ 74
   3.3.2 Lash’s (1999) States of Modernity ............................................... 75
   3.3.3 Constructivism and Rationality ..................................................... 77
   3.3.4 Influential Factors ......................................................................... 79
3.4 **SOCIO-ENVIRONMENTAL RATIONALITY: THE ROLE OF INSTITUTIONS** 80
3.5 Institutional Analysis of Behavioural Influence ............................... 83
3.6 Comparative Agent Framework and Properties .................................. 87
3.7 **CONCLUSION** ............................................................................... 90

4. **THE EUROPEAN UNION (EU) – A CASE OF FINANCIAL ACCOUNTING HARMONISATION** .................................................. 91

4.1 **THE EUROPEAN UNION (EU) AND FINANCIAL ACCOUNTING** .......... 91
   4.1.1 History of EU Financial Accounting Regulation and Harmonisation ... 92
4.2 **THE EUROPEAN UNION (EU) A CONTEXT FOR AGENCY** ................. 94
4.3 **FINANCIAL ACCOUNTING HARMONISATION IN THE EU** ................. 98
4.4 **NATIONAL RESPONSES TOWARDS EU FINANCIAL ACCOUNTING HARMONISATION** ................................................................. 101
   4.4.1 Perceptions of the ‘True and Fair View’ ........................................... 102
   4.4.2 Directive Diversity ........................................................................ 106
4.5 **NATIONAL INSTITUTIONAL ANALYSIS** ........................................ 108
   4.5.1 Institutional Analysis and the United Kingdom .............................. 110
   4.5.2 Institutional Analysis and the Netherlands ..................................... 113
   4.5.3 Institutional Analysis and Germany ................................................. 115
   4.5.4 Institutional Analysis and France .................................................... 118
   4.5.5 Findings from the Institutional Analysis ......................................... 121
4.6 **CONCLUSION** ............................................................................... 123

5. **RESEARCH METHODOLOGY AND THE OBJECT ORIENTATED (OO) APPROACH** ............................................................................. 125

5.1 **DESIGN OF THE RESEARCH** .............................................................. 125
   5.1.1 Organisation of the Research .......................................................... 126
   5.1.2 Methodology and Requirements ...................................................... 129
5.2 **OBJECT-ORIENTED (OO) METHODOLOGY/APPROACH** ..................... 130
   5.2.1 Components of a OO Methodology ................................................. 130
   5.2.2 Model Construction ....................................................................... 132
5.3 **SIMULATION** ................................................................................... 135
   5.3.1 Simulation of Agency ..................................................................... 135
   5.3.2 Artificial Intelligence (AI) ............................................................... 138
5.4 **METHOD OF ANALYSIS: QUALITATIVE CASE RESEARCH** ............... 141
   5.4.1 Case Methods ............................................................................... 141
   5.4.2 Validity of Simulation and Case Research ...................................... 143
   5.4.3 The Case Research Process .......................................................... 146
# Table of Contents

5.4.4 Case Selection ........................................................................................................... 148  
5.5 Limitations of Methodology ....................................................................................... 149  
5.6 Conclusion .................................................................................................................. 152  

6. **FORMULATING THE AGENT** ..................................................................................... 153  
6.1 Agent Design ............................................................................................................. 153  
6.2 A Belief-Desire-Intention (BDI) Model of Rational Action ................................. 156  
   6.2.1 The Theory of Practical Reasoning ................................................................. 156  
   6.2.2 Practical Reasoning, Statism and Environmental Dynamism ......................... 159  
   6.2.3 Environmental Reconsideration ..................................................................... 162  
   6.2.4 Consideration of Time .................................................................................... 164  
   6.2.5 BDI Components and Application to Current Research ............................... 166  
   6.2.6 Summary ......................................................................................................... 168  
6.3 Applying BDI to a Socio-Environmental Rationalist Agent (SERA) Framework .......................................................... 169  
6.4 Cases Applying the SERA Framework .................................................................... 171  
   6.4.1 Four Cases Describing the SERA Framework .............................................. 173  
   6.4.2 Conclusions to Case Formulations .................................................................. 177  
6.5 SERA and Collective Mental States ....................................................................... 178  
   6.5.1 Mutual Interests and Multi-Agent Communities ......................................... 179  
6.5.2 Multi-Agents & the SERA Framework ............................................................. 179  
6.6 Formulating an Example of a Socio-Environmental Rational Multi-Agent Community (SERC) .......................................................... 183  
   6.6.1 Describing the EU Case: An Example of a SERC ......................................... 184  
   6.6.2 Summary ......................................................................................................... 190  
6.7 Developing the Workings of the Framework and Cases ....................................... 192  
   6.7.1 From Abstract Specification to Concrete Model ............................................ 192  
   6.7.2 Refinement and Specification of the SERA Computational Model (Simulation One) .......................................................... 194  
   6.7.3 Refinement and Specification of the SERC (Simulation Two) ....................... 198  
6.8 Information Requirements and Simulation ............................................................. 201  
   6.8.1 Information Requirements and Simulation for SERA ................................ 201  
   6.8.2 Simulating SERA and SIR ........................................................................... 204  
6.8.3 SERC Information Requirements and Simulation ............................................ 206  
6.9 Conclusion .................................................................................................................. 211
# Table of Contents

7. **SOCIO-ENVIRONMENTAL RATIONALIST AGENT: ANALYSIS AND SIMULATION** ................................................................. 213
   7.1 **MODELLING AGENTS AND SIMULATION USING NetLogo** ................................................. 213
      7.1.1 Simulations in NetLogo ......................................................... 213
      7.1.2 Requirements and Attributes of NetLogo ......................................... 215
   7.2 **DEMONSTRATION OF SIMULATION ONE** ................................................................. 219
   7.3 **ANALYSIS OF RESULTS FOR SIMULATION ONE** ...................................................... 227
      7.3.1 SIMULATION AND OUTPUT .......................................................... 227
      7.3.2 VISUAL ANALYSIS: THE PROCESS .................................................. 227
   7.4 **VISUAL ANALYSIS: THE RESULTS** ............................................................................. 228
      7.4.1 SERA OUTPUTS AND PRESENTATION ................................................. 228
      7.4.2 Visual Analysis of the Socio-Environmental Rationalist Agent Contour ........................................ 232
         7.5.1.1 First Division Analysis: ‘Atomistic Society’ ..................................... 233
         7.5.1.2 Second Division Analysis: ‘Controlled Society’ ......................... 234
         7.5.1.3 Third Division Analysis: ‘Upheaval in Society’ ......................... 235
         7.5.1.4 Fourth Division Analysis: ‘Reforming Society’ .......................... 236
         7.5.1.5 Summary of the Visual Analysis ............................................... 237
      7.4.3 Visual Analysis of the Self-Interested Rationalist Agent Contour ............. 238
      7.4.4 Visual Analysis of the Socio-Environmental Rationalist Agent and Self-Interested Rationalist Agent Contours ........................................ 240
   7.5 **STATISTICAL ANALYSIS: THE PROCESS AND RESULTS** ........................................ 242
      7.5.1 Descriptives and Variance Analysis .................................................. 242
      7.5.2 Correlation Analysis ............................................................................. 245
   7.6 **SUMMARY OF FINDINGS IN RELATION TO THE RESEARCH QUESTIONS** .............................................. 247
   7.7 **CONCLUSION** ...................................................................................... 251

8. **EUROPEAN UNION (EU) CASE SIMULATION & ANALYSIS** .......... 253
   8.1 **DEMONSTRATION OF SIMULATION TWO** .................................................... 253
   8.2 **ANALYSIS OF RESULTS FOR SIMULATION TWO** ........................................... 262
      8.2.1 Visual Analysis: The Results .................................................................. 263
      8.2.2 Visualisation and Analysis of the Anglo-Saxon Agent Group .................. 266
      8.2.3 Visualisation and Analysis of the Germanic Agent Group ..................... 270
      8.2.4 Visualisation and Analysis of the Latin Agent Group ............................ 275
      8.2.5 Visualisation and Analysis of the Nordic Agent Group ......................... 279
      8.2.6 Visualisation Summary ........................................................................... 284
   8.3 **STATISTICAL ANALYSIS: THE RESULTS** ...................................................... 286
      8.3.1 Descriptives and Variance Analysis ..................................................... 287
      8.3.2 Correlation Analysis ............................................................................. 296
   8.4 **SUMMARY OF FINDINGS IN RELATION TO THE RESEARCH OBJECTIVES AND QUESTIONS** ........................................ 299
   8.5 **CONCLUSION** ...................................................................................... 302
9. CONCLUSIONS ...................................................................................................... 303

9.1 THE STUDY IN REVIEW .................................................................................. 303

9.2 RESEARCH IMPLICATIONS .............................................................................. 306

9.2.1 IMPLICATIONS FOR AGENCY THEORY .................................................... 307

9.2.2 Implications for Harmonisation in EU Financial Accounting ...................... 312

9.2.3 Implications, for the Wider Business Community and Society................. 317

9.2.4 Summary ..................................................................................................... 322

9.3 AREAS OF ADVANCEMENT AND RESEARCH QUESTIONS ...................... 322

9.3.1 Agency Theory, its Limitations and Research Question 1......................... 323

9.3.2 Agent Behaviour, its Context and Research Questions 2 and 3 ................. 324

9.3.3 Agency Theory, its Application and Research Question 4.......................... 325

9.3.4 Alternative Methods of Agency Research and Research Question 5........... 326

9.3.5 Implications of Applying the Socio-Environmental Rationalist Agent (SERA) and Research Question 6................................................................. 327

9.4 LIMITATIONS ................................................................................................ 329

9.5 CONTRIBUTIONS OF THE RESEARCH ....................................................... 330

9.6 FUTURE RESEARCH POSSIBILITIES ............................................................. 333

9.6.1 Research in Relation to the Theory of Agency ............................................ 333

9.6.2 Research in Relation to the Implications of the Extended Conceptualisation and Reformulation of Agent Behaviour ............................................. 334

9.7 CONCLUSION .................................................................................................. 336

APPENDIX 1 ............................................................................................................ 337

APPENDIX 2 ............................................................................................................ 343

APPENDIX 3 ............................................................................................................ 357

APPENDIX 4 ............................................................................................................ 381

REFERENCES ......................................................................................................... 399
List of Figures

FIGURE 2.1 - ALIENABILITY OF RIGHTS IN MARKETS AND ORGANISATIONS ........... 21
FIGURE 2.2 - THE SIMPLIFIED PRINCIPAL-AGENT MODEL .................................... 26
FIGURE 2.3 - THE PRINCIPAL AGENT MODEL AS A TRANSACTION SEQUENCE ..... 27
FIGURE 2.4 - THE AGENCY MODEL ........................................................................ 28
FIGURE 2.5 - PRINCIPAL AND AGENT IN CONTEXTUAL EXAMINATION ............ 30
FIGURE 2.6 - SHAREHOLDER AND CEO IN CONTEXTUAL EXAMINATION .......... 34
FIGURE 2.7 - IMPLICATIONS OF THE AGENCY RELATIONSHIP ............................ 37
FIGURE 2.8 - AN INITIAL THEORETICAL FRAMEWORK OF THE EXTENDED CONCEPTUALISATION OF AGENCY THEORY .................................................. 57

FIGURE 3.1 - A REPRESENTATION OF THE STAGES OF AGENCY ANALYSIS .......... 68
FIGURE 3.2 - THE DIMENSIONS OF RATIONAL AGENCY: SOME OF THE FIELDS THAT HAVE CONTRIBUTED TO THE STUDY OF RATIONAL AGENTS .............. 70
FIGURE 3.3 - MATRIX OF INSTITUTIONAL DIMENSIONS ...................................... 81
FIGURE 3.4 - TWO DIMENSIONS OF INSTITUTIONAL ANALYSIS ........................... 84
FIGURE 3.5 - COMPARATIVE FRAMEWORK OF THE SOCIO-ENVIRONMENTAL RATIONALIST AGENT (SERA) AND SELF-INTERESTED RATIONALIST (SIR) AGENT .................................................... 87

FIGURE 4.1 - FRAMING THE EU AS AN AGENCY RELATIONSHIP .......................... 95
FIGURE 4.2 - FRAMING EU-NATION INTERACTION AS AN SOCIO-ENVIRONMENTAL RATIONALIST AGENCY RELATIONSHIP ...................................................... 97
FIGURE 4.3 - THE LITERAL INTERPRETATIONS OF THE ‘TRUE AND FAIR VIEW’ ...... 103
FIGURE 4.4 - STANCES ON THE ‘TRUE AND FAIR VIEW’, WITH COUNTRY EXAMPLES .... 105
FIGURE 4.5 - MATRIX OF INSTITUTIONAL DIMENSIONS FOR THE UK ............... 112
FIGURE 4.6 - MATRIX OF INSTITUTIONAL DIMENSIONS FOR THE NETHERLANDS .... 114
FIGURE 4.7 - MATRIX OF INSTITUTIONAL DIMENSIONS FOR GERMANY ............. 117
FIGURE 4.8 - MATRIX OF INSTITUTIONAL DIMENSIONS FOR FRANCE ............... 121

FIGURE 5.1 - A KNOWLEDGE-ACCRUAL TRIANGLE ............................................. 144
FIGURE 5.2 - A PROCESS MODEL FOR CASE .......................................................... 146

FIGURE 6.1 - A SEQUENCING FRAMEWORK OF AGENT PRACTICAL REASONING .... 157
FIGURE 6.2 - AGENT AND ENVIRONMENTAL INTERACTION ................................. 161
FIGURE 6.3 - A SEQUENCING FRAMEWORK OF AGENT PRACTICAL REASONING WITH DYNAMISM AND REACTIVITY ......................................................... 163
FIGURE 6.4 - RATIONAL COMMITMENT TO PLANNING ...................................... 165
List of Figures

FIGURE 6.5 - MODELLING THE SOCIO-ENVIRONMENTAL RATIONALIST AGENT (SERA) INTERACTION AND BDI ................................................................. 167
FIGURE 6.6 - THE META-ARCHITECTURE FORMING THE SERA FRAMEWORK ......... 169
FIGURE 6.7 - THE SERA FRAMEWORK FOR MULTI-AGENT COMMUNITIES .......... 180
FIGURE 6.8 - FRAMING EU-NATION INTERACTION AS AN SERA RELATIONSHIP .... 182
FIGURE 6.9 - MODELLING THE INFORMATION REQUIREMENTS (VARIABLES) OF SIMULATION 1 .............................................................................. 197
FIGURE 6.10 - MODELLING THE INFORMATION REQUIREMENTS (VARIABLES) OF SIMULATION 2 .............................................................................. 200

FIGURE 7.1 - NETLOGO MODELLING ENVIRONMENT: INTERFACE TAB OF SIMULATION ONE .................................................................................. 216
FIGURE 7.2 - OPERATION OF SIMULATION ................................................................ 219
FIGURE 7.3 - A SNAP SHOT OF THE PROGRAMMING FOR SIMULATION ONE .......... 225
FIGURE 7.4 - 3D CONTOUR GRAPH OF THE SERA COMMITMENT VALUES AT ITS INTERSECTING InstnPow (PA) AND InstnUncern (PB) VALUES .......... 229
FIGURE 7.5 - MATRIX OF INSTITUTIONAL DIMENSIONS InstnPow (PA) AND InstnUncern (PB) COORDINATES AND SECTIONS OF ANALYSIS ........ 231
FIGURE 7.6 - 3D CONTOUR GRAPH OF THE SIR AGENT COMMITMENT VALUES AT ITS INTERSECTING InstnPow (PA) AND InstnUncern (PB) VALUES .......... 239
FIGURE 7.7 - 3D CONTOUR GRAPH OF THE SERA AND SIR AGENT COMMITMENT VALUES AT THEIR INTERSECTING InstnPow (PA) AND InstnUncern (PB) VALUES .......................................................................................... 241

FIGURE 8.1 - SIMULATION TWO: THE SOCIO-ENVIRONMENTAL RATIONALIST MULTI AGENT COMMUNITY ........................................................................... 254
FIGURE 8.2 - A SNAP SHOT OF THE PROGRAMMING LANGUAGE FOR SIMULATION TWO ...................................................................................... 260
FIGURE 8.3 - AGENT POSITIONING WITHIN THE MATRIX OF INSTITUTIONAL DIMENSIONS ................................................................................ 264
FIGURE 8.4A - 3D CONTOUR GRAPH OF THE ANGLO SAXON AGENT GROUP COMMITMENT VALUES AT ITS INTERSECTING InstnPow and InstnUncern Values Part 1 ................................................................. 267
FIGURE 8.4B - 3D CONTOUR GRAPH OF THE ANGLO SAXON AGENT GROUP COMMITMENT VALUES AT ITS INTERSECTING InstnPow and InstnUncern Values Part 2 .......................................................................................... 269
FIGURE 8.5A - 3D CONTOUR GRAPH OF THE GERMANIC AGENT GROUP COMMITMENT VALUES AT ITS INTERSECTING InstnPow and InstnUncern Values Part 1 ................................................................. 271
FIGURE 8.5B - 3D CONTOUR GRAPH OF THE GERMANIC AGENT GROUP COMMITMENT VALUES AT ITS INTERSECTING InstnPow and InstnUncern Values Part 2 .......................................................................................... 273
FIGURE 8.6A - 3D CONTOUR GRAPH OF THE LATIN AGENT GROUP COMMITMENT VALUES AT ITS INTERSECTING InstnPow and InstnUncern Values Part 1 ...................................................................................... 276
List of Figures

FIGURE 8.6B - 3D CONTOUR GRAPH OF THE LATIN AGENT GROUP COMMITMENT
VALUES AT ITS INTERSECTING INSTnPw AND INSTnUNCERN VALUES
PART 2 ...............................................................278

FIGURE 8.7A - 3D CONTOUR GRAPH OF THE NORDIC AGENT GROUP COMMITMENT
VALUES AT ITS INTERSECTING INSTnPw AND INSTnUNCERN VALUES
PART 1 ...............................................................280

FIGURE 8.7B - 3D CONTOUR GRAPH OF THE NORDIC AGENT GROUP COMMITMENT
VALUES AT ITS INTERSECTING INSTnPw AND INSTnUNCERN VALUES
PART 2 ...............................................................283

FIGURE 9.1 - MATRIX OF INSTITUTIONAL DIMENSIONS EXAMINING INDIVIDUAL AGENT
BEHAVIOUR ..........................................................309

FIGURE 9.2 – MATRIX OF INSTITUTIONAL DIMENSIONS EXAMINING EU MEMBER STATE
POSITIONS ........................................................................314

FIGURE 9.3 - MATRIX OF INSTITUTIONAL DIMENSIONS FOR SUBSIDIARIES OPERATING
IN DIVERSE ENVIRONMENTS ........................................319

FIGURE 9.4 - MATRIX OF INSTITUTIONAL DIMENSIONS DEMONSTRATING THE
SIGNIFICANCE OF SIR AGENT CONCEPTUALISATIONS TO THE SERA
CONCEPTUALISATION .........................................................331
List of Tables

TABLE 1. 1 - SUMMARY OF RESEARCH OUTCOMES AND DOMAINS IN RELEVANT CHAPTERS.................................................................8

TABLE 2. 1 - AGENCY THEORY SUMMARISED .................................................................39
TABLE 2. 2 - A REVIEW OF EXISTING RESEARCH IN AGENCY THEORY .......................61
TABLE 2. 3 - AGENCY THEORY RE-SUMMARISED ...........................................................60

TABLE 4. 1 - THE ENACTMENT OF THE EU FOURTH AND SEVENTH DIRECTIVES.........100
TABLE 4. 2 - ACCOUNTING SYSTEMS IN THE EUROPEAN UNION (EU).........................110
TABLE 4. 3 - EUROPEAN STOCK MARKETS: SHARE VOLUME 1997 AND 2004 ($MILLIONS).................................................................112

TABLE 5. 1 - POSITIONING RESEARCH DOMAINS.........................................................128
TABLE 5. 2 - POSITIONING A METHODOLOGY BETWEEN RESEARCH DOMAINS ...........134
TABLE 5. 3 - KEY CHARACTERISTICS OF CASE STUDIES .............................................142

TABLE 6. 1 - PRACTICAL REASONING SITUATIONS AND OPTIMALITY OF RECONSIDERATION ...........................................................................166
TABLE 6. 2 - A SOCIO-ENVIRONMENTAL RATIONALIST AGENT (SERA) CONSIDERING SHIRKING ........................................................................174
TABLE 6. 3 - A RELIGIOUS SERA CONSIDERING SHIRKING ........................................174
TABLE 6. 4 - A SERA SHIRKING GIVEN CHANGING INSTITUTIONS .............................175
TABLE 6. 5 - A SELF-INTERESTED RATIONALIST (SIR) AGENT CONSIDERING SHIRKING .................................................................176
TABLE 6. 6 - SUMMARY OF THE PROPERTIES OF THE CASES .................................177
TABLE 6. 7 - THE ENACTMENT OF THE EU FOURTH AND SEVENTH DIRECTIVES........189
TABLE 6. 8 - INFORMAL FOUR STAGE REFINEMENT PROCESS FOR THE SERA FRAMEWORK ........................................................................195
TABLE 6. 9 - MODEL VARIABLES OF SIMULATIONS ONE AND TWO DRAWN FROM TABLE 6.8 ..............................................................................196
TABLE 6. 10 - INFORMAL FOUR STAGE REFINEMENT PROCESS FOR THE SERC .........199
TABLE 6. 11 - ASSIGNED DEFAULT COMMITMENT VALUES OF MEMBER NATIONS....207
TABLE 6. 12 - ASSIGNED INSTITUTIONAL WEIGHTING FOR MEMBER NATIONS .......208
TABLE 7.1 - A SUMMARISATION OF FINAL COMMITMENT (finalcomm (CA)) VALUES FROM SIMULATION ONE FOR EACH AGENT TYPE ........................................242
TABLE 7.2 - DESCRIPTIVES OF FINAL COMMITMENT (finalcomm (CA)) VALUES FROM SIMULATION ONE .................................................................244
TABLE 7.3 - INDEPENDENT SAMPLES TEST FOR EQUALITY OF VARIANCES ........244
TABLE 7.4 - A CORRELATION OF INSTNPOW AND INSTNUNCERN AND FINAL COMMITMENT (finalcomm (CA)) VALUES .............................................245
TABLE 7.5 - SUMMARY OF THE NATURE OF FINAL COMMITMENT (finalcomm (CA)) IN SIMULATION ONE ........................................................................248

TABLE 8.1 - A SUMMARISATION OF FINAL COMMITMENT (finalcomm (CA)) VALUES FROM PART ONE AND PART TWO OF SIMULATION TWO ..................287
TABLE 8.2 - DESCRIPTIVES OF FINAL COMMITMENT (finalcomm (CA)) VALUES FROM SIMULATION ONE AND TWO .................................................................289
TABLE 8.3 - ANOVA OF TWO ANALYSES OF VARIANCES FOR EACH SIMULATION PART ........................................................................................................290
TABLE 8.4 - FINAL COMMITMENT (finalcomm (CA)) VALUES TABULATED BY AGENT GROUP FOR PART ONE .................................................................291
TABLE 8.5 - FINAL COMMITMENT (finalcomm (CA)) VALUES TABULATED BY AGENT GROUP FOR PART TWO ........................................................................292
TABLE 8.6 - FINAL COMMITMENT (finalcomm (CA)) VALUES TABULATED BY WEIGHTING OF INSTITUTIONAL RELEVANCE FOR PART ONE ..........295
TABLE 8.7 - FINAL COMMITMENT (finalcomm (CA)) VALUES TABULATED BY WEIGHTING OF INSTITUTIONAL RELEVANCE FOR PART TWO ..........295
TABLE 8.8 - A CORRELATION OF INSTNPOW AND INSTNUNCERN AND FINAL COMMITMENT (finalcomm (CA)) VALUES FOR ALL AGENT GROUPS IN PART 1 AND PART 2 ........................................................................297

TABLE 9.1 - SUMMARY OF RESEARCH OUTCOMES AND DOMAINS IN RELEVANT CHAPTERS ..................................................................................305
1. Introduction

The specific theory of Agency to be investigated pertains to the conceptualisation and formulation developed by Jensen and Meckling (1976) in the business literature. Agency Theory is critically reviewed, explored and extended in the research reported in this dissertation. The Theory of Agency as initiated by Jensen and Meckling (1976; 1994) describes a particular form of the agency relationship, one which involves a contract wherein one or more persons (the principal(s)) engage another person (the agent) to take actions on behalf of the principal(s). This delegation of some decision-making authority to the agent introduces relationship complexities with implications and effects that agency researchers still actively seek to understand.

1.1 Background to the Agent Relationships and Agency Theory

The focus on contracts and contracting is the most distinct feature of agency theory (Kumar, 2000: 14). The firm is considered to be a nexus of contracts and these contracts are implemented with the intention of ensuring that all parties, acting in their own self-interest, are at the same time motivated towards maximising the value of the organisation (Deegan, 2000: 212). This system of complex written and unwritten contracts is deemed to be an effective disciplinary mechanism for disparate individuals, specifically the owners (principals) and decision-making agents (Fama and Jensen, 1983).

Individuals within society are endowed with disparate resources. Typically, an individual does not possess the levels or mix of resources matching his or her needs or potentials, let alone sufficient of all resources simultaneously. More broadly a mix of resources will be present in any societal setting, including in the functional firm, where situations of interdependence will exist.
Chapter 1: Introduction

When resources are pooled together gains can are obtained through specialisation in joint activities. In agency this particularly pertains to the capital contributed by the principal to which the agent’s knowledge and skills are employed to attain some set goal(s). Without contractual constraints this asymmetry in the capabilities of the actors enables the agent to use the resources to his or her advantage. The agent is thus assumed to a self-interested rationalist (SIR). Mutually dependent behaviours, interests of the parties and some distribution of the actual gains attained are issues in the workings of an agency relationship.

The Theory of Agency has been the subject of extensive research since its introduction in modern form by Jensen and Meckling (1976) in their study of the structure of the firm. Existing research has applied their model extensively across numerous fields, ranging from economics through to international relations. Such intensive applications demonstrate the unquestionable generalisability of the theory of Agency. What is surprising, however, is that the theory will usually only correctly predict particular phenomena under investigation in the simplest of instances. However, even in the simplest of instances, such as explaining the structure of executive compensation, the predictions of the simple agency model have not been successful. As will also be seen, the simple agency model has had limited success in other contexts as well.

Possible reasons for this limited success appear to lie in its (assumed) universalist foundation and its common formulation around the notion that all individuals being rational will always act in accordance with their own self-interest somehow defined and determined. Such a notion has been extensively applied, particularly in areas such as neoclassical economical theory. While a hypothesis of self-interested behaviour may be extremely useful in some contexts, notably in economics, it may be misleading in others. This is especially so when narrow interpretations of self-interest are used. Human beings are more complex in their totality than can be represented in any parsimonious model. Given that the existing theory of agency conceptualises the agent as a SIR this may explain partly why the applications have limited success in reinforcing the theory even in the simplest of situations.
This research will demonstrate that there is a need to extend the conceptualisation and formulation of the traditional theory of agency. The traditional theory of Agency provides but a limited if putatively broad understanding of agent behaviour for which there is only limited empirical support. An extended conceptualisation with emphasis on the context of application will provide not only a more informed understanding of agent behaviour, the principal-agent problem\(^1\), and the agency relationship but also valuable insights and implications for the firm and for society in general. Some development of the theory will be needed for this to be successfully achieved along with specification of a more general formulation.

### 1.2 Research Problem and Justification for the Research

Research in agency theory has been extensively developed in a particular paradigm, one influenced by positivism (Lambert 2001). This positive-agency literature has, focused essentially on predictability with some empirical orientation. A satisfactory agency relationship is supposed to be achieved through constraining the behaviour of the assumed self-interested agent, with the particular intention of aligning interests coincident with those of the principal. This singular approach has dominated research in the Theory of Agency since its inception. Little attention has been given to the context in which both theory and applications are formulated, as will be established in the literature review.

In this positivist tradition much importance is attached to a particular form of “objectivity” as the criterion for judging the validity of the theory. This is without expressed concern as to the adequacy of the theory as constituted or to the common assumption that agents are all SIRs. Yet applied research repeatedly indicates that even in the simplest of instances the theory, as formulated, has limited success in prediction. No exact reasons are ever advanced for the limited success in predictive capacity of the current theory of agency, and few attempts have been made to improve the theory itself.

---

\(^1\) The usual problem of agency involves uncertainty as to how the agent will behave. The principal cannot be sure that the agent will behave with his/her interests in mind and hence, incurs the costs of monitoring and aligning the agent’s behaviour with those of the principal. The conflict of interest between shareholders of a publicly owned corporation and the chief executive officer (CEO) is a classic example of a principal-agent problem (Jensen and Murphy, 1990).
Chapter 1: Introduction

Current approaches involve a rather simplistic interpretation of the agency relationship. Research is needed that will explore the above issues and problems. From such explorations it is possible to extend the conceptualisation and reformulate both the traditional agency model and the Theory of Agency itself. Such is the intention of this research. The aim, then, is to both deepen and widen the scope of the existing agency research by looking beyond the narrow definitions of self-interested rationalism and incorporating other actors and influences into the model and the theory in context-sensitive ways.

This will involve a shift from focusing on the universalist assumption that all individuals, specifically agents, are inherently and determinably SIRs to a more relativist perspective wherein the circumstances and context within which the behaviour is transacted will be incorporated and examined. In particular the agent’s interactions with their environment via their institutional affiliations and interactions and the corresponding influences (through belief structures i.e., BDI model of rational action) will be incorporated.

Thus, agent behaviour is conceptualised as that of a socio-environmental rationalist decision maker. The transacting process is reformulated as being instrumentally mutually dependent where institutional affiliations and interactions support, direct, assist and constrain agent behaviour. This contrasts with the existing formulation of the transacting process in an asymmetric (informed by information asymmetry) mutually dependent form constrained by contractual restrictions and rewards. This extended conceptualisation and reformulation allows greater insights, practical implications for agents and principals as well as the firm and society in general (e.g., the EU financial accounting harmonisation process). Additionally, it appears that greater consistency can be achieved between predicted and observed outcomes.
1.3 Research Approach and Question

This dissertation contains a conceptual study that is exploratory, critical, and explanatory in nature with a mix of analysis and synthesis used. It is:

1. *Exploratory* in the sense that an alternative method of modelling agent behaviour and the transacting process within the Theory of Agency will be examined and developed.

2. *Critical*, in the sense that the research will identify and consider Agency Theory and the characteristics of the parties of the Agency model, describe the transacting process within this model, and consider the strengths and weaknesses of existing and alternative approaches.

3. *Explanatory* in the sense that the research will suggest alternatives as to the how and why of an individual’s behaviour in agency situations. Of particular interest are how the context influences the behaviour of the agent and how the agent then affects the transacting process.

4. Explicitly both *Analytic* and *Synthetic*, in that how the parts are conceived and formulated, and how they may be (re-) associated are directly assessed.

Research involving conceptual studies does not involve the use of functional forms with dependent and independent variables nor particular research hypotheses (Ives, Hamilton and Davis, 1980: 921). Ives et. al. (1980) terms this type of conceptual study as ‘non-data’ research. It is both more descriptive and conceptual in nature with no hypothesis-testing of the kind typically used where the research idea is initially formulated within an already adequate and comprehensive formulation. This study being conceptual in nature will, therefore, have research questions which are addressed through conceptual investigations and simulations rather than tested formalised hypotheses that are data based. It is thus non-empirical and represents a conceptual study with an extended application.
The research questions will be developed as well-defined questions, some of which may require further theoretical and, in the future, empirical investigation. Thus, the research has both a pure and an applied focus. The research questions to be addressed are defined in terms of research objectives. For each research objective a single research question has been chosen. Other research questions are possible and will, hopefully, be the focus of future research. Further development can lead to their specification and examination.

The research objectives and questions to be addressed are:

1. **To Evaluate Existing Agency Theory.**
   RQ1. What aspects of the existing theory of Agency require a reassessment?

2. **To Redevelop and Model Concepts of Agency.**
   RQ2. How can Agency be conceived and modelled more adequately, particularly after examination of SIR behaviour?

3. **To Discern the Influential Factors.**
   RQ3. What factors play a role in affecting the behaviour of individuals in agency?

4. **To Review Concepts and Formulation.**
   RQ4. How effective and influential is the extended conceptualisation and reformulation of agent behaviour in various contexts?

5. **To build an Operationalisation.**
   RQ5. How can an extended conceptualisation of agent behaviour be modelled using object-oriented methods so as to provide more informative understanding of the notion of agency?

6. **To Evaluate Practical Applicability.**
   RQ6. How applicable are the concepts, developments and modelling to various situations?
Outcomes that will be reported in Chapter 2 and 9 of the dissertation include:

1. A **Critique** of current approaches to the principal agent problem, with identification of current assumptions and their impacts on theoretical and empirical research in the area.
2. An **Articulation** of a more general extended conceptualisation and formulation of the principal-agent problem through examining micro level behaviour within which existing approaches can be positioned.
3. The **Development** of a specific formulation examining macro level behaviour that can be applied to identified areas of agency theory.
4. **Reports** on test outcomes from using the formulations in a case example, namely the EU case of financial accounting harmonisation.
5. **Identification** of consequent prospects and problems, including areas for further research and areas of immediate applicability.
6. An overall **evaluation**, which reports on the strengths and weaknesses of current and suggested approaches.

A summary of these outcomes in accordance with their research focus and orientation, and the area in the dissertation that they will be investigated together with the relevant research questions (RQ1 … RQ6) are presented in Table 1.1 below. This Table demonstrates and seeks to draw together the parts in the dissertation through its generalised and specialised examination of the components of Agency Theory, which are connected through the use of a select and relevant research method.


1.4 Methodology

This research aims to extend the conceptualisation and reformulation of traditional agent behaviour as conceptualised and formulated in the existing Theory of Agency. It is first necessary to look at the parts and whole, by what methods these might be more appropriately articulated. The parts are treated as associable objects, as entities in their own right and as interdependent parties. This methodology is denoted an Object-Orientated (OO) Methodology and differs significantly from many traditional research methods. Although it is not a research method as per say, it is a method for undertaking research which involves the use of designing and implementing computational systems examining particular objects of interest.
Chapter 1: Introduction

The focus of an OO methodology is on the objects of the research, and on describing and understanding the object(s) that would generate or lead to the reported outcomes. Through obtaining a deeper understanding of the behaviour of the agent (cast as an object) and the principal-agent situation a more informed understanding of the notion of agency and greater insights with practical implications for Agency Theory can be obtained.

The potential of the extended conceptualisation and reformulation will be demonstrated via simulation. NetLogo simulation software will be used to perform this. There will be two simulations:

1. A general case, a principal-agent relationship (a single object case), and
2. A specific case, the EU financial accounting harmonisation process (a multiple object case).

The simulation of the general case will be used to exemplify the extended conceptualisation and to test the reformulation of agent behaviour in a more theoretical situation with particular attention to the influences of differences in micro-level agent behaviour in agency relationships. The simulations of the specific case will be then used to apply the extended conceptualisation and reformulation of agent behaviour to a practical situation. This will determine its applicability to examining macro-level effects of agent behaviour in agency relationships in different contexts, i.e., are similar micro level behaviours conveyed/transmitted to the agent in wider interaction (e.g., the European Union (EU)).

This research then is a conceptual study further articulated through simulation of case applications. It is thus, experimental in nature as the data to be analysed is generated by the simulation. It will demonstrate that through seeking a deeper understanding of agent behaviour and the agency relationship, an object-orientated approach, a more adequate and informed explanation and understanding of the agency relationship and its outcomes can be attained. This can be demonstrated through object-based simulation.
1.5 Outline of Dissertation

This Dissertation consists of eight chapters other than the present one.

Chapter Two: Literature Review – A Review of Agency Theory
The composition of Agency Theory is examined. The question of what is agency, its assumptions, properties and applications is addressed. The chapter therefore begins with an examination of the literature underlying the Theory of Agency and then progresses through to a thorough examination of the theory itself and applications of the theory. Limitations of the theory will be identified and investigated, and a wider conceptualisation of the problem will be introduced. An initial theoretical framework of this conceptualisation will be developed with the direction of the research indicated.

Chapter Three: An Extended Conceptualisation of Agent Behaviour
The conceptualisation and formulation of agent behaviour is considered and along with the question of what alternative conceptualisation and reformulation can provide a more adequate understanding of agent behaviour than that of the current self interested rationalist, here termed ‘SIR’. A goal is to incorporate the contextual nature of human behaviour. Things such as societal affiliations and institutional interactions are to be incorporated into agent interactions. This extended conceptualisation of agent behaviour is termed the socio-environmental rationalist agent, termed ‘SERA’. Inline with this conceptualisation a more general reformulation of the agency relationship is also presented.

Chapter Four: The European Union (EU) – A Case of Financial Accounting Harmonisation
An instance of agency is considered. The question of how applicable the extended conceptualisation and reformulation of agent behaviour is to EU instances of agency is explored. This instance pertains to the case of the EU financial accounting harmonisation. Both the simplicity of the existing conceptualisation in traditional agency theory (as presented in Chapter 2) and the applicability of the extended conceptualisation and reformulation of agent behaviour (Chapter 3) are
demonstrated. This example will be simulated (Chapter 8) with differences evident from differing agent contexts.

**Chapter Five: Research Methodology and the Object Orientated (OO) Approach.** An OO approach is shown to be an appropriate method for exploration and application of the extended conceptualisation and reformulation of agent behaviour. Justification for the method employed and a discussion of its limitations are included.

**Chapter Six: Formulating the Agent.** How to develop the OO approach to model the extended conceptualisation and reformulation of agent behaviour is considered. The transacting process of the extended conceptualisation of agent behaviour is provided in greater detail (a further reformulation), and an object-orientated model is developed. What is termed the SERA framework can be used to demonstrate the reformulated agent behaviour. Lastly, refinement of the framework for simulation is undertaken.

**Chapter Seven: Socio-Environmental Rationalist Agent: Analysis and Simulation.** A simulation of the general case examining micro-level agent behaviour is presented with the behaviours to be expected from the simulation of SERA. The process and the simulation software, Netlogo, are described along with the method through which the extended conceptualisation and reformulation of behaviour is to be applied to the case. The results obtained from the simulation are presented using visual analysis (namely 3D contour graphs) and statistical analysis (e.g., using chi-square tests for interdependence). Behaviour of SERA is combined with that of the SIR agent. Research questions earlier presented in Chapter 1 are thus addressed and answered.
Chapter Eight: European Union (EU) Case Simulation & Analysis. Macro-level effects of different agents’ behaviours are considered in the simulation of a socio-environmental rationalist multi-agent community (SERC). The process and method through which the extended conceptualisation and reformulated behaviour is to be applied to the specific case of EU financial accounting harmonisation is presented. The results from the simulation are presented in the manner of the previous Chapter. This will assess the workings and applicability of the extended conceptualisation and reformulation of agent behaviour in a multi-agent community. Different outcomes are found to attend different SERA formulations. The remaining research questions are thus addressed and answered.

Chapter Nine: Conclusions. Implications that can be derived from the test results, the contributions to understanding, and the future of agent research possibilities are discussed. The extended conceptualisation and reformulation of agent behaviour is seen to provide a more informed understanding of the notion of agency with important theoretical and practical implications for the firm and society. Each of the areas for examination addressed in each of the chapters with the relevant research questions present five areas for advancement. A review of the current work is also undertaken in light of the findings and the implications identified. Limitations and suggestions for future research, including in empirical areas, conclude the dissertation.

In all, these chapters collectively present a thorough investigation of the theory of Agency. As well as an extended conceptualisation and reformulation of agent behaviour.
1.6 Conclusion

This Chapter has provided a brief overview of the research to be undertaken. The review of the literature in the theory of Agency demonstrates that the current conceptualisations and formulations of agent behaviour are limited in their applicability. Limitations in this simplistic interpretation provide justification for this research, and the impetus for an extended conceptualisation and reformulation of agent behaviour. Through the use of an Object-Orientated (OO) Methodology this relationship is conceptualised with greater emphasis on the context in which it occurs. Reformulated agent behaviour is modelled with a general and specific case simulated focusing on both micro and macro levels of agent behaviours. The results of the simulations are examined with consideration of the potential implications for both the notion of agency and for addressing firm and societal problems. So through the extended conceptualisation and reformulation of agent behaviour this research will demonstrate a basis for a more informed and adequate understanding of agent behaviour, the principal-agent problem and agency relationships.
2. Literature Review – A Review of Agency Theory

The initial beginnings of Agency Theory can be related back to the fundamental insights of Coase (1937) in describing the existence of the firm. This chapter will begin with an examination of the literature underlying the Theory of Agency and then proceed to a thorough examination of the theory itself. In doing so, the existing research and applications of the theory will be examined, limitations of the theory will be identified and investigated, and an alternative conceptualisation of the theory will be introduced. An initial theoretical framework of this conceptualisation will be developed presenting the direction of the research. The chapter, therefore, answers the question of what is agency, its assumptions, properties and applications.

2.1 The Theory of the Firm: Why they Exist

Coase’s (1937) and Williamson’s (1975) fundamental insights into transaction, coordination and contracting costs presents the beginnings of a succinct explanation of the existence of the firm and presence of the market. In doing so, Coase (1937) and Williamson (1975) differentiate the firm from the market. They focus on understanding why certain activities are kept within the boundaries of the firm while others are performed outside. Transaction cost models of organisations have proposed that firms make decisions about the location of business processes to minimise the combined cost of production and governance.

1 Williamson (1975) proposes that transaction cost economics can explain the limits of firm size. Williamson suggests that diseconomies of scale are manifested through four interrelated factors: atmospheric consequences due to specialisation, bureaucratic insularity, incentive limits of the employment relation and communication distortion due to bounded rationality. Furthermore, Williamson argues that diseconomies of scale are counteracted by economies of scale and can be moderated by adoption of the multidivisional organisation form and by high internal asset specificity. Combined, these influences tend to cancel out and thus there is not a strong, directly observable, relationship between a large firm’s size and performance.
The market is an economic system co-ordinated by the price mechanism (Coase, 1937: 387). Movements in prices direct exchange and hence production. Coordination is through a series of exchange transactions on the market (Coase, 1937: 388). Those inputs that are in demand and outputs that are in supply at a competitive price are taken to determine production decisions. There is therefore no central organisation that commands production but a series of transactions between buyers and sellers. They are negotiated contracts where all parties are assumed to operate in self-interest. In its pure form little knowledge about the other exchangers is needed, and pricing is purely based on individual interests and the "invisible hand" of a free economy (large number of buyers and sellers, instantaneous exchanges, etc.). Little coordination costs are needed in this pure market.

In the case of the firm each factor of production is owned by somebody and the coordination of the factors of production form an organisation. Within the firm there are therefore no market transactions, and in place of the complicated market structure with exchange transactions an entrepreneur-co-ordinator is substituted (Coase, 1937: 388). This entrepreneur-co-ordinator directs production or services and achieves production or performs services through the assistance of subordinates, who are all governed by a contract. The firm is then seen as a set of co-ordinated contracts taken together. These cover the way inputs are joined to create outputs and the way receipts from outputs are shared among inputs (Fama, 1980: 292). A firm consists of the system of contractual relationships, which comes into existence when the direction of resources is dependent on an entrepreneur (Coase, 1937: 393).

The market and the firm are two alternative methods of co-ordinating production. There are significant costs associated with production. The price mechanism, therefore, is the determining factor as to which alternative performs production or provision (Kulkarni and Herriot, 1999: 45). Production or provision in the market involves the costs of negotiating and concluding a separate contract for each exchange transaction involved in the production process. This may consist of multiple exchanges and hence, multiple contracts which may be costly and inefficient. Within a firm, a factor of production (or the owner thereof) is not required to make a series of contracts with the factors with whom he or she is co-operating with in the firm, as
would be necessary if this co-operation were to be arranged in the market (Coase, 1937: 391). For a series of contracts, one contract is substituted. A firm therefore according to Coase’s (1937) analysis exists when it is cheaper to administer or undertake activities internally than to purchase them in the market or to undertake activities externally. This is when the transaction\(^2\), coordination and contracting costs associated with firm production are less than the market-based costs (Kulkarni and Heriot, 1999: 45). The costs to be minimised are those of the series of linked activities and transactions that produce goods or services (Williamson, 1975:.10).

### 2.1.1 The Firm: The Theoretical Approaches

The vast literature of economics that falls under the label of ‘Theory of the Firm’ is not a positive theory of the firm, but rather a theory of markets (Jensen, 1983: 326). Economists have historically concentrated on the analysis of markets while treating firms as "black boxes" that simply convert inputs into outputs and act as profit-maximising entities without any consideration of the behavioural implications of the human beings involved in the production and management process (Jensen, 1998: 1). This model, therefore, does not examine how organisations are structured and how they function internally. Defining the firm as a black box diverts attention away from what and how production is being undertaken. Behavioural organisation theorists sought to address this limitation. They did so by breaking open the black box called ‘the firm’ describing it as:

---

\(^2\) Transaction costs include all search and information costs, as well as the costs of monitoring and enforcing contractual performance (Robins, 1987: 69). There are two types of transaction costs, these are ex-ante transaction costs and ex-post transaction costs. The ex-ante transaction costs include the costs of drafting, negotiating and safeguarding the agreement (Williamson, 1985: 20). The ex-post costs, on the other hand, include the haggling costs, set-up and running costs associated with the governance structures, bonding costs to effect secure commitments, and importantly, the mal-adaptation costs, should the transaction deviate form the specified terms (Williamson, 1985: 20). Both these costs vary with the asset specificity, uncertainty and frequency of transactions (Kulkami and Heriot, 1999: 44).

These costs are incurred because governance structures differ in their capabilities to respond effectively to transactional disturbances. Bounded rationality and opportunism (also known as behavioural uncertainty) create problems in properly negotiating and maintaining contractual commitments (Williamson (1985)). The former is interpreted as self-interest seeking with guile, while the latter implies that behaviour is ‘intendedly rational, but only limitedly so’ (Simon 1976). All complex contracts are unavoidably incomplete because of bounded rationality and hence, are subject to the hazards of opportunism (Williamson (1985)). With these two behavioural assumptions and asset specificity, it becomes even more important for contracting parties to resolve the transactional disturbances via governance structures and organisations.
• A nexus of transactions and contracts (Alchian and Demsetz, 1972; Demsetz, 1988, p. 156; Jensen 1994: 14),
• An open social system that must process information (Mackenzie, 1984), and
• A legal fiction, which serves as a focus for a complex process in which the conflicting objectives of individuals are brought into equilibrium within a framework of contractual relations (Jensen and Meckling, 1976: 9).

Behavioural organisation theorists have therefore largely focused on the internal aspects of organisations, ignoring the forces of markets in which organisations exist (Jensen, 1998: 1). Instead, they assume that organisations are equilibrium systems that, like markets, can be influenced, but cannot be told what to do (Jensen, 1998: 1). The influence of which rests on the rational and self interested nature of the human beings within the organisation, and the possession of information which is costly to produce and transfer among agents within the organisation (Jensen, 1998).

Transaction Cost Economics (TCE) and Agency Theory also both take exception to the standard economic modelling of the firm as a production function to which a profit-maximising objective has been ascribed (Archer, Karim and Al-Deehani, 1998: 150). Transaction Cost Theory regards the firm as a governance structure and Agency Theory considers it as a nexus of contracts\(^3\) (ibid).

A firm may, therefore, be described as an open social subsystem of interacting individuals that process information and coordinate activities with a view to achieve some predefined objective (Kulkami and Heriot, 1999: 46). The capacity to achieve this objective is limited by the inherent conflicts of interest among the parties to the firm. The behaviour of the organisation is thus the equilibrium behaviour of a complex contractual system made up of maximising agents with diverse and conflicting objectives (Jensen, 1983: 15). This is identified and addressed in the Theory of Agency, and will be demonstrated further on.

\(^3\) The nexus of contracts definition of organisations focuses attention on the problems that the contracts are intended to solve, i.e. the methods through which to perform activities in an organisation (Jensen, 1983: 21).
2.1.2 Decision Rights, Alienability and the Conflict of Interest

It is now necessary to examine the black box called ‘the individual’ and similarly recognise that, because of the inherent conflicts of interest among the parties to the firm, self-control problems could lead to non-functional behaviour (Jensen, 1994: 14) and other important issues. These conflicts of interest among parties to the firm arise not only because of the inherent self-interested nature of the parties but also because organisations by definition suppress the alienability of decision rights.

A decision right is the right to choose an action and to take an action (Jensen, 1998: 7). An alienable decision right is one that can be sold or exchanged by the owner, with the owner pocketing the proceeds offered in exchange (Jensen, 1998: 7). Alienability is, thus, the effective combination of two rights: the right to sell or transfer rights and the right to capture the proceeds of exchange (Jensen and Meckling, 1992: 10).

In an organisational setting alienability is not passed onto management or to the chief executive officer (CEO). Alienability is effectively retained with the owners of the firm (the shareholders). The bundle of decision rights owned in the name of such an organisation is vested nominally in its board of directors and CEO, and the rights are then partitioned out among decision agents in the organisation (Jensen and Meckling, 1992: 27). Management and the CEO are thus merely granted the right to make, implement and rectify decisions on behalf of shareholders without themselves directly capturing the proceeds or suffering the consequences of their actions. This is the limited liability enjoyed by the corporation. In contrast to individuals transacting in the market, they possess both the right to transact and the alienability of those rights (Jensen and Meckling, 1992: 2). They therefore unlike the management of a corporation enjoy all the benefits of the transaction but are liable for all the consequences.

---

4 The board of directors is viewed as a market-induced institution, the ultimate internal monitor of the set of contracts called a firm, whose most important role is to scrutinise the actions of the decision makers within the firm, i.e., the CEO (Fama, 1980: 294).
As Alchian-Demsetz (1972: 794) put it the essence of the classical firm is thus a contractual structure with:

1. Joint input production;
2. Several input owners;
3. One party who is common to all the contracts of the joint inputs;
4. Who has the right to renegotiate any input’s contract independently of contracts with other input owners;
5. Who holds the residual claim; and
6. Who has the right to sell his central contractual residual status.

The central agent, i.e. the manager, oversees this contractual structure and the contracts among the factors of production, which ensures the viability of the firm (Fama, 1980: 292).

Corporations would not exist if alienability of all decision rights were granted to each agent along with the rights. There would be nothing left over for the residual claimants in the enterprise, be they entrepreneurs, partners, or shareholders (Jensen and Meckling, 1992: 13). In other words, alienability is a control device that rewards and punishes agents by imposing on them the capitalised value of the future costs and benefits of their decisions (Jensen and Meckling, 1992: 14). The separation of ownership and control can thus be explained as an efficient form of economic organisation within the ‘set of contracts’ perspective (Fama, 1980). The exception to this is with private firms or situations of joint interest, where those who perform the decision rights are also those who have alienability of those rights. In this situation it is the alienability of rights that ensures that the operator of the firm makes appropriate decisions.

However, problems arise as to the assignment of decision rights. The agents to whom the principal delegates authority have an objective function that diverge from his or her own (i.e., because they are self-interested) (Jensen and Meckling, 1992: 16). Alienability cannot be used in a typical firm to solve this organisational problem, as
alienability (the right to pocket the proceeds) is reserved to the organisation or, more precisely, to the residual claimants (Jensen, 1998: 8).

Organisational problems within the firms must therefore be solved by substitute means, which provides the control that alienability provides in the market economy. This substitute control system is accomplished by devising a set of rules of the game for the firm (refer to Figure 2.1), which:

1. Partition out the decision-making rights to agents throughout the organisation, and
2. Create a control system that:
   a) Provides measures of performance; and
   b) Specifies the relationship between rewards and punishments and the measures of performance (Jensen and Meckling, 1992: 19; Brickley, Smith, and Zimmerman (2001)).

*Figure 2.1 - Alienability of Rights in Markets and Organisations*

This figure is not available online. Please consult the hardcopy thesis available from the QUT Library

Source: Jensen, 1998: 5
Recognising that firms can make relatively little internal use of alienability clearly demonstrates the problems faced by every firm in constructing substitute mechanisms for alienability to resolve the conflict of interest amongst the parties to the firm. Firms must, however, also get benefits from suppressing alienability otherwise the firm could not survive in competition with the market.

2.1.3 Theory of Agency and Transaction Cost Theory (TCT)

The theory of agency recognises the existence of the conflict of interest and incorporates alienability and suggests that multi-person, incentive, asymmetric information, and/or coordination issues are important in understanding how organisations operate (Lambert, 2001: 3). Transaction Cost Theory also recognises this conflict of interest between the parties, but demonstrates this through the notion that a party will seek to obtain quasi-rents from the other contracting party after the contract has been initiated. Thus, the fundamental behavioural assumption of both these theories is opportunism: a need to perform accordingly to satisfy one’s own self-interest or utility with guile (Williamson, 1975, p.26). While both theories present foundationally important contributions regarding the operations of the firm presented by their initiators (i.e., Coase (1937), Williamson (1975) and Jensen and Meckling (1976)), the points of juncture taken in ongoing research (i.e., the assumption of self-interest) have limited their growth potential.

The difference between the two theories lies in the focus of analysis, for Transaction Cost Theory it is the transaction or contract, while for Agency Theory it is the contracting process (Archer, Karim and Al-Deehan, 1998: 151). Agency Theory therefore examines contracting primarily from the ex ante perspective (i.e., the alignment of the respective interests of the parties to the contract), while Transaction Cost Theory examines contracting from the ex post perspective (i.e., the outcome itself and conflict resolution). Given that this research seeks to attain a deeper understanding of the individual in a contractual setting, it is more appropriate to reinvestigate the initial formulations of the contracting process (Agency Theory
perspective) rather than the end-product of the contracting process (Transaction Cost Theory perspective).

The focus on contracts and contracting is the most distinct feature of agency theory (Kumar, 2000: 14). The firm is considered to be a nexus of contracts and these contracts are implemented with the intention of ensuring that all parties, acting in their own self-interest, are at the same time motivated towards maximising the value of the organisation (Deegan, 2000: 212). This view differentiates Agency Theory from classical and neoclassical economics where market forces are deemed to be the disciplinary mechanisms on entrepreneurs who manage firms (Kumar, 2000: 14). In contrast, agency theory deems that a system of complex written and unwritten contracts are an effective disciplinary mechanism for disparate individuals, specifically the owners and decision-making agents (Fama and Jensen, 1983).

Agency theory, specifically that developed by Jensen and Meckling (1976), is also one of the initial theories to address the behavioural implications of the economic actors in a firm setting, which is often necessary but overlooked by neoclassical theory. The theory of agency is a step towards understanding the black box called the ‘individual’. However, the effectiveness of current approaches is questionable. Agent behaviour within the Theory of Agency will be the primary subject of investigation.

---

5 A quasi-rent is an above the market rate/charge for the use or production of an essential service resource brought about by a bilateral monopoly (Kline, Crawford, and Alchian, 1978: 298)
2.2 Agency Theory: A Description

The specific theory of Agency to be investigated pertains to the conceptualisation and formulation developed by Jensen and Meckling (1976). Agency theory allows the explicit incorporation of conflicts of interest, incentive problems, and mechanisms for controlling incentive problems into business, behavioural and economic models (Lambert, 2001:1). It thus provides a framework for addressing these issues and for examining the links between information systems, incentives, and behaviour. In essence, the theory provides a structure within which to model and understand a vast array of human organisational arrangements (Jensen and Meckling, 1994: 13).

2.2.1 A Description of Principal Agent Problems and Agency

The theory of Agency was first explicitly modelled by Jensen and Meckling (1976) in their study of the structure of the firm. Agency theory addresses all exchanges involving cooperative effort and delegation of work and decision making by one party (called the principal) to another (called the agent) (ibid). Jensen and Meckling describe an agency relationship as a contract (implicit or explicit) in which one or more persons, (the principal(s)), engage another person, (the agent(s)), to take actions on behalf of the principal(s) which involves the delegation of some decision-making authority to the agent. It is taken as unquestionable that an uninformed principal can benefit from this delegation to an informed agent and that it is in fact optimal for an uninformed principal to do so given their lack of skills, information, qualifications, knowledge, and experience (Bendor, Glazer and Hammond, 2001: 248).

The notion of agency is widely used in economics, philosophy, legal and social sciences, albeit with different but comparable meanings (Van Eck and Wieringa, 2001: 1). In law, agency is the relationship between two legal bodies where one legal body, the agent, acts on behalf of the other (the principal), and represents the other legal body towards third parties (ibid). In e-business, there is a similar relation between organisations and their information systems that represent them at a digital marketplace: these information systems act ‘on behalf of’ the organisations that
deploy them \((ibid)\). These agents are autonomous actors in an economic or legal sense. Motivations for actions may vary with a common guide found in ‘self-interest’ however defined \((ibid; Jensen and Meckling, 1976)\). Critical are particular usages of ‘self-interest’.

Human agents autonomously choose to engage in agency relations with principals, presumably because doing so promotes, or does not conflict with, their own interests (Van Eck and Wieringa, 2001: 1; Jensen and Meckling, 1976). By engaging in an agency relationship, however, an agent is bound to moral and legal rights that protect the interest of the principal through a legally enforceable contract entered into by both the principal and the agent (Van Eck and Wieringa, 2001: 2). Neither negotiation nor strategic behaviour, however, has to stop after a contract is signed. During the execution phase of a contract, a business party may try to act as strategically as possible within the borders set by the contract.

In the simplest agency models, the organisation is reduced to these two contracting characters: the principal and the agent, as demonstrated in Figure 2.2. The principal's roles are to supply capital, to bear risk, and to construct incentives, while the roles of the agent are to make decisions on the principal's behalf and to also bear risk (this is frequently of secondary concern) (Lambert, 2002: 4). The principal can be thought of as a representative shareholder or the board of directors and the agent, the CEO. In more complicated agency models, there can be multiple principals and/or multiple agents. Some agents can even be both a principal and an agent, e.g., in a hierarchical firm a middle level manager might be the agent of managers above him and the principal to employees below him (Lambert, 2002: 4). In other contexts the principal and the agent could be (i) bondholders vs. shareholders, (ii) regulator vs. regulatee (iii) citizens vs. government policy makers (iv) doctor vs. patient, (v) two separate firms, etc (Lambert, 2002: 4). They, however, do not have equally proportionate roles. The principal and agent are an asymmetric form. Agency theory thus explores the form taken by the contracting parties and the contracts used to discipline the contracting parties. Agency theory, thus, seeks to determine the most efficient contract governing the two parties given its assumptions about the parties, organisation and information.
2.2.2 Specific Formulations of the Principal Agent Model

Typically in the business literature, the principal agent model focuses on a transaction of two or more parts, principal and agent being held constant. In the first part of the transaction, the principal's roles are to supply capital, to bear risk, and to construct incentives. The principal then delegates decision making authority to the agent. This delegation is demonstrated in part 1 of Figure 2.3, the arrows representing the direction of flow of the ultimate exchange.
In the second part of the transaction, the agent accepts an obligation or responsibility to perform at a specified or agreed level. This is their commitment to achieving the principal’s set goal(s). The agent will then make decisions on the principal's behalf and also bear some risk (though this is frequently of secondary concern) (Lambert, 2001: 3). That is, the agent will assume responsibility by expending effort and executing actions (i.e. decision making in an uncertain environment), to meet the performance objectives specified in the contract. In doing so, the agent will generate and obtain valuable information required by the principal. Section A1.2 in Appendix 1 details attributes of the information transmission. This process is demonstrated by the direction of flow of the second arrow in part 2 of Figure 2.3.

In the third part of the transaction, the principal will reward the agent for attaining the performance objectives specified in the contract and hence, finalising its commitment represented by part 3 of Figure 2.3 (the transaction is represented by the direction of flow of the third arrow). Section 2 in Appendix 1 section A1.1 provides further details on the use of rewards.
Part 4 of the transaction depicts an arrow with a feed forward demonstrating the reengagement of the relationship. The relationship may dissolve (i.e., be a one-off transaction) or continue for repeated transactions depending upon whether the agent wants to reaccept the obligation to perform tasks on behalf of the principal. This is depicted in part 4 of Figure 2.3 by the dotted feed-forward arrow demonstrating the reflection on the part of the agent. Should the agent reaccept the obligation, the transaction is re-established and passes through all the parts again for another possible reengagement. This is represented in Figure 2.3 by the solid feed-forward arrow.

Butterworth (1987: 186) presents an alternative formulation that models the asymmetric agency relationship and entitles it the *Agency Model* (see Figure 2.4 below). Note that the principal and agent are just another box with a range of states distributed about them. Note the apparent object homogeneity with ‘state of the world’, ‘information system’, ‘decision process’ and so on all rendered in the same way, with like arrows connecting boxes. Allocations are then formally arbitrary, despite the specific intentions and interpretations of the situation. The actual figure presents one formulation which is underspecified in detail. Central to the argument for a reformulation is that such specifications always retain some element of arbitrariness or peculiarity which may see them better suited to some applications, and not to others. Strictly, they are particular specifications and embody ‘arbitrary’ assumptions, which do not reflect the transacting process or sequence.

*Figure 2.4 - The Agency Model*

This figure is not available online. Please consult the hardcopy thesis available from the QUT Library

Source: Butterworth, 1987: 186
There are considerably few papers which look beyond this model and question the assumption that the agent has superior information and model the principal as having superior information. For example, in the totality of the Agency literature to date only Dow and Raposo (2001) has sought to undertake research with this in mind, and have found that there are instances where the principal may possess a dimension of information not already acquired by the agent. This aspect of the agency relationship, i.e., the possibility of the principal possessing some dimension of information, requires further investigation and could be a subject for further research.

The above formulations only scrape the surface of contextuality. While Butterworth (1987) recognises the presence of the state and its influence on the decision process and on forming information, it does little to explain how. The previous discussion on the principal agent model as a transaction sequence depicted in Figure 2.3 ignores this state in totality. No mention is made of the context in which the relationship is undertaken or of the context in which the transaction takes place. If Figure 2.3 were to depict the depth to which the current formulations encompass and represent the actual agency relationship, i.e., inclusive of the context, it would be sketchy. This is depicted in Figure 2.5 below.
Figure 2.5 above clearly demonstrates a confined examination of the principal-agent relationship and transaction. It is confined in the sense that only certain areas are examined and to limited depths. This is shown by the encircled area of the figure which is confined to examining solely the contract to the almost ignorance of the characteristics and components of the agent. The extent of this confinement is demonstrated in Figure 2.5 by the barest encirclement of the agent figure. This occurs despite the relative size and depth of the agents and principals contextual influences. The relativity in contextual depth is demonstrated in Figure 2.5 by the 3D principal and agent cylinder in comparison to the depicted one-dimensional contract. Formulations in agency may be improved by considering the depth of the principal and agent to the relationship, and the transaction as objects with properties, i.e., their context, and thence examining the implications of the contextual formulations.
2.2.3 An Example of a Specific Formulation of Agency

The relationship between the manager and shareholder is considered to be an example of a pure agency relationship (Jensen and Meckling, 1976: 6) and is discussed at length by Steensma and Corley (2001). The fundamental assumption of this relationship is that the underlying interests of professional managers and stockholders diverge (Steensma and Corley, 2001: 489). Differences in attitudes toward risk may lead to differences between the principal’s and agent’s preferences concerning actions to be taken (Kumar, 2000: 17). The greater the differences are in risk-preferences, the higher the likelihood that the agent’s actions will not coincide with those of the principal. For example, according to Steensma and Corley (2001: 489):

1. Shareholders are wealth maximisers who want to increase the market value of their holdings through the long term profitability of the firms they invest in. A typical shareholder invests in a diversified portfolio of stocks to limit unsystematic risk. Because of this diversified portfolio, the shareholder is willing to bear a higher level of risk with any individual stock, as this risk can be offset by other low-risk stocks. In short, efficient allocation of risk bearing seems to imply a large degree of separation of security ownership from control of a firm (Fama, 1980: 291).

2. In contrast, managers, who have control of the firm, wish to maximize their own utility function. This is likely to involve, to some degree, their personal status and the security of their employment. To maintain their current position and security, professional managers adopt a short-term, risk-averse perspective when making strategic decisions, which is unlikely to be in the long-term interests of risk-taking shareholders.
Steensma and Corley (2001: 490) refer to a means by which to align the divergent interests of professional managers and shareholders. This is to compensate or reward managers through stock ownership (i.e. issuance of stock options). Take for example, when a manager is the sole security holder, and he or she consumes on the job, through shirking, perquisites, or incompetence, this yields marginal expected utility equal to that provided by an additional dollar of wealth usable for consumption or investment outside of the firm (Fama, 1980: 295). The manager pays directly for consumption on the job, and can not pass any of the associated costs onto any other security holder as he or she is the sole security holder (Deegan, 2000: 212; Enderwick, 2002: 95).

On the other hand, when the manager is no longer the sole security holder (as is the case in a shareholder and manager relationship), and in the absence of any form of personal expense for contractual deviations, the manager has an incentive to consume more on the job than is agreed to in his contract (Fama, 1980: 296). Stock ownership would thus give managers an incentive to make decisions consistent with maximizing shareholder wealth, because to do so will also maximize their own wealth. The magnitude of stock ownership by top management therefore increases the congruence of management and shareholder risk preferences and goals (Steensma and Corley, 2001: 490). By creating alienable common stock equity claims that can be placed in well diversified portfolios of widely diffused investors, risk-bearing costs are reduced to a fraction of those borne by owner-managers of privately held organisations (Jensen and Murphy, 1983: 24).

This particular share ownership strategy seems to be applied extensively in the US6. US CEOs receive a larger fraction of their pay in the form of stock options, and a lower fraction in the form of salaries than any of their global counterparts (Murphy, 1998: 7). For example, Murphy (1998) found that stock options (and other long term incentives) are absent in the nine of the 23 countries he surveyed, and compromise less than 5% of total pay in 13 of the 23 countries surveyed. This moderate use of

---

6 The governance problem within Asian relations based economies differs from the agency issue that dominates Western market based economies (Enderwick, 2002: 101). Separation of ownership and management is much less common, particularly where family-owned businesses dominate (ibid). Other problems result from poor levels of transparency and accountability (ibid).
stock options as a means to align the interests of managers and shareholders raises questions as to its effectiveness. The incentives generated by CEO stock ownership have also declined substantially over the past 50 years, even between the burst and boom year of 1974 and 1984 in the stock market (Jensen and Murphy, 1990: 41). While there maybe an observable relationship between management compensation and firm performance, it is equally plausible that such compensation plans could also be provided for by culturally specific notions of fairness or reward.

The conflict of interest between shareholders of a publicly owned corporation and the chief executive officer (CEO) is therefore a classic example of a principal-agent problem⁷ (Jensen and Murphy, 1990). As the above discussion has shown this divergence is attendant to thorough formalising of compensatory schemes, an area to be of common interest. This is demonstrated in Figure 2.6 below to be the main area of examination. Other aspects of the relationship are ignored and appear to be poorly captured in current conceptualisation and formulations. As, these aspects lie outside the main area of examination, which is depicted as the area outside the dotted circle in Figure 2.6. This in other words is the context of the relationship and transaction. This analysis of a specific situation of an agency relationship has also demonstrated the limitedness of the current conceptualisations in Agency theory.

---

⁷ A similar principal-agent problem occurs if the manager seeks financing through debt securities (Barnea, Haugen and Senebet, 1981).
This shareholder and manager relationship is but one specification of an agency relationship that is used. While this specification is useful for generating many insights, in more complicated agency models, there can be multiple principals and/or multiple agents (Bendor, Glazer and Hammond, 2001: 245). Some agents can even be both a principal and an agent; agents are generally responsible for a rich set of actions. For example, in a hierarchical firm a middle level manager might be the agent of managers above him and the principal to employees below him (Lambert, 2001: 3).

A network is an example of a multiple-agent model and setting. Networks have been studied extensively in the social sciences (Newman, 2003: 2). A social network is a set of people or groups of people with some pattern of contacts or interactions.
between them (Newman, 2003: 5). Typical social network studies address issues of centrality (which individuals are best connected to others or have most influence) and connectivity (whether and how individuals are connected to one another through the network) (Freeman (1996) and Couldry (2004: 5)). The study of networks is by no means a complete science yet, and many of the possibilities have yet to be explored in depth (Newman, 2003: 4). Understanding how agents are contextualised by more than ‘networks’ needs to be undertaken. This is a view espoused by scholars in networking theory, e.g., Nohria (1992) and Nohria and Eccles (1992). They emphasise among other things that it is the relationship rather than the transaction that is the central unit of analysis. This supports the view espoused in this research with regards to Agency theory, i.e., further examination of agent behaviour in the agency relationship is required as opposed to the extensive examination of contractual costs and incentives. The research undertaken and results obtained in this research is thus complementary and supportive to that in networking theory.

2.2.4 Characteristics of the Specification

The previous two sections (2.2.2 and 2.2.3) provided an overall picture of the agency relationship. Certain characteristics of the agency relationship, however, require further clarification to provide a richer specification of the relationship. These characteristics are information asymmetry, conflicting interests, agency problems and agency costs; each is now examined.

2.2.4.1 Information Asymmetry and Conflicting Interests

Aspects of Agency theory discussed so far have made the assumption that information may not be distributed equally to both the agent and principal. That is, the agent possesses some information that is valuable but unavailable to the market and principal, without which the market cannot identify the true nature of the activities (Barnea, Haugen and Senbet, 1981: 9). This inequivalent distribution of information is termed the incidence of information asymmetry (Butterworth, 1987: 187). If the agent to the relationship is assumed to be a utility maximiser, there is good reason to
believe that the agent will use the incidence of information asymmetry for their own interests (Jensen and Meckling, 1976: 5). This is not in the best interests of the principal and hence, creates conflicting interests between the parties.

Analysis of the impact of conflicting interests on corporate decisions is based on two fundamental assumptions. First, principals and agents behave according to their own self-interests; and second, each of the participants in the firm’s activities is rational and capable of forming unbiased expectations regarding their future wealth (Barnea, Haugen and Senbet, 1981: 8). The Agency literature identifies that where conflicts of interest are coupled with self-interested rationalist (SIR) behaviour the result is suboptimal business decisions (Jensen and Meckling 1976, Bricker and Chandar 1998, Cho 1992, Deephouse and Wiseman 2000). That is, the agent will select those actions that are in his or her own interests given the compensation scheme offered by the principal. This does not align with the interests of the principal. For example, a common occurrence is for agents to take actions that increase the reported measures in the short-term without increasing the real outcome (i.e., ‘performance padding’) so as to obtain a greater share of the reward (Lambert, 2001: 52).

Conflicts of interests occur because the risk bearing by the principal is separated from management, i.e., when ‘ownership’ is separated from ‘control’. Consequently, the actions of agents and investment opportunities are not perfectly observable by the principal and neither do principals know the actions that agents should and can take, or which of these actions will increase their wealth (Jensen and Murphy, 1990: 1; Murphy, 1998: 26; Deegan, 2000: 220; Bendor, Glazer and Hammond, 2001: 244). As the principal is unable to comprehensively control the activities of the agent there is, therefore, the incentive on the part of the agent to distort information to improve his or her share of the reward. The consequences of information asymmetry and conflicting interests are depicted in Figure 2.7 below.
Figure 2.7 - Implications of the Agency Relationship

Source: Osanabrugge, 2000: 96

2.2.4.2 Agency Problems

The problem of information asymmetry cannot be avoided, as the agency relationship is founded upon the exact notion that brings about such an asymmetry. This is the separation of ownership and control. Consequently, no contractual provision will necessarily resolve the manner. Instead, bonding costs are incurred to minimise the costs brought about by informational asymmetry, as demonstrated in Figure 2.6.

Informational asymmetry is not the only problem perpetuated with the separation of ownership and control. The goals and risk preferences are likely to conflict between those parties who possess ownership and those who possess control. The conflict here results in what Eisenhardt (1989) terms as the agency problem, which is also demonstrated in Figure 2.6. The agency problem can be partitioned into the temporal dimensions of pre-contractual and post-contractual effects.
The pre-contractual problem is that of self-selection (otherwise known as adverse selection) and arises because the principal cannot be certain about the agent’s motivation for entering the contract (Kumar, 2000: 18; Stanford, 2003: 3). An agent can, therefore, misrepresent his/her abilities in order to enter into a contract. This problem arises because agents frequently have private, pre-decision information concerning for example, their abilities, market conditions, and production costs (Kumar, 2000: 18). Therefore, this possession of private information by the agent leads to the incurrence of agency costs in differentiating the more qualified applicants from the less qualified, which is demonstrated in Figure 2.6.

The post-contractual problem is that of moral hazard and arises because the principal cannot be certain about the agent’s behaviour and its effects on the outcomes (Kumar, 2000: 18; Stanford, 2003: 3). This makes it difficult for the principal to attribute a poor outcome as the result of the agent’s aberrant behaviour (e.g., shirking, perk-taking) or instead is the result of some other factors beyond the agent’s control (e.g., economic climate, social upheaval). Consequently, the principal incurs costs in attempting to monitor the activities of the agent (as depicted in Figure 2.6). These costs are termed as agency costs and are detailed in section A1.2.3 of Appendix 1. A significant portion of the research focuses on the contracting process and its associated costs.

2.2.5 Summary

The usual problem of agency involves uncertainty as to how the agent will behave. The principal cannot be sure that the agent will behave with his/her interests in mind because of certain human, organisational and informational assumptions. Consequently, the principal incurs the costs of monitoring the agent’s behaviour and/or aligning agent incentives with those of the principal so that information is not manipulated on the part of the agent. The agent also incurs costs to assure the principal that he or she will act within his/her interests otherwise his/her position will be at risk. These costs are incurred by the agent during the initial contractual process. The concepts used in the current theory of agency are summarised in Table 2.1 below.
Table 2.1 - Agency Theory Summarised

Source: Kumar, 2000: 13

### 2.3 Existing Research in the Theory of Agency

Agency problems are taken to exist in all organisations and in all cooperative efforts—at every level of management in firms, in universities, in mutual companies, financial markets, in cooperatives, in governmental authorities and bureaus, in unions, and in relationships in the performing arts and the market for real estate (Jensen and Meckling, 1976: 7; Jefferies and Johnson, 2002: 2). Consequently, substantial attention has been devoted to developing the theory of Agency. This is demonstrated in Table 2.2 presented at the end of this Chapter. This table provides a summary of the diverse and extensive research undertaken in Agency theory with each work’s contribution towards the development of Agency theory. This will be examined in depth in later sections of the chapter.
2.3.1 The Theoretical Approaches to Agency

Essentially, there are two theoretical approaches to Agency: the ‘positive\(^8\) theory of Agency’ and the ‘principal-agent’ literature (Jensen and Smith, 1985: 2). Both approaches address the contracting problem between self-interested maximising parties and both use the same agency cost minimising tautology (Jensen, 1983: 27). They differ, however, in many respects.

The positive theory of Agency examines whether events occurring in practice reinforce the predictions of agency. Thus, it is generally non-mathematical and empirically oriented. It is concerned with modelling the effects of the contracting environment and the monitoring and bonding technology on the form of the contracts and the organisation (\textit{ibid}). Capital intensity, degree of specialisation of assets, information costs, capital markets, and internal and external labour markets are examples of factors in the contracting environment that interact with the costs of various monitoring and bonding practices to determine contractual forms (Jensen, 1983: 331). The positive Agency literature proceeds on the implicit assumption that the variables emphasised in the principal-agent literature are relatively unimportant in understanding the observed phenomenon when compared with the richer specifications of information costs, other aspects of the environment, and the monitoring and bonding technologies (\textit{ibid}: 332).

The principal-agent literature, on the other hand, examines the specific explicit aspects of the contract. For example, it examines the type of contractual incentives that can be used within the settings of the principal-agent relationship to achieve efficient risk bearing. The principal-agent literature is generally mathematical and non-empirically oriented focusing on modelling the agency relationship. It has thus concentrated more on analysis of the effects of preferences and asymmetric information and less on the effects of the technology of contracting and control.

\(^8\) Positivists assume that natural and social sciences measure independent facts about a single apprehensible reality composed of discrete elements whose nature can be known and categorised (Guba and Lincoln, 1994; Tsoukas, 1989). The objectives of the research enquiry often include the measurement and analysis of causal relationships between variables that are consistent across time and context (Perry, Riege and Brown, 1999: 16).
(Jensen and Smith, 1985: 3). In other words, it models the effects of three factors on contracting parties interacting in the hierarchical fashion:

1. The structure of the preferences of the parties to the contracts,
2. The nature of the uncertainty, and

While these two approaches differ in many respects, they both address the contacting problem among self-interested principals and agents and ensure that the conflict of interest is explicitly built into the analysis (Lambert, 2001: 3). The reason is that the conflict of interest forms a formidable aspect of the contracting relationship ex ante. It occurs for a number of reasons, including: (i) effort aversion by the agent, (ii) the agent can divert resources for his private consumption or use, (iii) differential time horizons, or (iv) differential risk aversion on the part of the agent (Lambert, 2001: 4). Agency theory models, are therefore, constructed based on the premise that it is important to examine incentive problems and their "resolution" in an economic setting in which the potential incentive problem actually exists or is known to exist (Lambert, 2001: 4).

### 2.3.2 Extension and Application of the Simple Principal-Agent Model

The simple principal-agent model has been extended in a number of ways. To model instances where the outcome might not be observable; to allow the agent and/or the principal to obtain information prior to the agent selecting his/her action; to include multi-periods (either where a single period model is repeated over time or where there are explicit interdependencies between the periods); and to model issues that arise when there are multiple agents in the firm (Lambert, 2001: 7). The model has also been applied to a diverse array of subjects ranging from accounting, economics, finance, management, international relations, and legal standard setting through to politics. This wide application rests on the fact that agency relationships are manifested in all cooperative efforts (Kumar, 2000: 15).
There is a problem however. Such extensions or even applications of the agency model are based upon the assumptions and framework of the original model, a model that is rarely ever questioned or criticised, and focuses almost exclusively upon compensation packages and incentives within the contract. For example, Agency theory assumes that individuals will only ever act in self-interest, and the key to a well functioning organisation is to put in place mechanisms that ensure the minimisation of self-interested behaviour (Deegan, 2000: 213). This focus is almost to the exclusion of all other factors that could play a role in the creation or distortion or management of the conflict of interest between the parties.

This is evident by examining Table 2.2 (presented at the end of the chapter, after Figure 2.8), which presents a summary of the existing research on agency. Seventy-six works are reported with their main structured features indicated. A large portion of this research (i.e., fifty-two works, refer to Table 2.2) has simply applied the simple agency model, which focuses on SIR behaviour and efforts to counter-act such behaviour with incentive schemes.

This preoccupation of the research with compensation and incentive schemes and contractual constraints may have obscured the need for the examination of some other important facets and fostered the limited application of the agency model. This is irrespective of the area of research. For example, Murphy’s (1998) study provides an in-depth and up-to-date description of executive incentive contracts by reviewing and updating much of the relevant and theoretical research on executive compensation and turnover. It is largely descriptive, and focuses essentially on the explicit aspects of executive incentive contracts. Drew and Standford’s (2003) study on Australian superannuation schemes also adopts a similar approach. Principal and agent problems are identified (e.g., misappropriation and mismanagement of members’ funds due to inadequate controls of agent behaviour) and the sole source of reduction in such problems is deemed to be achievable through further contractual constraints that restrict agent behaviour and contractual incentives that reward behaviour that conforms to the principals’ (members’) interests. This may be a well informed policy recommendation. Excessive controls may, however, interfere with agent autonomy adversely by obstructing the agent’s ability to achieve the desired goals for which he
or she was originally employed. This may well have an even more adverse affect on the operations than the assumed divergent agent behaviour.

Interest is further heightened by there only being a small proportion of research (12 works) which critiques the agency model and a further 18 that attempts to extend the model (refer to Table 2.2). Jefferies and Johnson’s (2002) study represents one of the few studies that critiques and attempts to extend the agency model. While their discussions of the generalised reward schemes for financial markets demonstrate that reward schemes lead to unrealistic market dynamics (e.g. instabilities) and various mechanisms are provided for re-stabilising the market. Such mechanisms relate to adjusting the strategy of reward schemes (e.g. asset bases and price movements) and rest solely on the notion of maximising agent wealth. Does this then represent a fruitful extension of the agency model if maximising agent wealth is yet again the main focus and the strategy being the only difference used?

Although other studies have examined additional issues (as evident from Table 2.2), for example, other aspects of the contracting process and/or the contract itself, the context within which the contract is established is not examined or even contemplated to be of importance. Even Kumar’s (2000) study, one that recognises the insufficiency of the agency research, does not explore the context within which the agency relationship occurs. Kumar (2000) does, however, extend the existing agency model through incorporating the dimensionality of agency problems and the multiple levels of agents (inherent in most agency relationships) within the context of franchising. Kumar deemed that a more refined understanding of these concepts was important for designing better contracts. This importance arises from several complex considerations. These considerations are that the:

---

9 Kumar (2000) argued that when franchisers emphasise the different goals, different agency problems become salient, and in turn driving franchisers’ choice of franchising form. Kumar (2000), however, found moderate evidence for the agency theoretic explanations of the relationship between franchiser goal emphases and the choice of the franchising form. In other words, agency theory appeared useful in explaining the existence of certain franchise forms but not all. An explanation for the existence of multiple forms of franchising was attempted but of the six hypotheses posed only three were supported.
1. Agent’s goals may diverge from principals’ goals in some situations but not others and hence, different types of agency problems might emerge.

2. Level of principal-agent goal divergence may vary from one situation to another, e.g., a higher level of risk sharing may suggest greater need for risk sharing.

3. Principal may be pursuing multiple goals and hence, there will be a need to design contracts that align the agent’s goals with the high priority goals of the principal (Kumar, 2000: 5-6).

It is thus plausible to suggest that if such goal divergences exist then contractual solutions that are appropriate for one problem may not be appropriate for others. There is no doubt that goal divergence between the parties influence the design of a contract. The need for designing different types of contracts has been at the heart of Agency theory since its inception (e.g., Jensen and Meckling 1976) and has assumed increasing importance in the light of recent empirical evidence (Kumar 2000). The ability to handle this diversity has been limited, in part it will be argued because of the methodology employed. However, will an increased understanding of the different types of contracts necessarily lead to the design of better contracts? Given that the contractual process is explored without any sufficient examination of the factors that perpetuate goal divergences on the part of the agent which necessitate the use of contracting. The answer thus is unlikely to be yes. These factors could include: economic circumstances, behavioural influences, and social interaction and conditioning. Contracts designed without a concern for their foundations, i.e., the context within which they occur, are not well informed and can not adequately address the problem.

Recall that the existing Agency theory assumes that such divergences occur solely due to the self-interested nature of the agent that causes him or her to mislead the principal and undertake those activities that are in his or her best interest. This is agent utility maximisation in part at the expense of the principal. There is thus an assumed goal divergence necessitating the need for counteracting to limit such behaviour. Should such an assumption of SIR behaviour assume prime importance in
Agency theory? The context within which the contract is initiated should also be a prime focus of Agency theory. Agents do not operate within a vacuum and contracts are not prepared in such a vacuum to necessitate the lack of interest in the context of agency. This minimal or limited examination of the context of agent behaviour in Agency research (i.e., context independency (Togati, 2001: 124)) can be likened to the practice of ‘judging a book from its cover’. Selective parts of the contracting process are being examined to the neglect of the whole, and it is the behaviour of the whole that is more informative than the behaviour of selective individual parts (Evans, 2002: 1). This will be demonstrated in the next section.

2.3.3 Self Interest: The Underlying Proposition of Agency

The self-interested nature of human behaviour was first explicitly made apparent by Adam Smith’s statement in *The Wealth of Nations* in 1776: ‘it is not from the benevolence of the butcher, the brewer, or the baker that we expect our dinner, but from their regard to their own interest’. This regard for self-interest has been incorporated into economics and most importantly in Agency theory. It’s incorporation has been in a narrow form and is central in the theory of Agency.

The central proposition of modern Agency theory is that SIR people always have incentives to reduce or control conflicts of interest so as to reduce the losses these conflicts engender and hence, maximise their own utility (Jensen, 1994: 15). The theory of Agency has thus reduced individuals to a determinable item by making this universal assumption that each and every party to a contract while being rational will always be self-interested. Yet a main purpose of the whole principal-agent relationship is to achieve a jointly beneficial outcome. The question here is that: if one thinks of themselves as a rational person, must they always behave in a self-interested manner through utility maximisation? According to Brennan (1994: 15) a surprising number of economists apparently think so. How is self-interest to be gauged when joint costs and outcomes exist?
Chapter 2: Literature Review – A Review of Agency Theory

The hypothesis of self-interest while extremely useful in some contexts may be misleading in others. According to Brennan (1994: 32) it is most appropriate in the perfectly competitive setting of neoclassical theory, that is, in those situations where the individual can have no influence on the welfare of others since he is by definition a price taker. Accordingly, it may be less appropriate in other circumstances where the individual is placed in a position of responsibility for others, as is the case in agency (Brennan, 1994: 32).

Self-interest may be a powerful force, but its sway is not exclusive. For example, Ridley (1996) states that individuals behave with self-interest foremost in mind, but also in ways that do not harm, and sometimes even benefit, others. Thus, the tendency to identify self-interest with rationality according to Brennan (1994) is mistaken, as it represents a serious oversimplification of an economic individual, and is not descriptive of human behaviour. Coincidentally, the narrowly SIR model of an economic individual is commonly viewed as an object of scorn among non-economists, as the economic individual is depicted as lacking both virtue and (most) vice. While he is never resentful at being treated unfairly, he is never angry at the unfair treatment of others. While he is never discouraged by failure, he will never perform without incentives. While unerring in his pursuit of (suitably discounted) long-term gain, he has no honour or self-esteem, and feels no shame or pride in accomplishment.

Thus, this narrow definition of rational SIR behaviour assumes both too much and too little about human nature. While Smith evidently believed that self-interest could be used to explain many economic phenomena, he was far from claiming that it explains all behaviour (Togati, 2001: 124). His ‘Theory of Moral Sentiments’ attests to this with, for example, his comment that ‘to restrain our selfish, and to indulge our benevolent affections, constitutes the perfection of human nature’.
2.3.4 Self-Interest and Management Compensation

The existing research on the theory of Agency is thus based on an oversimplified model of human behaviour. For example, in trying to understand executive compensation, economists are inclined to identify rationality with self-interested utility maximisation. Whereby it is assumed that, if the agent is not provided with adequate incentives through a compensation plan\(^\text{10}\), he or she being a SIR will manipulate the information so as to maximise his or her utility.

Recall that Agency theory predicts that a compensation policy will tie the agent’s expected utility to the principal’s objective, also a utility (Johnson and Greening 1999: 571). Jensen (1994: 3) therefore states that in order to increase the chances that managers will take the best actions possible, principals must ensure that the incentives (that is, the tradeoffs) they face encourage them to move in the correct direction. This implies that the principals must strive to ensure that the culture of the organization, and any other variables under their control (e.g., bonus scheme), reward proper, as opposed to improper, action (Jensen, 1994: 3, Deegan, 2000: 221). Existing research in Agency theory has, thus, predominantly examined how incentives influence the behaviour of SIR agents, and how to align these incentives in resolving the agency problem (as tabulated in Table 2.2). This places a large burden on the compensation contract because it is perceived to be the only manageable source of incentives for the agent (Lambert, 2001: 12) and the predominant mechanism for aligning the interests of a risk-averse self-interested executive (agent) with those of shareholders (principals) (Murphy, 1998: 26).

Murphy (1998) mentions several inextricably linked factors that have contributed to this widespread interest in executive pay. These are:

1. The undisputed escalation in chief executive officer (CEO) pay,

---

\(^{10}\) Compensation plans generally contain four basic components: a base salary, an annual bonus tied to accounting performance, stock options, and long-term incentive plans (including restricted stock plans and multi-year accounting based performance plans) (Murphy, 1998: 3).
2. The populist attack on wealth that followed the so-called ‘excesses of the 1980s’, associated with the perception that high CEO salaries is coupled to layoffs, plant closings, and corporate downsizing, and
3. The bull market of the 1990s, creating windfalls for CEOs whose pay is increasingly tied to company stock-price performance.

Stephen O'Byrne, head of Stern Stewart's executive compensation consulting practice, in Brennan (1994: 35) states that ‘the average CEO's total compensation program needs a lot more performance incentive to fully align the CEO's interests with those of the shareholders.’ This contains more than an echo of the simple agency model popularised in this context by Jensen and Meckling (1976). O'Byrne is referring to the finding of the much-cited study by Jensen and Murphy (1990) which purported to show that, on average, the total wealth of a CEO changes on average by only $3.25 for every $1000 change in shareholder wealth (and this includes the effect of CEO stockholdings as well as stock options and other incentive schemes). On the basis of this finding Jensen and Murphy (1990) conclude that the small observed pay-performance sensitivity seems inconsistent with the implications of formal principal-agent models. Current compensation practices, coupled with typical levels of CEO stock ownership, provide few incentives for average executives to take actions that increase shareholder wealth. If countless studies (e.g., Watts and Zimmerman (1978), Healy (1985)) have revealed that managers can manipulate the exact bases on which such compensation packages are formulated. How effective are compensation plans in enticing managers to act in accordance with the interests of shareholders.

Table 2.2 demonstrates that Jensen and Murphy’s (1993) study is not the only study not to reinforce the predictions of the simple agency model. Table 2.2 demonstrates that there are several studies (i.e., eighteen works, marked with an asterisk) that examine incentive schemes and management compensation, which fail to reinforce the predictions of the simple agency model (22 works in total). Is the alignment of interests with compensation and incentive schemes effective at all? Evidence that the simple agency model may not be descriptive of the decisions of those in positions of responsibility for others was provided by a recent study by Gibbons and Murphy
Gibbons and Murphy (1992) argue that existing compensation arrangements give CEOs an incentive to reduce these expenditures as they near retirement, and this is the clear prediction of the simple agency model. What the study finds, however, is that R&D, advertising expenditures, and capital expenditures increase rather than decrease as the CEO nears retirement.

Further examination of Table 2.2 also indicates that the simple agency model has limited success in other contexts as well, e.g. in governance, finance, and human resource management. Lambert (2001) states that the Agency literature has not to date made much progress in facilitating the comprehension of how, why and when earnings management takes place. This brings to question whether there is a relationship at all between the alignment of interests and the compensation and incentive schemes offered? As there is no doubt that CEOs and other top managers exert at least some influence on both the level and structure of their pay (Murphy, 1998: 24).

Why might the predictions of the simple agency model fail to explain the behaviour of agents (i.e., their assumed SIR behaviour)? Could this be because of the over simplification of human behaviour and over emphasis on incentive schemes. The change in shareholder wealth may be an appropriate measure of the principal’s objective in the CEO-shareholder agency relationship, but it is an imperfect measure of the CEO’s individual performance, interests and behaviour (Jensen and Murphy, 1990: 26).

2.3.5 Critique of Self-Interest & the Use of Management Compensation

Brennan (1994) attacks the use of incentives for executive compensation and, indirectly, for use in society in general. Brennan argues that economics views rational behaviour as self-interested and this proposition is wrong both in a positive sense (that is people don’t behave that way) and in a normative sense (because if they did behave in a SIR way, the world would be a more brutish and undesirable place).
Brennan (1994) is correct, in that people do not always behave in a rational way, and people do not always act in their own self-interest. Brennan cites two sorts of evidence that indicates the narrowly SIR model of human behaviour is inadequate: 1) people do evidence concern for the welfare of others, and 2) people often do not evidence a concern for their own welfare (1994: 37).

Brennan (1994) thus argues in favour of the perfect agent model, that is, agents have the capability of rising above their own narrow self-interest and are altruistic. If agents were completely self-interested rationalist would this then not lead to a scenario where principals would need to continuously revise their incentives offering more rewards so information is not manipulated and excessive shirking does not occur? Then if these incentives were not provided would this then not result in excessive corporate collapses associated with the manipulation of information and excessive shirking? This rarely occurs in reality and is regarded as an extreme case scenario. Corporate collapses do occur but, recent Australian corporate collapses, e.g., HIH and Onetel, have demonstrated that compensation and incentive schemes are not responsible, while accounting and auditing practices have proved to be accommodating of aberrant behaviours.

This does not mean that agency problems or even the over simplification of the existing agency model can be solved by instilling greater altruism in people. Agents may well be more or less altruistic there are nevertheless no ‘perfect agents’ in the real world (Jensen, 1998: 6). No agent can so thoroughly embody the preferences of a principal or be that principal’s perfect agent (ibid) as each agent and/or principal is an individual. There will always be differences with regards to their preferences. The question is as to its significance and its management. Simply because the agent is unable to embody the preferences of the principal does this mean that they will adopt a self-interested maximisation approach to reasoning, and require the imposition of rewards and constraints to align interests/preferences? Jensen and Meckling (1976) assume so.
Human beings are more complex in their totality than can be represented in any parsimonious model. The preoccupation of the Agency literature with incentive effects and alignment has obscured the need for the examination of other factors influencing human behaviour. Behaviour is influenced by more than the need to maximise self-interest. For example, self-actualisation, honour, reputation, and job-satisfaction are likely to assume greater importance as one moves up the corporate hierarchy towards the CEO (Brennan, 1994: 34). Especially, nonpecuniary rewards associated with success and accomplishment, and nonpecuniary punishments associated with failure, do provide incentives for managers (Jensen and Murphy, 1990: 35). Additionally, the literature on the power of human emotions suggests that ideologies and conceptions of fairness and procedural justice shape judgments of what represents an equitable allocation of scarce resources or a just resolution of conflicts of interest (Goldgeier and Tetlock, 2001: 68). This is not to say that there is no place for economic incentives but that they are less likely to be paramount in influencing behaviour. The behaviour of individuals is ultimately shaped by their upbringing, that is, the institutions to which they affiliate and interact with. Adam Smith in his ‘Theory of Moral Sentiments’ even suggests that men are influenced by the environment of their profession or calling. For example, Temel’s (2000) thesis demonstrates that culture through the use of national institutions, as a vehicle for cultural value transmission, influences the accounting practices adopted by corporations.

2.4 Problems to be Addressed

Research has claimed that the premise for the existence of the firm has been the ability to reduce the cost of transactions by internalising the provision of an activity to the firm setting (Coase 1937, Williamson (1975) and section 2.1). While this theory does provide an explanation as to why certain activities will always be performed by the market or the firm, it does not provide an explanation as to why certain firm structures exist or an explanation of the role of the individual in the transacting process. The theory of agency seeks to incorporate these two aspects.
According to Agency theory, the modern corporate form exists because the principal has the necessary resources, and with a diversified risk portfolio can delegate responsibility to the agent who has the appropriate skills to manage and organise subordinates to attain the predefined objectives. Their interaction with one and another is assumed to be dominated by the concern for self-interest and hence, likely to result in a conflict of interest given the differing goals and horizons of the parties. Building incentives into contracts is deemed to align the interests of the agent with those of the principal, and is deemed to be an appropriate method to control self-interest (Jensen and Meckling 1976).

Recognising that self-control problems exist and that there is a need to provide for such instances in contracts is a step in the right direction. However assuming that all principals and agents will act in a self-interested manner and not considering the context of rewards or the context in which the agency relationship is transacted, effectively ignores the problem of impulse control and the problem of agency. Self-interest does not always determine or justify behaviour. Research (Tabulated in Table 2.2) has demonstrated that there are instances where the simple predictions of self-interest do not explain behaviour. Self-interest represents one simplistic, narrow explanation of agent behaviour (i.e., a single case) but, is not in the least the underlying explanation of agent behaviours. Thus, what needs to be incorporated into Agency theory is the interplay of other factors that may influence agent behaviour besides the need to maximise one’s utility. Recall that the behaviour of individuals is ultimately shaped by their upbringing, that is, the institutions to which they affiliate and interact with.

### 2.5 Initial Formulation: the Interplay of Institutions

The growth and mutations of the institutional fabric are an outcome of the conduct of the individual members of the group, since it is out of the experience of the individuals, through the habituation of the individuals, that institutions arise; and it is in this same experience that these institutions act to direct and define the aims and end
of conduct (Veblen in Staveren, 1999: 141). Institutions are, therefore, formed within society to ensure that certain norms and values are supported and adhered to.

Societal institutions include the legal system, the financial system, the social class structures, the nature of business ownership, the educational system, religious institutions and so on (Hofstede 1980). An affiliation and interaction with such institutions aligns an individual’s beliefs in accordance with such values and norms, and consequently through a subsequent affect on their desires and intentions their behaviour is constrained accordingly. For example, a well defined and codified legal system and a strong presence of religious institutions are both likely to enforce conservative behaviour, and influence individuals’ beliefs and hence, behaviours accordingly through their desires and intentions.

Organisations are embedded in their environments (Lambert, 2002: 222) and consequently, are social as well as technical phenomena, and their structures and processes are not changed purely by technical rationality (Westney 1993; Ray, 2002: 351). The firm is much like a social system, individuals involved in the provision of goods and/or services interact and communicate with one and another; rules are established and adhered to; and there are divisions within the workforce as there are in society. The firm as a social system also requires these institutions to control its activities. Agency problems associated with informational-asymmetry and managerial perk consumption in a firm for example may be resolved via the operation of well-functioning markets (Haugen and Senbet, 1979: 682). As there are sufficient pressures present to force management to carry out decisions on the basis of the shareholders (ibid: 681).

For example, an ongoing firm is always in the market for new managers (Fama, 1980: 292). In such an efficient labour market, the adjustment in the manager's wage provides for a full ex post settling up, so that the manager is disciplined to behave in the optimal interests of the firm (Haugen and Senbet, 1979: 682). There are managerial labour markets both within the firm and outside the firm. Within the firm each manager has a stake in the performance of the managers above and below him
since his marginal product is likely to be a positive function of theirs and, as a consequence, undertakes some monitoring in certain situations (Fama, 1980: 295). Outside the firm the managerial labour market uses the performance of the firm to determine each manager's outside opportunity wage (Watts and Zimmerman, 1978: 117). A decline in firm value in the stock market offers incentives for an outsider or group to tender for control of the firm and install outside directors (i.e., market of takeovers) who will eliminate those managerial activities which are not in the best interest of the shareholders (Watts and Zimmerman, 1978: 117; Fama, 1980: 295). The discipline imposed by managerial labour markets, therefore, can resolve potential incentive problems associated with the separation of security ownership and control of the firm (Fama, 1980: 295). Labour market is just one example of an influential institution. Product market competition also disciplines managers since firms that are inefficiently managed will be unprofitable and will not survive (Jensen and Murphy, 1983: 25).

Organisations face many stronger, heterogeneous, institutional forces to the extent that their external environments consist of influential but diverse regulations, norms, and cognitive models (Scott, 1995; Oliver, 1991, 1992; Scott and Meyer, 1983: 50-151; Friedland and Alford, 1991; Powell, 1991: 195; Greenwood and Hinings, 1996; Hoffman, 1999). These fields influence managerial perceptions (Bloodgood and Morrow, 2000: 209). For example, organisational culture includes, among other things, the mission and vision of the corporation, the values, beliefs and behavioural norms and expectations shared by the organisation's members, which directly influence the organisational member's innovation, performance, satisfaction and stress levels (Cooke and Szumal, 1993; Kumar and Ranjan, 2002: 212). Culture tends to constrain and direct management behaviour, which subsequently affects overall performance through the mechanism of day-to-day practices such as decision making, problem solving, and strategy formulation (Christensen and Gordon, 1999:399). When organisations require a new strategy they hire new managerial staff who typically has participated in other organisational fields and can therefore bring a new perspective to the organisation (Bloodgood and Morrow, 2000: 212).
The stronger the organisational culture, the higher the behavioural consistency and therefore, the lower the requirement of formalisation and centralisation within the organisation (Edwards, Kumar and Ranjan, 2002: 75). Societal institutions and systems such as those in law, politics, education and finance, on the other hand, are related to the development of the corporate form. Individuals within the firm are thus subjected to their influence. Their affiliation and interaction with them generates information which is likely to influence their beliefs and behaviour (through subsequent desires and intentions) accordingly in the firm and in society. This is in accordance with institutional theory (Meyer and Rowan, 1977; DiMaggio and Powell, 1983) which suggests that socially constructed belief systems become institutionalised in organisations and their structure (Scott, 1987) through incorporating environmentally embedded (Granovetter, 1985; Stinchcombe, 1965) and institutionally rationalised rules into their structures (Ibarra and Andrews, 1993).

The unique contribution of institutional theory is its emphasis on how institutions shape the way organisational populations emerge and evolve in context (Wells, 2001). People find, ally with, invest in, and oppose organisational activities based largely on their beliefs about what is possible and appropriate, affected by societal patterns (Wells, 2001: 80). Through institutional affiliation and interaction much behaviour is influenced, accepted and legitimised without conscious awareness. By doing so (i.e., aligning themselves with institutions in their environment), individuals attempt to maximise their legitimacy, stability, and chance of survival (Zucker, 1987; Bloodgood and Morrow, 208; Meyer and Rowan, 1977; Meyer and Scott, 1983; DiMaggio and Powell, 1983). Heterogeneity in these institutional elements can play a role in promoting divergent behaviour (Aunno, 2000: 683). The behaviour of an individual or an agent will, thus, vary from situation to situation depending on the societal institutions to which an individual or an agent affiliates and interacts with and their extent or level of affiliation and interaction. The SIR behaviour supported through informational asymmetry is not the primary force that influences agent behaviour in attaining the principal’s goal(s).
The principal, however, remains to be motivated by self-interest (as assumed and established in the existing Agency literature). As, the principal’s motivation for assigning the control of his/her resources is with a view to maximise their worth and return. The principal’s behaviour is thus assumed to be static and uninfluential of the institutional environment. Further examination of the principal’s behaviour is the subject of future research. It is the motivating force(s) of agent behaviour that is of interest and in question.

There are two formative forces that may influence the behaviour of the agent. Firstly, there are those that are formally conveyed and institutionalised, contractual requirements (i.e., requirement of having written contracts for employment agreements) are an example. These are discussed thoroughly in the existing research as the sole means through which to align agent behaviour with that of the principal. While this research is of the opinion that the sole use of the assumption of self-interested rationalism in determining agent behaviour is problematic. This is not to say that there is no place for economic incentives or contractual requirements but that they are less likely to be paramount in influencing behaviour, and hence represent one of the two forces. Secondly, there are those that are informally conveyed via institutional affiliation and interaction (e.g., customs, norms and values), as discussed earlier. This force influences the agent’s beliefs, desires and intentions, which merge with the prescribed behaviour informed by the formal force. The outcome has a perceptual influence upon what the agent should or should not do, which will eventually affect the agent’s behaviour. This may also result in self-interested behaviour should the environment be conducive to promoting such behaviour. This process is illustrated in Figure 2.8 below. Notice that these forces do not influence the principal. As aforementioned the principal’s behaviour is not of focus and is assumed to be static and self-interested, uninfluenced by other forces but is influential in stipulating behaviour. This simplistic portrayal of principal behaviour is depicted through its one dimensional presence in Figure 2.8.
Figure 2.8 - An Initial Theoretical Framework of the Extended Conceptualisation of Agency Theory

TRANSACTION: Structure of Organisation

EXTERNAL CONTEXT: Institutional Environment

INSTITUTIONS

Means-End Reasoning

Institutionalisation of Social Belief System (Formal Process)

Traditions, Customs, Morals, Values (Informal Process)

Beliefs, Desires & Intentions

Prescribes Behaviour

Stipulated Behaviour

INSTITUTIONS

Merger

AGENT

Means-End Reasoning

Beliefs, Desires & Intentions

Prescribes Behaviour

Stipulated Behaviour

INTERNAL CONTEXT OF RELATIONSHIP:

Behavioural Implications

PRINCIPAL

CONTRACT
Figure 2.8 is a template specifying organisational behaviour in accordance with formal (contractual) and informal structures\(^\text{11}\), the informal of which is the focus of this research. Figure 2.8, therefore, presents an initial theoretical framework that will be used for this proposed thesis to incorporate the contracting environment within the simple agency model. Agency theory no longer rests on the uncertainty of agent behaviour but the uncertainty of the environment that existing agency theory has assumed to be static. Uncertainty now rests with institutional change and the agent’s response to the information generated from its institutional affiliation and interaction. The behaviour of the self-interested agent can also be depicted within this framework. This involves the processes contained within the transaction box to the exclusion of the external environment informing the agent’s belief structure. The above discussion demonstrates how the external context (institutional affiliation and interaction) can influence the internal context (i.e., agent behaviour) of agency. The agent’s behaviour is informed from an external force. This is demonstrated in Figure 2.8. Simon (1996) reinforces this behaviour through his statement that any decision arises from two sources: the internal and the external environment. So, the agent does not necessarily solely act upon the assumed information asymmetry present in the principal-agent relationship. The agent also acts upon the information he or she receives through institutional affiliation and interaction, such information informs the agent’s beliefs and eventually his or her behaviour. This process is demonstrated in Figure 2.8 by the flow of the dotted arrows from the institutions through to the internal context. In doing so, it highlights the importance that the context plays in agency, and the role of institutions in informing agent behaviour, which may or may not be in the interests of the principal. In previous formulations discussed earlier in the Chapter this aspect was neglected. The influence of the states (internal and external) and its interplay on agent behaviour was assumed to be non-existent. Figure 2.8 includes the entirety of the agent’s context in examining the principal-agent transaction (this contrasts with the nominal examination in earlier formulations whose sole focus was contractual and one dimensional), which is presented to exist within and be influenced by an external context, the institutional environment.

\(^{11}\) This is the institutional framework. Aron (2000) also makes mention that an institutional framework comprises of both formal and informal constraints, which is a reinforcement of North’s (1990) continuum of constraints with unwritten taboos, customs, and traditions at one end and constitutions and laws governing economics and politics at the other.
Chapter 2: Literature Review – A Review of Agency Theory

Consideration of the environment within which the contractual relationship is incepted (i.e., the context of the contract or the nature of the exchange, and the behavioural influences upon the contracting relationship) is, therefore, an aspect that needs to be incorporated into the Agency research, and is demonstrated in Figure 2.8 by the surrounding dotted rectangle. As, it is through the consideration of the environmental context of the principal-agent relationship, that greater insights into agent behaviour and the principal-agent problem can be obtained. This is an extension to the existing agent behaviour in the literature which is demonstrated in left portion of Figure 2.8 by the transaction box surrounding the agent, principal and contract to the exclusion of all institutional influence and the environment.

Of the studies listed in Table 2.2 Heffernan is the sole study which critiques existing Agency theory, and extends the model with moderate levels of success. Heffernan (1999) demonstrates that through the use of institutional arrangements, i.e., set contractual arrangements such as routines and mission systems, in combination with well designed incentive structures, set goals can be achieved with some success. A statement by Jensen (1994: 14), one of the early theorists in Agency research, provides further support for such incorporation. Jensen (1994: 15) states that ‘there is a need to examine the institutional structures, contracts, and informal arrangements that are created to reduce conflict, to govern our relations, and to increase the extent of cooperation and the benefits reaped from it’. Despite this statement no research has been undertaken with this in mind. This proposed dissertation will, therefore, adopt this role. The concepts to be used in this extended conceptualisation are summarised in Table 2.3 below. As can be seen from examining Table 2.3, these concepts differ significantly in focus from those of the existing Agency theory presented in Table 2.1, which denotes a varied approach from the existing research.
Table 2.3 - Agency Theory Re-Summarised

<table>
<thead>
<tr>
<th>Key Idea</th>
<th>Principal-agent relationship should reflect the context within which the contractual relationship is incepted.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit of Analysis</td>
<td>Context of the Principal-Agent Relationship</td>
</tr>
<tr>
<td>Human Assumption</td>
<td>Sociable Individual</td>
</tr>
<tr>
<td></td>
<td>Rational Actor</td>
</tr>
<tr>
<td></td>
<td>Dynamic Actor</td>
</tr>
<tr>
<td></td>
<td>Reactive</td>
</tr>
<tr>
<td>Institutional Assumptions</td>
<td>Heterogeneity in Institutional Affiliation and Interaction</td>
</tr>
<tr>
<td></td>
<td>Heterogeneity in Institutional Influence</td>
</tr>
<tr>
<td></td>
<td>Institutional Affiliation and Interaction conveys information</td>
</tr>
<tr>
<td></td>
<td>Information asymmetry between principal and agent</td>
</tr>
<tr>
<td>Informational Assumptions</td>
<td>Two Informative Forces: Formally (contractual) and Informally (institutional) Conveyed</td>
</tr>
<tr>
<td>Relationship Problems</td>
<td>Principal and Agent have partly differing goals and risk preferences</td>
</tr>
<tr>
<td></td>
<td>Principal and Agent have partly differing influences upon their behaviour</td>
</tr>
<tr>
<td>Problem Domain</td>
<td>Environmental Uncertainty within which the Principal-Agent Relationship is Transacted</td>
</tr>
</tbody>
</table>

2.6 Conclusion

The theory of Agency has undertaken a conceptualisation of actors of agency based on a narrow line of thinking, namely that of self-interested rationality. Agents are assumed to act only in accordance with their self-interest fostered through informational asymmetry to the ignorance of the environment, which is assumed to be uninfuential. This is but one conceptualisation of the uncertain behaviour of agents. The discussion presented in the sections above clearly show that another line of thinking is possible, which results in an extended conceptualisation of agent behaviour. This is not to say that the assumption of SIR behaviour is incorrect but rather that there is a need for a more contextual basis. In particular, this relates to the agent’s institutional affiliation and interaction.
<table>
<thead>
<tr>
<th>Reference</th>
<th>Issues Under Investigation</th>
<th>Application of the Simple Agency Model</th>
<th>Reinforces Predictions of Simple Agency Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bertrand and Mullainathan (2000)*</td>
<td>Incentive Schemes, Management Compensation &amp; Governance</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Brennan (1994)*</td>
<td>Incentive Schemes, Rationality &amp; Self-Interest</td>
<td>-</td>
<td>X</td>
</tr>
<tr>
<td>Butterworth (1987)</td>
<td>Conflict of Interest and Separation of Ownership from Control</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Ciancanelli and Gonzalez (2000)</td>
<td>Corporate Governance &amp; Banking Sector</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Cole and Eisenbeis (1990)</td>
<td>Principal-Agent Conflicts in Thrift Crisis</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Davidson (1996)*</td>
<td>Agency Problem Management &amp; Application to South African Firms</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>De Loo and Verstegen (2000)</td>
<td>Action Learning &amp; Management Control</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Dewatripont, Jewitt and Tirole (2000)*</td>
<td>Incentive Schemes &amp; Multitask Agency Problems</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Author(s)</td>
<td>Title</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-----------------------------------------------------------------------</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Dhami (1998)*</td>
<td>Labour Contracts, Compensation &amp; Multiplicity of Tasks</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Fama (1980)*</td>
<td>Incentives, Firm Structure &amp; Agency Problems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fama and Jenson (1983)</td>
<td>Organisational Structure, Agency Problems &amp; Residual Claims</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Ferrall and Shearer (1994)</td>
<td>Incentives, Transaction &amp; Optimal Contracts</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Gibbons and Murphy (1992)*</td>
<td>Executive Compensation, Investment Expenditure &amp; Agency Problems</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Grasshoff and Schwalbach (1997)*</td>
<td>Incentive Schemes &amp; Management Compensation</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Jefferies and Johnson (2002)*</td>
<td>Agency Theory, Reward Schemes &amp; Market Models</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Jensen (1994)</td>
<td>Incentive Schemes, Rationality &amp; Self-Interest</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Jensen and Murphy (1990)*</td>
<td>Incentive Schemes &amp; Management Compensation</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Jensen and Smith (1985)</td>
<td>Incentive Schemes &amp; Management Compensation</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Authors</td>
<td>Topic</td>
<td>Transaction Costs</td>
<td>Agency Theory</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------------------------------------------------------------</td>
<td>-------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Kaufman, Englander and Marcus (1989)</td>
<td>Transaction Costs, Agency Theory &amp; Management Structure</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Kayo and Fama (1997)</td>
<td>Bankruptcy Law and Amendments reducing Agency Costs</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Kumar (2000)</td>
<td>Dimensionality of Agency Problems, Multiple Agents &amp; Organisational Form</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Li and Li (1999)</td>
<td>Bankruptcy Law, Agency Costs &amp; Information Disclosure</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>Martimort (1999)</td>
<td>Regulatory Capture, Regulatory Institutions, Interest Groups &amp; Regulatory Efficiency</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>Mashaw (1997)</td>
<td>Game Theory, Institutional Structures, Governance &amp; Democracy</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>Menard (1996)</td>
<td>Organisational Structure, Transaction Costs &amp; Agency Theory</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Merrett and Houghton (1999)*</td>
<td>Incentives &amp; Dual Positions in Principal &amp; Agent Relationships</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>Murphy (1998)*</td>
<td>Incentive Schemes &amp; Management Compensation</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>Ortin-Angel and Salas-Fumas (19998)*</td>
<td>Incentive Schemes, Bonus Payments &amp; Management Compensation</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Oyer (2000)*</td>
<td>Incentive Schemes &amp; Management Compensation</td>
<td>-</td>
<td>X</td>
</tr>
<tr>
<td>Parks and Conlon (1995)*</td>
<td>Monitoring &amp; Environmental Munificence &amp; its effects on Compensation Schemes</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pontes (1995)*</td>
<td>Incentive Schemes &amp; Compensation Contracts</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>Randhir and Lee (1996)*</td>
<td>Incentive Structures, Contractual Agreements &amp; Resource Degradation</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>Reichelstein (1992)</td>
<td>Incentive Schemes &amp; Executive Compensation</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>Rosen (1987)</td>
<td>Transaction Costs, Labour Markets &amp; Firm Structure</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>--------------------</td>
<td>-------</td>
<td>-------------------------------------------------</td>
<td>-------------------------------------------------</td>
</tr>
<tr>
<td>Shapira (2000)*</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Singh and Sirdeshmukh (2000)*</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Steensma and Corley (2001)</td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tower and Kelly (1989)</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Van Eck and Wieringa (2001)</td>
<td></td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>Van Osanabrugge (2000)</td>
<td></td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>Verrecchia (1986)</td>
<td></td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>Watts and Zimmerman (1979)</td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Wolfers (2002)</td>
<td></td>
<td>X</td>
<td>-</td>
</tr>
</tbody>
</table>

**NB.**
- X: Indicates that the research exhibited the required aspect.
- : Indicates that the research did not exhibit the required aspect.
? : Indicates that the findings were not clear or conclusive.
N/A : Indicates that an empirical examination was not undertaken.
3. An Extended Conceptualisation of Agent Behaviour

The previous chapter, Chapter 2, provided an extensive overview of the Agency literature. An examination of this literature demonstrated the simple, and, it is argued, simplistic notions upon which agent behaviour is constructed. Consequently, an alternative conceptualisation of agent behaviour was introduced. This chapter will provide further detail on this alternative conceptualisation to develop the extended conceptualisation and reformulation of agent behaviour. It involves the incorporation of the contextual nature of human behaviour, particularly institutional affiliations and interactions, into agent interactions. Consideration of the environment within which the contractual relationship is undertaken, and the associated behavioural influence upon agent behaviour, presents the extension to the conceptualisation of agent behaviour in the existing Agency literature. This extended conceptualisation is termed the socio-environmental rationalist agent (SERA). A general reformulation of the agent’s transacting and reasoning process is also necessary. The agency relationship is seen no longer as a formulation of asymmetric mutual dependence informed by self-interested rationalist (SIR) behaviour. It is one of instrumental mutual dependence rationally informed by institutional affiliations and interactions that assist, direct, support and constrain agent behaviour.

This chapter answers the question of how the alternative conceptualisation and reformulation, an extension of the existing research, can provide a more informed understanding of agent behaviour. The sections in this Chapter develop, illustrate and discuss the proposed extended conceptualisation and reformulation. This is first set in the context of theory development.

---

1 Primarily the Agency literature commonly presents the agency relationship as a mutually dependent asymmetric form. The prevailing thought within this conceptualisation is that the agent being rational will always act in accordance with their self-interest as this maximises their utility. This is state determined and determinable. The theory of Agency has, thus, reduced individuals to a homogenous item through this universal assumption. This universal assumption being that each and every agent to a contract with the principal while being rational will always be self-interested in a consistent way. This reductionist approach of agency has eventuated because the theory is formulated with similar fundamental assumptions such as that of maximisation rationality. These fundamental assumptions assume away the contextual nature of human behaviour and interaction.


3.1 The Development of Theory

The development of a theory begins with the researcher thinking of an explanation for some phenomena (Watts and Zimmerman, 1986: 9). For example, in the context of agency this could be the contemplation of how individuals behave in the firm setting or in forms of mutually dependent asymmetric forms. Certain assumptions are then made by the researcher to aid this explanatory process. For example, in order to generate an explanation of an agent’s behaviour, agents may be assumed to be rational and self-interested individuals. SIR agents may be assumed to make decisions and act in accordance with maximising their own utility. Assumptions are also made about information, its availability and the like (discussed in section 2.2.4.1). From such a succession of assumptions, the researcher derives empirical tests. Observing management’s decision-making strategies, their performance and the state of fringe benefits, say, may indicate how agents behave in a firm setting. Hypotheses are then set to test these later assumptions.

Theory in this view consists of 2 parts:

1. Assumptions of various sets, including the definitions of variables and the logic that relates to them, and
2. A set of substantive hypotheses (Watts and Zimmerman, 1986: 9). These are built upon (or beside) the constructed set of assumptions.

Part 1 is used to organise, analyse and understand the empirical phenomena of interest, and from part 2 predictions may be generated from the analysis in part 1. No theory can, however, explain and predict all phenomena. Since theories are based on assumptions which simplify reality (Watts and Zimmerman, 1986: 10). Reality remains complex and changing (Watts and Zimmerman, 1986: 10).
The assumption that rational agent behaviour is informed by self-interest is a general and broad assumption. It represents only one attribute of ‘the rational agent’, as is demonstrated in Figure 3.1 below. This assumption is positioned close to the apex of the pyramid and rests upon four levels of prior assumptions with a focus on the principal. Through using self-interest as the key assumption of rational agent behaviour a significant portion of the agency relationship is omitted. Diagrammatically this is represented by the spotted regions of the pyramid, which embody the properties of the principal and agent as well as the type and the attributes of the interaction. Agent behaviour is thus conceptualised and formulated on some what a simplistic and limited basis. This is with limited contextual input through the notion of self-interested rationalism.

Further analysis of the notion of rational agent behaviour is now needed to demonstrate the extent of the limitation of self-interest. This will aid the development of an extended conceptualisation and reformulation of rational agent behaviour to incorporate a wider level of analysis, specifically the context of agent behaviour. Through understanding the constitution of objects their behaviour and the outcomes of their actions can be more fully explained and understood (Finnemore and Sikkink, 2001: 394). In terms of the diagram the task is to examine the seven levels and ways to consistently link between these. The specification of the rational agent (the top level) provides a starting point.
Figure 3.1 – A representation of the Stages of Agency Analysis

- Attributes of Theory
  - Conceptualisation
  - Approach
  - Specification
- Attributes of Agency Theory
  - Specification
  - Frame
  - Self-Interest
  - Rational Agent (Section 2.3.3)
  - Formulation of the Interaction (Section 2.2.2)
  - Attributes of P&A Interaction (Section 2.2.4)
  - Properties of the P&A Behaviour (Section 2.2.2)
  - Principal & Agent (P&A) Relationship (Section 2.2.1)

Levels of Assumption at Stages of Analysis

Narrower Focus

Wider Focus

Direction of Influence
3.2 The Notions of Rationality

Jensen and Meckling (1994) mentions that it is inconceivable that purposeful action on the part of human beings can be viewed as anything other than responses to incentives. According to Jensen and Meckling (1994), the issue of incentives goes to the heart of what it means to maximize or optimize, indeed to the very core of what it means to choose. For there to be no incentive reasoning, all alternative courses of action or choices must promise the same degree of utility as viewed by the individual (Jensen and Meckling, 1994: 3). Consequently, according to Jensen and Meckling (1994: 3) rational individuals always choose the option that makes them better off as they see it. Note the role of perception. In addressing ‘as they see it’ uniform agents would be expected to see things ‘the same way’. The essential principle in SIR behaviour is that a simple conception and narrow formulation will suffice. For reasons presented in the previous Chapters, this research takes a contrary view.

3.2.1 Types and Uses of Rationality

Rationality in agency though based on very simple, general assumptions has provided the central objects of study in many research disciplines, including economics, philosophy, cognitive science, and most recently, computer science and artificial intelligence. Figure 3.2 depicts the fields of research within select research disciplines that have utilised and contributed to the concept of rational agency. In doing so, they rely on minimal assumptions about human cognition and motivation (Goldgeier and Tetlock, 2001: 67).
Rationality describes the extent to which individuals possess and analyse information and are able to process it effectively (Ferguson and Ferguson, 1994: 4). In other words, it is the thought process based on available information that guides and justifies one’s decisions and subsequent actions. The thought process is constructed in a chain of reasoning. A rational agent that acts in its own best interest (i.e., it engages in self-interested rationalism), has preferences over possible outcomes and chooses to act in such a way that optimises outcomes with respect to these preferences. (Van der Hoek and Wooldridge, 2003: 133).
Ferguson and Ferguson (1994: 4) mention three types of rationality: maximisation rationality; bounded rationality; and procedural rationality. Each of these adopts a differentiated reasoning process. More explicitly:

1. **Maximisation Rationality** implies that individuals have all the information relevant to any decision, which they are able to utilise effectively, so as to maximise profits or utility (Ferguson and Ferguson, 1994: 4).

2. The concept of **Bounded Rationality** implies that individuals make decisions on the basis of partial information (Ferguson and Ferguson, 1994: 4) from their limited resources to reason (e.g., a limited amount of time, or processing power, to reach a conclusion).

3. This contrasts with **Procedural Rationality** where general behavioural ‘rules’ (either innate, cultural or learned) are established and the lessons of the past are carried forward to help solve current problems (Ferguson and Ferguson, 1994: 4).

In both maximisation and bounded rationality the reasoning typically involves maximising one’s profit or utility. With bounded rationality this ability is to some extent impaired by the availability of information. On the other hand, with procedural rationality, one manifests rationality through the application of rules from past experiences.

### 3.2.2 Research Examining the Notions of Rationality

Findings from behavioural organization theory, behavioural decision theory, survey research, and experimental economics leave no doubt about the limited success of maximisation rationality choice as a descriptive model of human behaviour (Jones, 1999: 297). Numerous empirical studies of human decision making have demonstrated that humans often do not conform to the strictures of rational maximisation choice theory (Slovak 1990) and that lessons or rules based on past experiences or history are not always suitable or applicable for current problems based on differentiated environmental situations and surroundings.
Chapter 3: An Extended Conceptualisation of Agent Behaviour

The response of social scientists to the vast number of empirical findings demonstrating the limited success of the rational model may be divided into two schools. The first school ignores the demonstrated weaknesses of the underlying assumptions for example, denying that assumptions ought to be subject to empirical test (Jones, 1999: 310). Then there has been a tendency to discover incentives in the environment that must have been there to account for any observed deviations (ibid). The second school has begun a research program of incorporating elements of bounded rationality into models of political and economic decision making (ibid).

Bounded rationality is a school of thought about decision making that developed from the dissatisfaction with the "comprehensively rational" economic and decision theory models of choice (ibid: 299). Such models assume that preferences are defined over outcomes, that those outcomes are known and fixed, and fiat decision makers maximize their net benefits, or utilities, by choosing the alternative that yields the highest level of benefits (ibid). With bounded rationality this is not always determinable nor achievable (Ferguson and Ferguson (1994)).

According to bounded rationality people making choices are intendedly rational. They want to make rational decisions, but they cannot always do so (i.e., they have bounded rationality) because they are bound by the level of information they possess (ibid: 298). In other words, there are limits on rationalisation. These limits are of two types:

1. *Procedural limits*, which limit how individuals undertake decision making, e.g., individuals do not consider all aspects of a decision facing them; and
2. *Substantive limits*, which affect particular choices made by individuals directly, e.g., individuals have trouble figuring out what factors are relevant to a given decision making situation (ibid: 297).

There is, thus, a degree of uncertainty present in an individual’s rationalisation process. When there is a mismatch between the decision-making environment and the choices of the decision maker, this mismatch is referred to as "bounded rationality showing through" (Jones, 1999: 298; Newell & Simon 1972; Simon 1996b). In essence, bounded rationality, like maximisation rationality, assumes that actors are
self-interested but takes into account the cognitive limitations of decision makers in attempting to maximise their self-interest or utility (Jones, 1999: 299).

Rational choice has thus been used extensively in the service of materialist and individualist theories such as neo-realism and neo-liberalism, in which the relevant actors want material security and/or wealth (Finnemore and Sikkink, 2001: 391; Goldgeier and Tetlock, 2001: 67). Human beings have so been exclusively defined as SIRs, and economists have assumed that self-interested rationalism will prevail in almost all circumstances (Goldgeier and Tetlock, 2001: 85). Such theories rely on minimal and limited assumptions about human cognition such motivation and (perceptions of) the external environment.

The task environment is tightly specified, so that the investigator knows exactly the preferences (goals) of the subject to solve the problem (Jones, 1999: 311). If the environment and the goals of the decision maker are known, then the decision maker's actions are deducible. Rational-actor theories of decision-making, therefore, require no theory of decision makers, because all behaviour is explained in terms of attaining self-interest (Simon 1979). Bounded and procedural rationality, on the other hand, does not indicate or describe how an individual determines the action he or she takes, other than to state that the ability to act rationally is limited by factors internal and external to the individual.

Jensen and Meckling (1976), the first explicit modellers of the theory of Agency, have based the reasoning of agents in performing delegated tasks on self-interested rationalism. The concept of rationality employed in describing agent behaviour is that of maximisation rationality. Through adopting such a rational-actor theory of decision-making they have inadvertently limited the fuller development and application of Agency theory.
3.3 Rational Models within Agency

Several rational models have been incorporated into the theory of Agency examining agent behaviour. These are those that relate to the agent itself and the state within which the agent exists. Each of these will be discussed in turn.

3.3.1 Rational Models within Agency

The use of maximisation rationality in describing agent behaviour is modelled upon the Resourceful Evaluative Maximiser (REM) Model. This model uses the proposition that people are inherently SIRs with unlimited wants (Jensen, 1998: 6). People systematically evaluate their preferences, and being resourceful individuals will make substitutions and choose that approach that maximises their welfare. Hence, the assumption is that agents are resourceful, evaluative maximisers, or REMs.

In recent years attempts have been made to incorporate the non-maximisation aspects (i.e., the ‘non-rational’ aspect) of human behaviour into the notion of rationality. This has resulted in the development of models such as the Pain Avoidance Model (PAM). This particular model is of the view that people will switch from the REM model in times of fear, particularly when they fear the unknown. Their self-interest maximisation now rests with the need to perform activities that overcome their own fear. Consequently, they may make decisions and take actions that harm themselves, their organisation, and the people around them (Jensen, 1998: 6) and hence, not necessarily be welfare maximising. It may not be welfare maximising, but is not the need to overcome one’s fear an act of self-interest? Could this fear be associated with the uncertainty in their environment (i.e., fear of the unknown demonstrating agent’s lack of knowledge) and hence, result in what is termed bounded rationality? So is then PAM not a form of bounded rationality which incorporates the maximisation aspects of human behaviour in times of uncertainty and fear?
Jensen (1998) places the two inconsistent views of human behaviour (REM and PAM) into a single framework to which he labels the Dualistic Model of human behaviour, where people are seen as being in one of two regimes at any one moment in time (analogous to Lash’s (1999) modernity principle 1 and 2). The general point is that human behaviour is essentially dualistic: people evidence both rational and non-rational components, and these components coexist in inherent contradiction (Jensen and Meckling, 1994: 7). An issue is whether there can be common ground between the two mutually inconsistent views. After all are there not different levels of rationality and fear intensity; i.e., are individuals not more fearful or more self-interested in certain instances than in others? Are there not instances in everyday life where one is fearful and yet self-interested; e.g., in times of war people are fearful but yet feel the need to go to war to protect themselves. This demonstrates both the lack of conceptual and contextual basis within the concept of maximisation rationality. As well as the limitations of any singular maximisation approach. There is an apparent need to adopt an alternative conceptualisation of agent behaviour. This is not to say that there is no place for SIR behaviour within agency, but that it is less likely to be paramount in influencing behaviour except in certain states. For example, an agent assumed to live with its principal in a vacuum may consider no other external influences on behaviour apart from its self-interest.

3.3.2 Lash’s (1999) States of Modernity

Somewhat reflecting the nature – nurture debate, Lash (1999) sees modernity as cast in two ways. The individual is seen as reflective of their own state (Modernity 1) or of that in the environment (Modernity 2). Alternative modernities reflect alternative conceptualisations.

The first modernity works in abstraction. This abstraction is of subject and object. There is a relation of an abstract disembodied subject with an abstract disembodied object (Lash, 1999: 19). In other words, the subject lives in a vacuum concentrating on itself, its existence to the neglect of the surrounding objects. The subject and object exist in their own right and follow their predefined rule(s) neither of each influencing the other. The need to want more and to satisfy these wants is a pre-given
rule of human nature that exists regardless of the surrounding objects. The subject (such as a agent) is solely self-interested in terms of desires. The objects are there for the taking and are used to satisfy a need. Social actors (that are cast as objects) come under the sway of pre-given rules, whether in the norms of modern institutions and organisations or in the institutions of the welfare state, and the church and the family (Lash, 1999: 3). This is analogous to the concept of maximising rationality by a decision maker taking from the world as it wants.

Decision makers rarely work in social isolation. Occasional leaders such as Adolph Hitler, Josef Stalin, Kim II Sung, and Saddam Hussein who centralized enormous authority in themselves are seen as bizarre exceptions (Goldgeier and Tetlock, 2001: 75). Decision making more typically unfolds in complex social and political networks of accountability (ibid). Agents are also decision makers, but assuming they do so through the self-interested motivations of rationality without any social interaction is a clear indication of the limitedness of the theory.

In the second Modernity individuals must find rules to encounter specific situations (Lash, 1999: 3). This is much like the view of procedural rationality. Agents are not seen as existing within a vacuum and adhering to a predefined type of behaviour. Instead they adopt differentiated rules with each situation they encounter. This modernity is also, however, different from procedural rationality. Individuals are in fact living with risk and choosing their behaviour accordingly, grounded by their current surroundings not just from the rules developed from their past. This grounding takes the form of the community, history, tradition, symbolism, place, materialism, language, life-world, politics, religion, etc (Lash, 1999: 5). Both the subject and the object are no longer individual (as they were in the first modernity) but collective (Lash, 1999: 19). How the subject behaves is grounded by their surrounding objects. This view also approximates that of constructivism.
3.3.3 Constructivism and Rationality

Constructivism, like rational choice theory, offers a framework for thinking about the nature of interaction, but focuses more on the behavioural and social aspects of the interaction. It is a social theory that makes claims about the nature of social life and social change. Constructivism is also founded upon a different theory from that of rationalism (i.e., realism) and operates at a different level of abstraction.

Realism research discovers knowledge of the real world by naming and describing broad, generative mechanisms that operate in the world, so as to obtain an understanding of the common reality of an economic system (Bhaskar 1979; Perry et al., 1999 in Healy and Perry, 2000: 123). This is the theoretical foundation upon which the assumption of self-interested rationality is built. Such an assumption is broad enough to develop a "family of answers" that cover several contingent contexts and different reflective participants, albeit imperfectly (Pawson and Tilley, 1997, p. 152). In contrast, constructivism does not discover knowledge through the generation of broad, generative mechanisms. Each individual is seen to be a construction of their own socio-environment.

Constructivism is an approach to social analysis that deals with the role of human consciousness in social life (Finnemore and Sikkink, 2001: 391). Unlike proponents of materialist theories (such as self-interested rationalists), constructivists cannot take identities and interests for granted (Finnemore and Sikkink, 2001: 394). Constructivism thus asserts:

1. Human interaction is shaped primarily by ideational factors, not simply material ones;
2. The most important ideational factors are widely shared or "inter subjective" beliefs, which are not reducible to individuals; and
Chapter 3: An Extended Conceptualisation of Agent Behaviour

Each individual is, thus, shaped and moulded differentially in accordance with their socio-environment. That is, each individual’s interpretation of their socio-environment and involvement in that socio-environment will influence their identity. Individuals may then use rational calculations in selecting what aspect will influence their identities (Finnemore and Sikkink, 2001: 410). Rationality can, thus, also be informed by the socio-environment and not just by self-interest. An individual (in some practical sense) can be rational and yet justify and/or undertake actions with other motivations, impulses, interests or needs in mind. A simple demonstration that emotions, coupled with strong, deeply internalised intuitions about fairness, can shape strategic interaction is provided by the ultimate game (Goldgeier and Tetlock, 2001: 85). Their reported experimental results consistently revealed that respondents often reject very low offers (less than 20% of the total sum or gain) of compensation. The respondents did not try to maximize their own payoffs and instead, they turned down low offers and received zero. The Respondents appear to react emotionally, indeed indignantly, to the low offers (ibid).

Self-interested rationality may be intended but it may not necessarily always be achieved. There are clearly wider social factors at play in the rationality of individuals (Tankersley, 2000). Scholars in fact were quick to notice that norms and social understandings often had different influences on different individuals (i.e., an individual’s beliefs). Explaining these differences is a crucial research task (Finnemore and Sikkink, 2001: 397). The influence of social factors upon rationality is vastly underestimated in standard rational choice theories (Jones, 1999: 305).

It is important to note that the argument here is not to reduce explanations of behaviour to socio-environmental factors, but rather to consider how the socio-environment and cognition interact in systematic and identifiable patterns to produce variations in behaviour. In doing so, it is not being argued that all important regularities in human behaviour are reducible to the socio-environment. The guiding philosophy of social science is contextualist, not reductionist (Goldgeier and Tetlock, 2001: 68).
So how is it possible to incorporate the socio-environment context into Agency theory? A solution is to adopt *socio-environmental rationalism* as an explanation of agent behaviour. This is not to say that *self-interested rationalism* will not play a role in the rationality of agent behaviour but that its predominant influence will be removed. It is thus probable to suggest that in making decisions or performing activities individuals use their *socio-environmentally-constructed rationality*. The agent is thus termed as a SERA.

### 3.3.4 Influential Factors

There are virtually an infinite number of possible background factors that could be classed as being socio-environmental and influential on an individual’s beliefs. There is, however, a common point of comparison. The behaviour of an individual is shaped by their upbringing, and that is the institutions to which they affiliate and interact with. This was introduced in Chapter 2 and outlined in the initial theoretical framework (Figure 2.8). This now clearly reflects the socio-environmental rationalist approach.

The agent is now assumed to use their socio-environmental rationality transmitted via their institutional involvement to reason and make decisions. In doing so, institutional affiliations and interactions assist, direct, support and constrain agent behaviour. The potential of institutional affiliation and interaction lies in its ability to complement rational choice theories by showing how belief systems affect individual (agent) behaviour. This implies the need for further work that more directly probes *belief structures* and how they affect agent behaviour (discussed further in Chapter 6 section 6.2 as BDI (beliefs-desires-intentions): a belief structure in rational action).
3.4 Socio-Environmental Rationality: The Role of Institutions

Societal institutions include the legal system, the financial system, the social class structures, the nature of business ownership, the educational system, religious institutions and so on (Hofstede 1980; Ray 2002). Economic institutions, particularly of production, provide the material basis of the social, political and cultural life whereas legal institutions set up and enforce rules required for the proper functioning of all spheres of life (Ray, 2002: 349). Following Ray, the Parliament and the civil service are the political institutions (ibid). The production system, enterprises trade unions and intricate civil associations, the system of property rights prevailing in the society and the monetary and financial system (the central bank, commercial banks and insurance companies) are the socio-economic institutions (ibid). Socioeconomic and political institutions make up the social structure within which individuals and collectives behave in specific ways (ibid). Hence society may be conceived of as an arrangement of institutions, which constitutes the social ground work within which individuals and collectives act.

Institutions are formed within society to ensure that certain norms and values are supported and adhered to. Normative codes typically include rules, regulations, norms and customs regarding the appropriate and socially meaningful arrangements and patterns of behaviour, that did not originate from the actions of one individual alone, but from actions of the collective (ibid). These norms and values are those that gave rise to the establishment of institutions. For example, highly conservative cultures generally have well defined and complex regulatory frameworks. Essays on weapons taboos, on military culture, on humanitarianism, and on identity politics have all demonstrated how social structures of different kinds reshape actors interests, self-understandings, and behaviour (Finnemore and Sikkink, 2001: 396). They are, thus, humanly devised constraints that shape and are embedded in human behaviour and interactions (North 1990:3; Jacobson, 2000: 152). It is through affiliating and interacting with these institutions that an individual’s beliefs about the state of the environment are influenced and hence, their behaviour accordingly.
Chapter 3: An Extended Conceptualisation of Agent Behaviour

The level of influence will vary from individual to individual depending upon the extent or level of their affiliations and interactions. This extent or level of influence can be assessed on the basis of the influential power the institutions possess and the variability in their influence. This can be considered diagrammatically by using two variables:

1. InstnPow: denotes the extent of influential power exerted by institutions upon individuals affiliating and interacting with them, and
2. InstnUncern: denotes the extent of uncertainty or variability in institutional influence upon individuals affiliating and interacting with them.

Both can vary over a range, nominally 0 to 100. Diagrammatically these two variables of institutional influence are presented within a matrix in Figure 3.3 below.

Figure 3.3 - Matrix of Institutional Dimensions

![Figure 3.3 - Matrix of Institutional Dimensions](image-url)
Types of societies corresponding to varying levels of institutional influence are written into each of the quadrants within the matrix. The four institutionally influenced societies as quadrants are the:

1. ‘Atomistic Society’ (A) where there is no or very low levels of institutional influence whether it be in terms of the variability and/or power wielded. Institutions therefore play no significant role in influencing behaviour. An example of an ‘atomistic society’ is scattered small bands of nomads traipsing sparsely populated areas, removing themselves from the traditional constructions of society and control.

2. ‘Controlled Society’ (C) where the power exhibited by institutions is unwavering and excessive. Such excessive influential power promotes conservatism within society. An example of a ‘controlled society’ was Communist China in the 20th Century.

3. ‘Upheaval in Society’ (U) where there is great institutional variability none of which have any influential power. The volatility in institutional influence therefore has no lasting influence on societal behaviour. An example of ‘upheaval in society’ would be post-war Iraq following occupation.

4. ‘Reforming Society’ (R) where there is uncertainty wielded by powerful institutions who are implementing change and inadvertently creating variability. Such excessive levels of influential power and variability promote variability in societal behaviour. An example of a reforming society would be Russia and its move to a market economy (though some would argue that it is reverting to a controlled society as its institutions regather power and reduces uncertainty).

Such a schema both classifies and associates. It provides a useful simplification that can be variously developed, applied or revised. In such a specification, such as Figure 3.3, it is the institutional affiliation and interaction that will assist, direct, support and constrain agent behaviour to some extent. An institutional analysis demonstrates how this may be attained.
3.5 Institutional Analysis of Behavioural Influence

Central to institutional analysis are questions dealing with the origins of institutions, and the ways in which institutions affect the behaviour of individuals (Korpi, 2001: 237). Institutions may work their effects directly (e.g. by specifying the outcomes to be desired) or indirectly (e.g. through effects on actors' identities) (Jupille and Caporaso, 1999: 432). Whatever the causal pathway, actors' goals do not (or, at the limit, cannot) exist independently of institutions (ibid). Institutional analysis, therefore, consists of two dimensions:

1. How institutions are devised, and
2. How they shape human interaction.

Each dimension will be explained below and its relation to rationalism and agency will be explained in greater detail.

The first dimension of institutional analysis concerns the theoretical role of institutions. Are they exogenous (i.e. given outside of theory) or endogenous (explained in theoretical terms) (Jupille and Caporaso, 1999: 431)? If institutions are the dependent variable, they are endogenous, and research focuses on explaining institutions. Here, analysts examine institutional origins, why certain ones take hold but others do not, the dynamics of institutional choice, and so forth (Jupille and Caporaso, 1999: 432). In other words, they do not influence behaviour but rather are outcome of some arrangement, i.e., they have no explanatory role in individual behaviour. This is the approach supported in the existing Agency literature. Self-interest being the primary force in influencing agent behaviour, institutions are developed to support and reinforce the role of self-interested rationalism.

Where institutions are exogenous, analysts invoke them into explaining behavioural dynamics and outcomes. Institutional explanations examine the ways in which institutions structure incentives, instantiate norms, define roles, and prescribe or proscribe behaviour so as to alter outcomes relative to what would have occurred in
the absence of (or under alternative) institutions *(ibid)*. This approach reflects that of SERA, i.e., the idea that institutions have a great explanatory role in influencing individual (agent) behaviour.

The second dimension of institutional analysis concerns the theoretical place of actor preferences. Following, Jupille and Caporaso, op.cit., the word preferences mean the fundamental goals (over outcomes) rather than strategies of the individual *(ibid)*. From one perspective, an actor’s preferences over alternative outcomes are exogenously given and remain stable or at least uninfluenced by institutions *(ibid)*. Here, institutions alter the relative costs and benefits of various strategies but do not affect the actor’s underlying motivations *(ibid)*. Even where rationality is bounded, institutions may make available new information about strategies and/or outcomes, but the fundamental preferences remain unaltered *(ibid)*. This is the perspective adopted in the existing Agency literature. That is, agents are assumed to only define their goals with reference to their self-interest and no or little reference to the external environment, including institutional influence. The intersection of this exogenous second dimension with the endogenous first dimension (where institutions are absent from analysis) reflects the top right hand corner of Figure 3.4, which is the position of existing theory of Agency.

**Figure 3.4 - Two Dimensions of Institutional Analysis**

This figure is not available online. Please consult the hardcopy thesis available from the QUT Library

Source: Jupille and Caporaso, 1999: 433
Chapter 3: An Extended Conceptualisation of Agent Behaviour

From a second perspective, preferences over outcomes are partially or wholly endogenous to institutions. Institutions may work their effects directly (e.g. by specifying the outcomes to be desired) or indirectly (e.g. through effects on actors' identities) (Jupille and Caporaso, 1999: 432). Whatever the causal pathway, actors' goals do not (or, at the limit, cannot) exist independently of institutions (Jupille and Caporaso, 1999: 432). The interaction between the institutional system and individual action (behaviour) is partly determined by institutions, and partly by the freedom of choice of institutional association and interaction (Ray, 2002: 351). This is the approach adopted in the extended conceptualisation of agent behaviour; it is the institutional affiliations and interactions that influence the behaviour of agents. The intersection of this endogenous second dimension with the exogenous first dimension (where institutions are incorporated into the analysis) reflects the bottom left hand corner of Figure 3.4, namely the sociological new institutionalism. This will be incorporated into agency.

This discussion demonstrates that the theory of Agency has used a conceptualisation of the agent based on one particular line of thought. Agents are assumed to act only in accordance with their self-interest to the ignorance of their environment, which is assumed to be uninfluential. This is but one conceptualisation and the above discussion clearly shows that other lines of thinking with different conceptualisations of the agent are possible. The agent will now be assumed to use their socio-environmental rationalism transmitted via their institutional involvement in making decisions and performing actions. The influence of this will be to assist, direct, support and constrain agent behaviour in attaining the principal’s goal. This is not to say that the assumption of self-interested rationalism is incorrect, but rather that there is a need for more contextual basis. The theoretical framework provided earlier in the literature review (notably Figure 2.8) clearly reflects the socio-environmental rationalist approach. The internal environment of the agent has expanded to accommodate more than the processes of self-interested rationalism and this is the external environment. SERA thus represents a broader and more general model of agent behaviour. In comparison to the SIR agent, which represents a specific and specialised model of agent behaviour where institutional influence and the environmental context is non-existent.
Institutional influence for the socio-environmental rationalist agent is instrumental to the agent’s decision making process (i.e., rationalism). Affiliating and interacting with institutions can direct, support, assist and constrain agent behaviour in a principal-agent relationship much like the varied instruments in a manufacturing process interacting with inputs and transforming them accordingly to form outputs. For example, Ray (2002) established that an active transnational corporation (TNC) within a carefully designed institutional and policy framework played a key role in transforming Singapore, which emerged from a small backward economy in the 60s into a technological powerhouse by the 90s. The institutional framework pursued by Singapore facilitated the rapid diffusion of skills, technology, and market access to participants (Ray 2002). TNCs thus contributed most when interaction with local institutions of the national economy was present directing, supporting, assisting and constraining their operations and activities.

Institutions are instrumental to agent behaviour. This may or may not be in the interests of the principal but there is still mutual dependence between the parties. The principal still requires a goal to be attained (self-interest on their part) and this is justification for the agent’s existence. The asymmetry between the parties is of little relevance in influencing agent behaviour in the extended conceptualisation of agent behaviour. The agent relationship is one of instrumental mutual dependence, whereby agent behaviour is informed by their institutional affiliations and interactions. Such influences will assist, direct, support and constrain agent behaviour and be instrumental to agent behaviour and to the success or detriment of the relationship. This highlights the importance that the context plays in agency, and the role of institutions as instruments in directing, supporting, assisting and constraining agent behaviour in the relationship. Therefore, the behaviour of an agent needs to be examined in the context of existing institutions which form the environment in which the agent socialises overtime.
3.6 Comparative Agent Framework and Properties

SERA represents a broader and more general model of agent behaviour through its inclusion of institutional interaction. This broader model engages the agent with two external sources: the principal during the tenure of the relationship through which the transaction opens and closes; and the societal institutions that the agent affiliates and interacts with through which its behaviour is informed. This is depicted in Figure 3.5. The lettered arrows (i.e., O and C) demonstrate the opening and closing of the transaction and also the sequence with which they occur in the transaction (i.e., 0 and 5). The first two numbered arrows (i.e., 1 and 2) demonstrate institutional interaction between the agent and institutions. The second set of numbers (i.e., 3 and 4) positioned over the wavy arrow demonstrate the agent’s deliberation and reasoning following the influence of institutional affiliation and interaction. This influence is then resolved by the agent and then communicated to the principal through his or her behaviour in form of goal commitment (namely arrow labelled 5). Institutional influence is thus instrumental to agent behaviour. It is a multi-step event, consisting of the processes O/0, 1, 2, 3, 4, and C/5 labelled in Figure 3.5.

Figure 3.5 – Comparative Framework of the Socio-Environmental Rationalist Agent (SERA) and Self-Interested Rationalist (SIR) Agent
The SIR agent as presented in the existing theory of Agency, on the other hand, represents a special and controlled case of agent behaviour through its exclusion of institutional interaction. Within this confined case the agent engages with one external source and that is the principal through which the transaction opens and closes. This interaction is also depicted in Figure 3.5; the dotted box surrounds the relevant portion. There are two flows of interaction and that is from the agent to the principal represented in Figure 3.5 by lettered arrows O and C. This denotes the use of the agent’s own preferences (uninfluenced from any external source) in determining their behaviour, which is then communicated to the principal in terms of his or her goal commitment. The agent’s self-interest is thus instrumental in determining their behaviour. It is a single step event, consisting of the processes O/0 and C/5 labelled in Figure 3.5.

What is now apparent from a comparative analysis of the agents is that where information is known and the state is (assumed to be) fully determined the response becomes automatic. The agent then becomes more of an artefact than an entity in its own right. Such a limited situation of agency is evident in much current literature. Self-interested rationality is really is one state of rational agent behaviour rather than a situation of agency that is analysed. This is also demonstrated in Figure 3.1 by the smaller 3D oval labelled SIR positioned within the larger oval of rational behaviour. The extended conceptualisation, SERA, represents the fill of the larger oval of rational behaviour.

These discrete actors (agents SIR and SERA) posses the following properties:

1. **Autonomy** – an agent is able to operate and make decisions independently (Wooldridge, 2002: 9; Beer, 1995: 173). Autonomous agents are also assumed to have their own beliefs, morals and values that are not subservient to those of others (Friedman and Nissenbaum, 1997: 466). Both agents exhibit this property although to varying degrees. This is the basis they use to form their decisions. The SIR agent extrapolates from within their self to form decisions, the extent of which is restricted by contract. Whereas SERA extrapolates from their institutional associations to form decisions, the extent of which varies from their affiliation and interaction.
2. **Pro-activeness** – an agent is able to exhibit goal-directed behaviour, i.e., an agent will adopt a goal and will attempt to achieve that goal they possess. Agents are the producers of action. They perform actions in order to shape and modify the environment they inhabit; they are not merely the passive recipients of actions, but rather they are active and purposeful. (Van der Hoek and Wooldridge, 2003: 134). This requires the agent to be well informed and knowledgeable of their environment and capabilities. Both agents exhibit this property. Decision making is delegated to both agents to perform activities on behalf of the principal to attain a predetermined goal given the abilities each exhibit.

3. **Reactivity** – an agent needs to be responsive and preceptive to changes in the environment and hence, also affected by them. In essence, agents are flexible they may change or adapt their behaviour dynamically during their association (Conrad, Turker and Saake, 1997: 502). This is a property exhibited by SERA, who observes the environment and is responsive to it, performing actions in accordance with it. The SIR agent, on the other hand, operates in a static environment of limited change.

4. **Social Ability** – an agent must be able to interact (negotiate and cooperate) and communicate with other agents and objects in society (Wooldridge, 2000: 3-5, Van Eck and Wieringa, 2001: 3; Wooldridge, 2002: 23). SERA is a social being who not only operates within an environment but is also interactive with it. The SIR agent, on the other hand, operates within a vacuum to the exclusion of objects within it.

An examination of the properties exhibited by the agents indicates that SERA exhibits properties far more complete, diverse and contextually sensitive than that of the SIR agent. SERA represents a broader model of agent. The SIR agent is a special (and limited) case of agent behaviour. Further examination of these properties in assisting the agent to undertake decisions delegated to them will also highlight differences at a deeper level. This relates to the belief structures that facilitate the resolve for decision making, which is depicted in Figure 3.5 by the wavy shaped arrow and will be examined in Chapter 6.
3.7 Conclusion

The original formulation of Agency theory is one of asymmetric mutual dependence where the agent is conceptualised as a SIR decision maker. A review of the rationalist, bounded rationalist and constructivist literature reveals that there is in fact an alternative course of conceptualisation. This is one of an extended form of constructivism, the extension being that of an institutional analysis. Through the use of an institutional framework, as an instrument of the agency, contextual analysis will now be incorporated into the theory of Agency. The contextual analysis in agency is an analysis of the internal environment (i.e., the agent’s beliefs and behaviour) and the external environment (i.e., societal institutions) of agency. Agents are now assumed to act in accordance with their socio-environmental rationalism and thus, are conceptualised as socio-environmental rationalist agents (SERAs). The formulation involves a relationship of instrumental mutual dependence informed by institutional affiliations and interactions. How this extended conceptualisation will be reformulated further within the form of agency will be addressed more specifically in Chapter 6.
4. The European Union (EU) – A Case of Financial Accounting Harmonisation

A critique of the current approaches to the principal agent problem, and an identification of the current assumptions and their impacts on theoretical and empirical research was undertaken in Chapter 2. The limited nature of the underlying assumptions and principles of Agency using the self-interested rationalist (SIR) agent were revealed. Chapter 3 introduced the notion of socio-environmental rationalism and presented an articulation of a more general, extended conceptualisation (SERA) and general reformulation of agent behaviour in the principal-agent relationship within which existing approaches or cases can be positioned or applied. This chapter examines how applicable this extended conceptualisation and reformulation of agent behaviour is to instances of agency. The harmonisation of financial accounting in the European Union (EU) is the chosen application. Current and extended conceptualisations of agency will be considered in a simulation of the financial accounting harmonisation process in the European Union (EU) in Chapter 8. The basis of accounting in Europe and the EU harmonisation process are the focus of this Chapter.

4.1 The European Union (EU) and Financial Accounting

The ethos of the European Union (EU) is to create a common European market for goods, services, labour and capital. A common market for goods and services has been established since the elimination of trade barriers between member states in 1992. With various intra-regional labour standards and agreements in place the mobility of labour is well underway. It is the mobility of capital that is still in the developmental stages. While restrictions on capital inflows and outflows have been reduced and a single currency, the Euro, has been adopted, a point of contention is the harmonisation of company law, in particular the laws and regulations governing financial accounting.
4.1.1 History of EU Financial Accounting Regulation and Harmonisation

The historical origin of accounting regulations in Europe, being the legal prescription or the professional governing of accounting, can be traced back to 17th Century France (Gulin, Ferdo, Vasicek and Lajos, 2002: 3). The most significant contribution in legal prescription was the obligation to draft the balance sheet and profit and loss account provided by Jacques Savary and Jean-Baptiste Colbert in their drafting of the *Code de Commerce* in 1673 (original title: *Ordonnance de Commerce*) (ibid). Through the Napoleonic Wars French mandatory requirements (Napoleon's Trade Law from 1807 prescribed the obligation to draft the balance sheet and the profit and loss account as per the *Code de Commerce*) were transported through continental Europe. The first circle of countries directly adopting the French law were Belgium and Netherlands (Gulin, Ferdo, Vasicek and Lajos, 2002: 4). Directly after that, the French law served as a basis for drafting the trade laws in Germany and Sweden, and later also in the other parts of continental Europe (ibid). This was the beginning of accounting regulations harmonisation at the European level.

After the hostilities of World Wars I and II, the Treaty of Rome 1957 established the European Community (EC now named the European Union, EU) and initiated the comings of the harmonisation of the national regulations. While being the second historical phase of financial accounting harmonisation in Europe, it represented the beginnings of EU financial accounting harmonisation.

EU Member States agreed to harmonise their company laws ‘to co-ordinate the safeguards’ contained therein ‘for the protection of the interests of members and others … with a view to making such safeguards equivalent’ (Treaty of Rome Article 52 to 58, and especially Article 54(3)(g)). This agreement stemmed from an understanding that, stakeholders and business activities could benefit from the harmonisation of corporate laws and regulations governing financial accounting rather than through confinement to their national regulations. The belief is that improvements in the comparability of financial accounts between enterprises will facilitate a more informed international comparison of corporate performance and prospects, with consequent economic benefits. For example, the requirements of national regulations meant that the particulars that companies had to provide were at
variance, both qualitatively and quantitatively, from one nation to another (Ernst and Whinney, 1980: 8). This situation was thought to be prejudicial to the fusion of national markets into a common European market giving rise to not only interpretation and analytical problems, financing and compliance costs for European multinationals, but also inequivalent safeguards for European multinationals.

In the 1970s, the European Commission formally attempted to reduce national variations in corporate regulations through the harmonisation of financial accounting standards (Joy, 1996: 17). Harmonisation was to be achieved through all member states implementing a series of Company Law Directives\(^1\) issued by the Commission. The framework and details of these Directives initially resting heavily upon the Germanic approach to financial accounting were later redrafted to the Anglo-Saxon approach to accommodate the arrival of the United Kingdom (UK) and Ireland as new members in the EU (Walton, Haller and Raffournier, 1998: 14; Walton 1997; Diggle and Nobes 1994; Nobes, 1993: 165). Although these Directives have been implemented in every EU member state, a harmonised European financial accounting system is yet to develop. Significant variations in accounting rules and practices still exist in European countries, in part because of national interpretations in implementation.

This chapter will describe the state of EU harmonisation, and how it could be of relevance to Agency theory and the current research. Examined in the next section is how national ideologies and institutions in Europe can influence the exchange between the citizens (the nominal principals) and the national Governments (the nominated agents) with an intermediating institution.

---

\(^1\) A Directive is legislation binding on all EU member states, requiring incorporation into national law (Harris, 1999: 58). The incorporation of the EU Directives into national law is a complex, lengthy process, the method of implementation being left to the discretion of national authorities (Choi, Frost and Meek: 1999: 267). The Directives provide the framework for implementation wherein member states may exercise flexibility in applying national accounting standards and may add additional requirements where appropriate (Iqbal, Melcher and Elmallah, 1997: 22).
4.2 The European Union (EU) a Context for Agency

In the simplest of agency models, the agency relationship is reduced to two characters: the principal and the agent. Recall that the agency relationship is a contract in which one or more persons (the principal(s)) engage another person (the agent) to take actions on his/her behalf which involves the delegation of some decision-making authority to the agent (Jensen and Meckling 1994, section 2.2.1). In the context of the EU, the citizens of Europe are the principals and each of the respective member nations’ governments are the agents. The citizens engage their governments to act on their behalf towards achieving a common European market for goods, services, labour and capital via an electoral contract (an initial referendum and national election) that transfers the delegation of decision making authority to the national governments. It is, however, difficult for citizens themselves to monitor the behaviour of national governments so EU organisations (e.g., EU Commission, EU Council, and EU Parliament) are employed to do so – much like the shareholders and board of directors scenario in the context of a corporation (as discussed in Chapter 2). The EU case is a case of multiple agents and dual parties\(^2\). The European Commission is the dual party: it is both an agent to the citizens (the principals) and a principal to the member nations (the agents). This is depicted in Figure 4.1 below, which presents the application of this multi-agent dual party relationship within the context of the EU.

\(^2\) A dual party is a party that can represent both a principals and agents. This is much like the board of directors in a corporation, they are an agent of the shareholders and a principal of the Chief Executive Officer (CEO) (as discussed in Chapter 2A).
Chapter 4: The European Union (EU) – A Case of Financial Accounting Harmonisation

Figure 4.1 - Framing the EU as an Agency Relationship

The EU Commission performs a substantial role in the EU financial accounting harmonisation process as a dual party. As an agent to EU citizens (the principals) it has the responsibility to administer and monitor the implementation of the EU Financial Accounting Directives on behalf of the EU citizens (Harris, 2000: 54). As a principal to national members (the agents) it provides the necessary resources (i.e., some monetary funding, a forum and legislative backing) for the national governments – who are expected to have the resources, ability, knowledge and the skills to employ them – to achieve the goal of financial accounting harmonisation.

The focus will be upon the principal and agent relationship between the EU commission and member nations (the lower portion of Figure 4.1), which is the more active portion of the agency relationship in this case. This is because not all citizens possess the power to directly approach and influence governments. The EU Commission with commissioners from various member states who are more informed and possess the necessary resources to more adequately represent the interests of EU citizens\(^3\). Once the citizens of each member nation agree to join the EU they hand

\(^3\) The EU commission is currently composed of 20 members, who are proposed by the governments of the member states and appointed for a five-year term; it is now also subject to a vote of appointment by the European Parliament before it can be sworn in (Wissen 2003). The commissioners are not appointed as negotiators promoting the interests of their respective states, but are supposed to act completely independently in the interests of the Community, i.e. the EU citizens (Wissen 2003).
over their collective welfare in nominated areas to the EU Commission to act on their behalf. The transactional process between the EU Commission and member nations then commences.

In the first transactional process (labelled 1 in Figure 4.1), the EU Commission provides the necessary resources (the incentives, the forum and common legislative backing) to the national governments to achieve the goal of financial accounting harmonisation. Each member state has control of the resources and is delegated the responsibility of ensuring that their behaviour (i.e., employment of resources) adheres to the goals and the ethos of the EU, which is presented in Article 52 to 58, and especially Article 54(3)(g) of the Treaty of Rome 1957. Therefore, in the second transactional process (labelled 2 in Figure 4.1), each member state contracts to adhere to the policies set up to ensure that a common European market for goods, services, labour and capital is established and equivalent safeguards are provided. Finally, in the last transactional process (labelled 3 in Figure 4.1), each member state is provided with a reward for adhering to such policies and committing to the goals of the EU. Rewards would be continuing membership, perhaps some incentives, and access to benefits brought about union such as the increased flow of goods, services, labour and capital between member nations. Once integration begins, member states would find that progress towards greater integration would facilitate the pursuit of their own goals. These states would then pressure their governments to take further steps towards integration. The additional steps would in turn stimulate further pressure for more steps, and the process would continue.

Should the EU environment continue to be framed in the traditional agency sense each member state would be expected to adopt and adhere to the financial accounting policies within the Directives that maximise their own utility and to reject those that do not. This is not necessarily the case with the notion of socio-environmental rationalism, which was introduced in Chapter 3. Should the EU case be framed in the context of socio-environmental rationalism, it is expected that the behaviour of respective member nations (the agents) would reflect their institutional settings. Institutions are the instruments of the interaction influencing agent behaviour in the principal-agent relationship. Hence, the agents (member nations) rather than adopting and adhering to financial accounting policies representative of their simple/narrow
self-interest, will adopt and adhere to those policies in accordance with their institutional setting. Figure 4.2 below depicts and explains the application of the socio-environmental rationalist agency relationship to the EU–Nation context. Each member nation after initiation of the collective transaction (labelled 0 in Figure 4.2) engages with their national institutional settings (demonstrated by the arrows labelled 1 and 2 in Figure 4.2) about the type of behaviour to be presented. This then influences each respective nation’s belief structures (labelled 3 and 4 in Figure 4.2), and finally their commitment towards harmonisation (labelled 5 in Figure 4.2). In summary, the institutional force present within the principal-agent relationship (EU Commission and member nation relationship) thus acts on the agent, influencing their behaviour towards the attainment of the principal’s goal(s).

Figure 4.2 - Framing EU-Nation Interaction as an Socio-Environmental Rationalist Agency Relationship
Ideally this force might be resolved in a complementary way (to both the agent and principal) by the agent, but when the actual forces effecting decision making are uncertain the outcome is variable. The exact process to be used is a method of reasoning termed ‘BDI rational action’, which is discussed and examined in Chapter 6 (section 6.2). It is this process that frames the agent’s decision making (through their beliefs-desires-intentions) to consider the impacts from the instruments of the interaction, i.e., their institutions. Institutions are thus instrumental to the principal-agent interaction, assisting, directing, supporting and constraining agent behaviour, which may or may not be complementary to both parties depending on the forces conveyed therein.

The following sections will now focus on the broader context of the interaction. This involves an examination of the EU financial accounting harmonisation process. This is necessary to determine the conceptualisation that provides a more informed understanding of member nation (agent) behaviour in the harmonisation process, a multi-agent dual party agency.

### 4.3 Financial Accounting Harmonisation in the EU

Alexander and Archer (1998: 9) perceive that a true single European accounting way of thinking would imply a true single economic market and a common body of commercial law embedded in a single European culture, each company facing the same regulatory environment in each constituent part of the market (Walton, Haller and Raffournier, 1998: 7). Thus the harmonisation of financial accounting in the EU involves interactions at many levels within an overall assumption of convergence or uniformity. European efforts in this direction are now considered.

The EU Commission has attempted to achieve harmonisation through the issuance of Company Law Directives (briefly mentioned in section 4.1.1). Note that the EU has used ‘Directives’ (where nations interpret and legislate) rather than ‘regulations’ (where nations uniformly implement). The former are ‘European framework laws’ while the latter are ‘European laws’ under the proposed new constitution (McDonald
and Deardon: 2005: 33). Clearly agency issues and problems are much more likely or feasible with Directives.

These Directives encompass a range of issues including: auditing (Eighth Directive), formation of a company (First, Second and Ninth Directive), Mergers (Third, Sixth, Tenth and Thirteenth Directive), Listing Particulars (Supplementary Directive), and others. Of the Directives, the Fourth Directive and Seventh Directive deal exclusively with financial accounting issues and standards, and thus are perceived to be the most relevant and important for financial accounting (Alexander and Nobes, 1994: 92). It is, therefore, their adoption and adherence that will be of prime focus.

The Fourth Directive contains a comprehensive set of accounting rules that introduce the key presentation norms and rules\(^4\) of accounting for limited companies (Walton, Haller and Raffournier, 1998: 25, Elnathan and Krilich, 1992: 48). The Seventh Directive extends the principles of the Fourth Directive to the preparation of consolidated accounts\(^5\) (Walton, Haller and Raffournier, 1998: 25, Elnathan and Krilich, 1992: 48). The Fourth and Seventh Directive are also the most controversial of the Directives. Both introduced accounting requirements that were never required in most EU Member States before, such as the ‘true and fair view’ and the consolidated financial statement. This possibly explains why significant delays were experienced in the implementation of the Directives into national law. Table 4.1 lists the time periods in which the Fourth and Seventh Directives were incorporated within each EU member’s national legislation. A delay of three to eleven years was experienced in the implementation of the Fourth Directive and from three to nine years for the Seventh Directive.

\(^4\) These rules deal exclusively with financial statements, their contents and methods of presentation, valuation methods, and the disclosure of information (Iqbal, Melcher and Elmallah, 1997: 45). Broadly, it requires limited companies to prepare a balance sheet, an income statement, and notes to the financial statements on the basis that the preparation of such statements present a ‘true and fair view’ of the financial position of the enterprise.

\(^5\) Consolidated accounts show the holding company and its subsidiary together as though they were one entity with intercompany transactions being eliminated (Newham, 1984: 64). The intent of consolidated accounts is to provide meaningful, relevant, useful, and reliable information of a group of companies from an overall perspective (Rezaee, 1991: 206).
Since the implementation of these Directives, no further efforts on the part of the EU have been made or will be made to reform the Directives or to introduce a new set of Directives. EU efforts now concentrate on strengthening its commitment and contribution to the international standard-setting process. Despite this move, no amendments, revisions or reintroductions of the EU Directives are proposed. The present EU Directives appear set to remain in force and will be a requirement for all EU corporations well into the future. Chapter 9 addresses the implications of this further.

Table 4.1 - The Enactment of the EU Fourth and Seventh Directives

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>EU</td>
<td>1971</td>
<td>1973</td>
</tr>
<tr>
<td>member states</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Austria</td>
<td>1996 (a)</td>
<td>1995 (a)</td>
</tr>
<tr>
<td>Belgium</td>
<td>1983</td>
<td>1990</td>
</tr>
<tr>
<td>Denmark</td>
<td>1981</td>
<td>1990</td>
</tr>
<tr>
<td>Finland</td>
<td>1995 (a)</td>
<td>1995 (a)</td>
</tr>
<tr>
<td>France</td>
<td>1983</td>
<td>1986</td>
</tr>
<tr>
<td>Germany</td>
<td>1985</td>
<td>1985</td>
</tr>
<tr>
<td>Greece</td>
<td>1986</td>
<td>1990</td>
</tr>
<tr>
<td>Ireland</td>
<td>1986</td>
<td>1992</td>
</tr>
<tr>
<td>Italy</td>
<td>1991</td>
<td>1991</td>
</tr>
<tr>
<td>Luxemburg</td>
<td>1983</td>
<td>1986</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>1983</td>
<td>1988</td>
</tr>
<tr>
<td>Portugal</td>
<td>1989</td>
<td>1991</td>
</tr>
<tr>
<td>Spain</td>
<td>1989</td>
<td>1989</td>
</tr>
<tr>
<td>Sweden</td>
<td>1995 (a)</td>
<td>1995 (a)</td>
</tr>
<tr>
<td>UK</td>
<td>1981</td>
<td>1989</td>
</tr>
</tbody>
</table>

Note (a): Adopted upon accession

Source: Adapted from Flower and Lefebvre, 1997: 25

---

6 Specifically, the EU is now playing a more active role in the ‘formulation’ of international accounting standards with the International Accounting Standards Committee (IASC) so as to enable a consistency between the EU Directives and international accounting standards (Alexander and Archer, 1998: 107).
4.4 National Responses towards EU Financial Accounting Harmonisation

How do multiple agents respond when directed towards a common measure? The existing theory of Agency assumes this to be similar to a simple agency relationship, that is, agents will be motivated by self-interested rationalism with no institutional influence. The socio-environmental rationalist approach to agency assumes that even in multiple agent communities agents will be influenced by their institutional affiliations and interactions. Hence, the question is how do different nations respond when directed towards the common measure of financial accounting harmonisation?

At the time of drafting the EU Directives, the aim was to develop and incorporate a series of financial accounting standards that best represented the totality of the financial accounting standards existing in all EU Member States. According to Walton, Haller and Raffournier (1998: 14) the EU Directives were inadequate in integrating the mixture of principles and practices drawn from different countries and different traditions towards a common basis. This may reflect the unequal power distribution between member nations in the multi-agent dual party relationship (which is addressed later in Chapter 6). How then will member nations decide the basis for their adoption of the EU Directives? Do they respond as a SIR agent or as socio-environmental rationalist agent (SERA)?

One particular experience open to examination relates to the adoption of the ‘true and fair view’\(^7\). The adoption of the ‘true and fair view’ indicates a diversity of responses with inadequate attempts to integrate or standardise European practices. Given the underlying assumption of agent behaviour in the existing Agency literature (i.e., self-interested rationalism) nations should not adopt the policy given its inadequate representation of member states’ financial accounting practices. Alternatively, given the assumptions of socio-environmental rationalism member nations should adopt the ‘true and fair view’ if it is in accordance with their institutional settings. Actual

---

\(^7\) The ‘true and fair view’ is a requirement that the financial statements be prepared in accordance with and present a ‘true and fair view’ of the financial operations and position of the enterprise. Any application of the provisions of the directives which do not represent a ‘true and fair view’ are to be overridden or departed from, and an alternative procedure which represents a ‘true and fair view’ is to be adopted (Article 2(5) of the Fourth Directive).
practices show clear national interpretations of a posited common European standard. So what informed this adoption: self-interested rationalism or socio-environmental rationalism? The following section addresses this question.

### 4.4.1 Perceptions of the ‘True and Fair View’

The ‘true and fair view’ is a requirement that the financial statements be prepared in accordance with and present a ‘true and fair view’ of the financial operations and position of the enterprise. Walton, Haller and Raffournier (1998: 14) state that the ‘true and fair view’ concept was adopted as the overriding principle solely to accommodate the arrival of the United Kingdom (UK) and Ireland as new members in the EU. The concept originated in the UK and represented a significant departure from the previous draft requiring the Germanic approach (Walton 1997; Diggle and Nobes 1994), which required financial statements to conform and adhere to the legal principles of proper bookkeeping (Nobes, 1993: 165). This previous draft was most representative of the existing practice in continental EU Member countries (Blake et al, 1998: 148).

Essentially, the ‘true and fair view’ is a highly subjective concept requiring the exercise of professional judgment on behalf of the accountant or auditor (Walton, 1995: 217). While being officially recognised in the documents, there is no interpretation of its meaning in the statutes or the Directives, nor has it been the subject of judicial interpretation (cf., the German approach which encompasses the use of rigid and detailed rules and regulations as a basis for account preparation) (Gray and Coenenberg, 1984: 101). Consequently, the ‘true and fair’ concept has been interpreted in different ways in different EU member countries, both linguistically and philosophically (Alexander and Nobes, 1994: 105).

On a literal translation, eight languages in the EU have a unitary wording (see Figure 4.3). It is only the English language, the language from which the concept originated, that has the dual wording: ‘true and fair’ (Nobes, 1993: 39). To cope with this uncertainty or even to understand the concept, Member States (from non-English speaking nations) incorporated this new concept as an adjunct to pre-existing
Chapter 4: The European Union (EU) – A Case of Financial Accounting Harmonisation

requirements (Walter, Haller and Raffourneir, 1998: 15). Accordingly, France simply added the ‘true and fair view’ to its pre-existing requirement that the accounts were to be ‘sincere and regular’ (Walton, Haller and Raffourneir, 1998: 15, Walton, 1995: 7). The Netherlands also represents a similar case scenario, requiring the accounts to present a ‘faithful view’ and to be in accordance with the ‘principles acceptable in economic and social life’ (Blake and Amat, 1993: 161; Nobes, 1993: 37). On other hand, in Germany there is no ‘true and fair’ override provision (Blake and Amat, 1993: 132). Germans define the ‘true and fair view’ as referring only to the notes of the annual accounts (Walton, 1995: 7). This incorporates the conservative German provision that under no circumstances will there be a departure from the law. Note the revision in Germany’s position, a reassertion of their more traditional stance, which is illustrated in Figure 4.3.

Figure 4.3 - The Literal Interpretations of the ‘True and Fair View’

This figure is not available online. Please consult the hardcopy thesis available from the QUT Library

Source: Nobes, 1993: 39
Chapter 4: The European Union (EU) – A Case of Financial Accounting Harmonisation

Philosophically, EU countries can be placed on a continuum with respect to their stance towards the implementation of the ‘true and fair view’, as demonstrated in Figure 4.4 below. Starting from the nations most accepting of the notion of the ‘true and fair view’, the ultra-liberalists, to those who reject the notion in its entirety, the ultra-conservatives, five different positions may be identified (Nobes, 1993: 45; Alexander and Nobes, 1994: 106).

1. The **ultra-liberalist** who adopt the concept in its entirety, perceive the ‘true and fair view’ to be a tool for maintaining flexibility, allowing directors/auditors to interpret and override laws and standards. The UK and Ireland are examples of nations exhibiting this stance.

2. The **liberalist** adopt an approach of a lesser extreme, in that they perceive the ‘true and fair view’ as a tool to facilitate insight in the interpretation of legislation and (non-governmental) guidelines, and only in exceptional circumstances is the law overridden. The Netherlands is an example of a nation exhibiting this stance.

3. The **moderates** represent an intermediate position between the two extremes of perceiving the ‘true and fair view’ to be a tool for compromise. It may be used to interpret and override government requirements. France and Spain are examples of nations exhibiting this stance.

4. The **conservatives**, on the other hand, perceive the ‘true and fair view’ to be a tool for guidance, aiding directors/auditors in interpreting government or non-government requirements. Thus, in practice an override will probably not arise. Italy is an example of a nation exhibiting this stance.

5. Lastly, the **ultra-conservatives** who reject the concept of ‘true and fair’ in its entirety perceive the ‘true and fair view’ to be a tool for clarification. Thus, the ‘true and fair’ concept relates only to notes of the annual accounts, and consequently is not used to depart from the law. Germany is an example of a nation exhibiting this stance.
Thus, the implementation of the ‘true and fair’ concept has in fact been interpreted in different ways in different EU member countries, both literally and philosophically, and even adapted in certain nations (e.g. Germany). This implies that a number of different financial statements could give a ‘true and fair view’ of any particular state of affairs or profit or loss, frustrating harmonisation efforts in the EU. This is neither in the self-interests of the nations (agents) nor the EU Commission (principal). As it creates disharmony and may impede investment and capital flow between nations. The question here is why are nations opting not to adopt the ‘true and fair view’ in its entirety, even though it is a lax requirement (allowing a substantial degree of flexibility) through which its implementation would improve harmonisation efforts. An application of the existing assumptions of Agency theory would suggest that it would be in the best self-interest of agents (member nations or national governments) to do so. Is there something more to agent behaviour, than just such self-interest?
4.4.2 Directive Diversity

The ‘true and fair view’ is not the only aspect of the Directives that has been applied in diversity. Standards that are stipulated by the EU Commission for implementation have been circumvented and the alternatives to the stipulated policy have been adopted. Under the Fourth Directive alone, there are more than 30 optional areas that provide alternative ways of implementation (Joy, 1996: 19). Asset revaluation is a case example that is often cited in the literature to demonstrate the diversity of practices, and the lack of uniformity. Article 32 of the Fourth Directive stipulates that the valuation of an asset should be in accordance with the historical cost convention. Article 33 of the Fourth Directive, however, allows member States ‘to permit or require in respect of all companies’ to depart from the historical cost convention (Gray and Coenenberg, 1984: 89). Instead of the historical cost convention, member states have an extensive range of options to choose from, implementing the option that suits them.

Similarly, options exist in the Seventh Directive on Group Accounts in areas such as: the definition of a subsidiary/concept of a group; exemptions from consolidation; valuation methods across group accounts; research and development (R&D) and the recognition of goodwill. This is only a limited sample, as according to Gray, Coenenberg and Gordon (1993: 35) there are fifty-one obvious options. If they are all assumed to be yes/no options, Gray, Coenenberg and Gordon (1993: 35) extrapolate that this means there are $2^{51}$, that is, ‘two zillion’, ways of implementing the Seventh Directive.

---

8 Asset revaluation is an incremental increase or decrease in the value of asset to a value more indicative of its present worth to the business. Assets are revalued usually as a consequence of a rise in national inflation levels.

9 Historical cost of an asset is the cost of an asset at the date of acquisition or completion of production. The costs associated with production and/or the cost incurred to bring the asset into a sellable or useable condition are inclusive for example, freight charges, import levies, transit insurance, tax, installation expenses etc.

10 Options permit revaluation at current values, replacement values, occasional revaluations, valuations adopted for tax purposes, or other types of inflation accounting for example, fiscally based valuations (Walton, Haller and Raffournier, 1998: 14; Roberts, Salter and Kantor, 1996: 3).

11 Goodwill is the difference between the cost of the investment to the parent and the value of the subsidiary’s net assets at the time the investment is purchased. Goodwill arises when the parent pays a premium for acquiring the shares of the subsidiary (Newham, 1984: 65). That is, the parent company anticipates greater benefits than fair market value of net assets acquired for example, an added team of executives will bring about a major synergy or certain patents lend themselves to higher profit potential (Mueller, Gernon and Meek, 1997: 25).
The most controversial topic of the Seventh Directive is the concept/definition of a group. The concept/definition of a group for consolidation purposes was not formalised in the text of the Directive (Flower and Lefebvre, 1997: 343). The term ‘group’ is not mentioned and instead a number of conditions for the preparation of consolidated accounts are specified. These conditions relate to the legal concept of control. Member states, however, may choose to go beyond this mandatory provision, and consolidate accounts in accordance with the optional concept of economic control. Each member state may tailor its requirements by choosing certain options and rejecting others, incorporating certain aspects of the legal concept of control and some or all aspects of the economic concept of control.

For example, with the early development of the stock exchange in the UK, the requirements emphasise the existence of a de jure (legal power) to control through share ownership. In Germany, with a greater portion of corporations subject to family ownership and extensive banking facilities, the requirements emphasise the existence of de facto (economic) management control (Radebaugh and Gray, 1997: 257). Some countries have been more imaginative than others in their interpretation of the Directive in that their interpretation have given rise to various ways in which the boundaries of a group may be demarcated (Radebaugh and Gray, 1997: 343). At this present time, no two countries apart from the UK and Ireland have an identical accounting group concept (Radebaugh and Gray, 1997: 343). This provides a clear demonstration of the key role that institutions can play in influencing the behaviour of member nations, as agents in EU principal-agent relationships.

According to the principles of the existing theory of Agency, each EU member nation being an agent is a SIR seeking to adopt those policies that maximise national utility. Given this, nations should then undertake those actions that would increase their share

---

12 Article 1.1 of the Seventh Directive requires consolidation where the parent undertaking has the ‘legal power to control’ the subsidiary, which is presumed to exist in four cases: (1) the holding of the majority of the voting rights; (2) the right to appoint or remove a majority of the board of members; (3) the right to exercise dominant influence pursuant to a contract or provision in the articles of association; and (4) the holding of a majority of the voting rights pursuant to an agreement with the shareholders (Flower and Lefebvre, 1997: 348).

13 Article 1.2 of the Seventh Directive stipulates economic control exists if a parent undertaking has a participating interest in the subsidiary and either: (a) the parent actually exercises a dominant influence on the subsidiary company; or (b) the subsidiary and parent undertaking are managed on a unified basis (Flower and Lefebvre, 1997: 349).
of the rewards of economic union such as, increased capital mobility and efficiency, and increased investment and comparability. These rewards could only eventuate through the implementation of a harmonised financial accounting system. The degree of diversity continuing to persist in EU financial accounting (demonstrated in the discussions above) does not reinforce or support the notion that member nations are acting in accordance with such a simple mode of self-interested rationalism. Diversity is not in the best interests of member nations (the agents) or the EU citizens (the nominal principals). Collectively disharmony in accounting procedures decreases the utility of countries involved. This is discussed at length in Temel’s (2000) study of the practical implications of EU disharmony. An extensive review of the research by Temel (2000) concludes that the consequences as a community range from comparability problems; the existence of an unequal level playing field; impaired business development; and impediments to the efficient operation of the EU capital market.

Why would some nations depart from the stipulated standards to adopt alternatives that increase diversity in EU financial accounting, which contrary to the apparent interests and utility of both agents and principals? An examination of the ‘true and fair view’ and the definition of a ‘group’ demonstrate that institutional affiliation and interaction may be an explanatory force of national government behaviour. This will be examined further in the following sections

4.5 National Institutional Analysis

The Fourth and Seventh Directives were prepared for the sole purposes of achieving harmonisation. The inclusion of a number of options, however, has allowed its actual implementation in member states to be different. Companies could comply with the Directives while still employing methods that were far from harmonised. A case study conducted by Walton (1992) revealed that accounting measurements were not uniform within the UK and France, let alone throughout the Community. Implementing alternatives rather than the stipulated standards effectively increases disharmony and hence, reduces the utility of member nations (agents). Self-interested
rationalism, as commonly interpreted is not then the driving force of member nation (agent) behaviour.

The use of socio-environmental rationalism to describe the financial accounting harmonisation process, on the other hand, would consider the institutional affiliations and interactions of member nations and their influence on member nations’ (agents’) behaviour in Directive implementation. National institutions would, therefore, be instrumental in directing, assisting, supporting and constraining member nation behaviour in achieving the citizen’s (principal’s) goal of financial accounting harmonisation. An analysis of the institutional affiliations and interactions of EU member nations and their association with financial accounting harmonisation will examine the plausibility of this supposition.

The institutions to be analysed include:
1. the accounting profession,
2. the legal system,
3. statutory regulations\textsuperscript{14},
4. the financial system,
5. the financial accounting system, and
6. the tax system.

The fifteen EU member nations and their institutional affiliations and interactions cannot be examined without compromising on detail. So the accounting systems of only four EU member nations will be analysed: namely the UK, the Netherlands, Germany and France will be analysed. Each of these four member nations represents a different accounting system operating within the EU, as demonstrated in Table 4.2 below. While each classification contains a number of nations, these four nations in particular are chosen as they represent the prominent nations within the EU and within each classification. These four nations will now serve as a subject for institutional analysis.

\textsuperscript{14} Because regulations often codify widely held beliefs and stem from government initiatives, they can be viewed as institutional forces (Carroll, Delacroix and Goodstein, 1988; Edehnan and Suchman 1997).
4.5.1 Institutional Analysis and the United Kingdom

The chief influence on the UK financial accounting system is the UK accounting profession (Parker, 1998: 101). The early establishment of the accountancy profession, its perceived standing in the community, and the confidence of accountants in the suitability of their notions of profit measurement and asset valuation, lead to the belief that accountants should determine what constitutes acceptable accounting principles and standards (Parker, 1998: 104). This explains to date why the UK is one of the few countries to adopt the ‘true and fair view’ as a primary requirement for preparing accounts. The highly subjective concept requires the exercise of professional judgment on behalf of the accountant or auditor which is of no scarcity in the UK (Walton, 1995: 217). The accounting profession thus supported the adoption of the ‘true and fair view’ as a requirement of the Fourth Directive.

15 A classification of accounting systems undertaken by Radebaugh and Gray (1997) reveals that:
1. The UK system of accounting is based on the Anglo-Saxon system of accounting;
2. The Dutch system of accounting is based on the Nordic system of accounting;
3. The German system of accounting is based on the Germanic system of accounting; and
4. The French system of accounting is based on the Latin system of accounting.

Note that while these four nations have been classified into groups it is possible for a nation to be classified within a specific accounting system and still exhibit traits specific to the individual nation.
Chapter 4: The European Union (EU) – A Case of Financial Accounting Harmonisation

The accounting rules are seen to develop from the expertise and ethical practices of accountants. The British Government is not involved with business in the way that is often said to be the case in nations such as France where accounting is under the overall direction of the government. This does not mean that the British Government does not introduce accounting regulations, but rather the policies it does select are informed by the accounting profession. The accounting profession thus provides assistance, direction and restraint in the adoption of the accounting policies particularly those of the Fourth and Seventh Directive, which were put fourth towards national governments for implementation.

The UK common law system demands that the law specify general principles (Alexander and Archer, 1998: 7). Accountants alone appear to be responsible for determining the specific contents of accounting policy, standards and practice through the professional accounting bodies (Radebaugh and Gray, 1997: 91; Puxty, Willmott, Cooper and Lowe, 1987: 279). While over time successive Acts of company legislation added structure and other requirements, accountants still exercise considerable discretion in the application of professional judgement (Choi, Frost and Meek: 1999: 69). As long as mandatory laws and established practices are followed, corporate directors in conjunction with accountants are allowed to exercise professional judgement on many other issues, enabling a great deal of flexibility in the determination of financial results (Iqbal, Melcher and Elmallah, 1997: 118). This flexibility allows the selection of financial accounting practices that present a ‘true and fair view’ of corporate performance. The ability of UK directors and accountants to revalue assets reflects this condition. An ability to undertake such a practice is a direct consequence of the accountancy profession exerting its influence on accounting policy formulation with little assistance but support from the legal system.

The stock exchange occupies the central place in arrangements for the funding of large-scale business and for the pricing and trading of securities, as demonstrated in Table 4.3 below (Paker, 1998: 96). Thus, financial accounting is oriented towards meeting the information needs of investors. Financial accounts and reports are thus prepared with extensive and substantial information presenting results optimistically with a view to satisfying the needs of all investors. The expansive role of the stock exchange has thus directed and supported the adoption of informative policies (e.g.,
disclosure on environmental practices) and optimistic policies (e.g., requirement to revalue assets) from the Fourth and Seventh Directives.

Table 4.3 - European Stock Markets: Share Volume 1997 and 2004 ($millions)

<table>
<thead>
<tr>
<th>Exchange</th>
<th>1997 Volume</th>
<th>2004 Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>London (UK)</td>
<td>13,618.422</td>
<td>34,492.3</td>
</tr>
<tr>
<td>Milan (Italy)</td>
<td>8,153.044</td>
<td>21,217.2</td>
</tr>
<tr>
<td>Frankfurt (Germany)</td>
<td>2,221.185</td>
<td>25,248.7</td>
</tr>
<tr>
<td>Amsterdam (Netherlands)</td>
<td>901.225</td>
<td>5,065.5</td>
</tr>
<tr>
<td>Stockholm (Norway)</td>
<td>437.767</td>
<td>4,077.5</td>
</tr>
<tr>
<td>Paris (France)</td>
<td>440.998</td>
<td>30,989.6</td>
</tr>
<tr>
<td>Warsaw (Poland)</td>
<td>73.927</td>
<td>2,230.7</td>
</tr>
<tr>
<td>Athens (Greece)</td>
<td>32.352</td>
<td>2,230.7</td>
</tr>
<tr>
<td>Vienna (Austria)</td>
<td>21.880</td>
<td>5,570.8</td>
</tr>
</tbody>
</table>

Source: Harris, 1999: 210 and Brog, Mullin and Sandell (2004)

A highly influential accounting profession, lax legal system and expansive stock market have instrumentally informed the selection of those EU policies from the Fourth and Seventh Directives that emphasise the presentation of a flexible, optimistic, open and publicly accountable approach. The flexibility demonstrates a high degree of institutional variability with moderate levels of institutional power. In terms of the matrix of institutional dimensions presented in Chapter 3, this implies that the UK member state is positioned in the top left quadrant, namely the ‘upheaval in society’ quadrant (further reasoning for this positioning is provided in Chapter 8 section 8.3), which is presented in Figure 4.5 below.
4.5.2 Institutional Analysis and the Netherlands

Dutch accounting presents a paradox of systems, in that while the Netherlands is a code law country, few detailed legal and accounting rules are contained within the code. Essentially the Civil Code has not provided a detailed framework. Instead the Dutch accountancy laws apply a comprehensive, coherent set of guidelines, which stipulate all the important aspects pertaining to financial accounting. Although the guidelines are not legally binding, they have the authoritative standing of the Council for Annual Reporting (Raad voor Jaarrekening) who publishes the guidelines and is influenced by the Netherlands Institute of Registered Accountants (NIvRA) (Nobes, 1992: 17).

The financial accounting guidelines are inherently flexible in that they do not specify a precise accounting procedure that should be followed for corporate financial transactions. The guidelines simply specify a number of accounting procedures or treatments to be followed for recording corporate financial transactions. It is left to the discretion of the individual accountant to determine the appropriate treatment given the circumstances and the position of the corporation. This perhaps explains why such a liberal view such as, a ‘faithful representation of the accounts in accordance with the guidelines’ was selected, quite similar to the stipulated ‘true and fair view’. Much like the UK accounting profession the Dutch accounting profession performs a vital role in directing, supporting and constraining the adoption and selection of accounting policies.

The Dutch Government, like the British Government, has adopted a somewhat laissez-faire approach towards regulating financial accounting (Alhasim and Arpan, 1998: 35). Even with the government’s implementation of company law through the 1970 Act on Annual Accounts of Enterprises only basic rules were laid down in law allowing considerable flexibility in financial reporting (Van der Tas, 1998: 216). Perhaps it is the long-established use of lax regulations and standards that accustomed and assisted with the minimal adherence to the EU financial directives.
This lax legislation governing accounting practices is supplemented by the opinions and pronouncements of a number of sources other than the Commercial Code and accounting profession (Newham, 1984: 258). These include the trade unions and the business community. Financial accounting practices undertaken by corporations, therefore, are more inclined to take into account the preferences of the broader community. This has resulted in a great deal of disclosure beneficial to the business community than that stipulated by the EU Directives. For example, the practice of social reporting with regards to employment and environmental activities has been established since the 1970s (Radebaugh and Gray, 1997: 95). The broader business community has thus assisted with the development and adoption of those policies that enhance the informative content of financial accounts.

A lax legislative system, and a highly influential trade union and business community has informed the selection of those EU policies that emphasise the presentation of an open, liberal and social accountable approach. The laissez-faire approach towards accounting demonstrates a low to moderate level of institutional variability (with limited structure) with low levels of institutional power. With respect to the matrix of institutional dimensions presented in Chapter 3, the Netherlands member state is positioned within the bottom left quadrant, namely the ‘atomistic society’ quadrant. As presented in Figure 4.6 below.

Figure 4.6 - Matrix of Institutional Dimensions for the Netherlands
4.5.3 Institutional Analysis and Germany

Under the German legal system, financial accounting and reporting is subject to the detailed regulations of the Commercial Code (Handelsgesetzbuch, HGB) and the principles of proper bookkeeping (Grundsätze ordnungsmäßiger Buchführung, GoB) (Ballwieser, 1996: 479). The process of formulating accounting regulation is the duty of the government and parliament. The German private standard setting body has no authoritative standing compared to that of its UK counterpart (Haller, 1998: 80). The German Accounting Profession’s pronouncements on accounting standards have no formal legal status and are only a guidance measure (Joy, 1996: 47). The dominance of this legal prescription exists despite a strong and highly trained academic and practitioner accounting community. This justifies why the stipulated ‘true and fair view’ was not adopted, but rather the requirement that the accounts conform to the facts and the regulations was adopted. The strength of the legal system and its prescription has thus assisted, directed and supported the selection and adoption of accounting policies from the Directives.

German accounting theorists also take the view that financial accounting should be regulated by the law as precisely as possible. Companies should have few options, or better still, none at all (Gray and Coenenberg, 1984: 124). Consequently, strict adherence to the laws has become the most important principle to be observed when preparing financial statements rather than any overriding requirement to provide a measure of performance or financial position. For example, the stipulated requirement that assets be recorded at their historic cost is deemed necessary to guard against the presentation of an overly optimistic view of net assets and wealth and thus, deter the ability of corporate executives to undertake untrustworthy activities. Other professionals of accounting have thus constrained growth in certain accounting through the controlled adoption of accounting policies.

Another peculiarity of the German accounting rules is the close relationship between the commercial profit and the determination of taxable profit (steuerliche Gewinnermittlung). The so-called ‘principle of bindingness’ (Massgeblichkeitsgrundsatz) states that balance sheet items and their valuation in the commercial balance sheet (Handelsbilanz) are simultaneously binding for the
determination of taxable profit. Tax liability can only be reduced if the same options are exercised in the commercial annual financial statements (Gray and Coenenberg, 1984: 58, Nobes, 1992: 9). Thus, the commercial financial statements form an authoritative basis for tax accounts. Any policies adopted from the Directives have been of a conservative nature (i.e., to minimise tax liability) and limited in disclosure. The tax system thus has constrained the development of a publicly open and informative accounting system, adopting those accounting policies from the Directives that present a conservative view of profits, such as in the expensing of Research and Development Expenditure as opposed to the capitalisation of such expenditure.

With regards to financing the activities of German corporations, equity financing via the stock market plays a relatively minor role. This is a consequence of the strict legal requirements of the stock exchange, and investors’ perceptions that they need a high degree of security for their investments (Reeves and Kelley-Holmes, 1997: 47). It is perhaps this desire for security that encourages investors to invest in corporations through Germany’s extensive universal banking system, which is the dominant source of finance for corporations (Radebaugh and Gray, 1997: 99; Reeves and Kelley-Holmes, 1997: 47). A substantial portion of bank deposits are thus invested in extensive holdings in commercial and industrial corporations in various industries (Jorg, 1995: 93, Reeves and Kelley-Holmes, 1997: 35). As a consequence, a preference for developing and maintaining a corporate-creditor relationship at the expense of reporting high levels of profit developed. Hence, the standards that are adopted report lower profits ensuring that funds are not diverted to dividend payments and instead are available for debt commitments. Financial statements, therefore, play a limited role in providing information for investors who are deemed to be

---

16 Tax accounts do not represent an independent set of accounts as in the UK and the Netherlands but are derived from the commercial accounts (Seckler, 1998: 361).

17 Only about 3% of all companies in Germany are listed on the stock exchange (Ballwieser, 1996: 480), and in 1994 only 5% of the adult population were share-owners, compared to 21% in the UK (Haller, 1998: 89).

18 German companies, such as the car manufacturers Porsche AG and BMW AG or other worldwide operating companies such as Bertelsmann AG, Henkel KGaA, Robert Bosch GmbH, are to a large extent in the hands of only a few investors (Haller and Walton, 1998: 5).
in insignificant actors in the corporation. The financial system has thus directed and constrained the adoption of accounting policies from the Fourth and Seventh Directives. For example, revaluation of assets is prohibited and assets must at all times be recorded at historic cost.

A comprehensive legislative system, and a highly influential tax and banking system has informed the selection of those EU policies that emphasise the presentation of a rigid, secretive, conservative and less informative approach to financial accounting. The strict adherence to certain institutional arrangements demonstrates a low degree of institutional variability with a high degree of institutional power. In terms of the matrix of institutional dimensions presented in Chapter 3, this implies that the Germanic member nation is positioned within the bottom right quadrant, namely, the ‘controlled society’ quadrant presented in Figure 4.7 below.

Figure 4.7 - Matrix of Institutional Dimensions for Germany

---

19 There is little need to provide financial information to the public, of whom only a very small portion, 5% of the German population, are investors.
4.5.4 Institutional Analysis and France

Traditionally, accounting in France has been highly codified. French civil law is primarily based upon codes and statutes, for example, the *Code Napoleon* or the modern version the *Plan Comptable Général* (PCG) (the Accounting Plan). These constitute the totality of the law (Joy, 1996: 33). The PCG is a standardised accounting manual, which serves as a basis for accounting in all classes of enterprise. The PCG discusses the basic principles of organising the accounting function in an enterprise, clarifies how the chart of accounts are to be used for the purposes of financial accounting, and provides guidance on valuation and income measurement issues (Camfferman, 1997:112). The form of these accounts developed out of the belief, on the part of the French Government, that a national uniform system would promote a more equitable distribution of wealth and a more informed planning strategy. Those accounting policies that were adopted from the Fourth and Seventh Directives were thus inflexible in nature. The presentation of accounts in accordance with the PCG is one example.

In other words, the French accounting system much like the German accounting system emphasises the necessity of accuracy and precision rather than the informational quality of the accounts (Ernst and Whinney, 1980: 94). Conformity with the rules and uniformity outweigh the need to provide users of the accounts with any additional information they need beyond what is stipulated in the PCG (Radebaugh and Gray, 1997: 106; Ernst and Whinney, 1980: 93). The provision of extra information is deemed to create a sense of inconsistency with the standards and PCG, which will substantially reduce comparability within and across industries and thus, create uncertainty in industry comparisons. It is this long-established approach to accounting that accustomed the French Government to adopt the aspects of the EU financial directives that are in line with the PCG and to disclose little more than those requirements.

Accounting regulations are also codified in an accounting plan drafted by a government appointed body, the *Conseil National de la Comptabilité* (the National Accounting Council), which is responsible to the Ministry of Finance for the development and maintenance of the PCG. In other words, the French Government,
much like the German Government, is involved in the creation and design of accounting legislation. In addition, through its provision of direction and constraint in the adoption of accounting policies, State endorsement is crucial and provides authority to accounting rules (Scheid and Walton, 1998: 294). Consequently, much like the German accounting profession, the French accounting profession is relatively small and lacks the authority and status of its counter-parts in the UK and the Netherlands (Radebaugh and Gray, 1997: 105). Their professional pronouncements have no formal status, being recommendations that regulators may consider (Choi, Frost and Meek: 1999: 54). This lack of a highly influential accounting professional body perhaps explains why the stipulated ‘true and fair view’ was not adopted in the presentation of accounts but was rather an adjunct to the requirement that there must be a presentation of a ‘sincere and regular view in accordance with the PCG. The lack of authority on behalf of the accountant or auditor constrained the adoption of the ‘true and fair view’ as a primary requirement.

The traditional objective of accounting in France has been to inform the government for the facilitation of national economic planning. The information presented in the annual accounts, however, has also been designed to meet the information needs of creditors and employees. Measurement practices and disclosures are also undertaken with the information needs of these groups in mind. This is because these groups are seen to be highly dependent upon the success of the enterprise, and thus, have a right to access information in regards to the security and financial performance of the company (Gray, Coenenberg and Gordon, 1993: 22; Fortin, 1991: 101). Investors such as shareholders, on the other hand, are regarded as being external to the organisation and consequently, are given little priority. This preference for maintaining a relationship with certain institutions (i.e., creditors and employees) has forgone the need to provide extensive information in the corporate annual reports, and supported and constrained the adoption of accounting policies that provide information suitable for investors.
While the French stock exchange is the second most active in Europe (refer to Table 4.3), and it still plays a limited role in influencing accounting policy selection in France (Scheid and Walton, 1992: 69). Creditors (as mentioned above) such as banks and other financial organisations, play a significant role in France. They are the auspices for investment. For example, individuals have preferred to deposit their money in one of the many state-owned savings or banking institutions rather than to make direct investments in an unguaranteed stock exchange (Harris (1999)). Consequently companies, large, medium and small, have relied on banks and government agencies to finance their activities through either bond or equity issue (Newham, 1984: 155; Scheid and Walton, 1998: 300). Financing is thus, directed more towards debt rather than equity. Given that the finance from national banking institutions dominates the provision of corporate finance, as is in Germany, corporations are less inclined to present results optimistically. To do so would result in the reporting of higher profits and thus, divert funds away from securing the payment of loans towards the payment of dividends. The financial system has thus directed and supported the adoption of accounting policies that provide a conservative view of operations (e.g., direct expensing of Research and Development expenditure).

A comprehensive legislative system, and a highly influential national government, business community and banking system has informed the selection of those EU policies that emphasise the presentation of a rigid, uniform, conservative and less informative approach to accounting. The basis upon which accounting policies are adopted (i.e., economic planning) demonstrate more than a moderate degree of institutional variability and a high degree of institutional power. In terms of the matrix France can be positioned within the top right quadrant, the reforming society quadrant as presented in Figure 4.8.
4.5.5 Findings from the Institutional Analysis

The institutional analysis, undertaken in the previous sections, presents an explicit description of the influence of national institutions upon national accounting systems and hence, their adoption of the EU Financial Accounting Directives. An analysis of the attributes of the institutional arrangements within each member nation and their consequent effects on the selection of accounting policies demonstrate the plausibility of the supposition that societal institutions have influenced the adoption of particular styles of financial accounting from the EU Directives that are diverse and rarely in accordance with the principles of harmonisation.

Each of the four member states are positioned within different areas of the matrix of institutional dimensions, as was shown in Figures 4.5 to 4.8. The varied institutional influences are a prime demonstration for the reasoning of varied levels of harmonisation. There is broad agreement that the institutions of EU member states have gained great authority in influencing the direction of European integration (Moravcsik 1998). Contrary to Tarrow (2001) the era of strong states is not ending (Tarrow, 2001: 1). European states and their extensions elsewhere continue to succeed remarkably in circumscribing and controlling the level of their commitment with the broader community. Thus, the simplistic assumption of agency with its
narrow self-interested rationalism, does not assist in the explanation of member nation (agent) behaviour.

The above findings are further supported by March and Olsen (1998) who contrast two interpretations of human behaviour: the logic of consequential calculation and the logic of appropriateness. The consequentialist interpretation coincides with the self-interested notion of rationality and the appropriateness interpretation coincides with the socio-environmental notion of rationality. The consequentialist interpretation sees actors within a system as being interacting autonomous, egoistic, self-interested maximisers (March & Olsen 1998: 953). The appropriateness interpretation sees actors as acting in accordance with rules and practices that are socially constructed, publicly known, anticipated, and accepted (ibid). These authors do not believe that the two logics are mutually exclusive or that one particular interpretation is all encompassing (Jacobson, 2000: 152). Any action probably involves elements of both. Because action is based on conformity with rules as well as calculations of self-interest; institutions do matter. Thus, as was demonstrated above sole application of SIR behaviour or the consequentialist interpretation is limiting in explanation.

The relevance of institutions in understanding accounting policy choices and adoption is also supported in an earlier study by Temel (2000) which demonstrated that societal institutions were the social channels through which cultural values were transmitted to the accounting system and hence, the driving force for the diverse adoption of EU Directives. Accounting policies were adopted in conformance with the cultural values of member nations rather than with the principles of harmonisation in mind (Temel 2000).
4.6 Conclusion

This Chapter demonstrated the applicability of the conceptualisations of the existing theory of Agency and that of the extended conceptualisation of agent behaviour in principal-agent relationships. The context used to demonstrate this applicability relates to the EU financial accounting harmonisation process. This particular principal-agent relationship represents one of multiple agents and dual parties, presenting a comprehensive case for analysis. The extended conceptualisation presents a more informed understanding of agent behaviour (member nation) in the EU context.

Self-interested rationalism does not necessarily inform member nation behaviour in policy selection but rather their institutional settings appears significant. Institutions were the instruments through which member nations’ (agents’) behaviour was driven. Affiliations and interactions with institutions were instrumental in supporting, assisting, directing and constraining member nations’ (agents’) behaviour towards the EU citizens’ goal of harmonisation. The notions of socio-environmental rationalism provide a more adequate understanding of agent behaviour in the EU context. This may also be the case in many other contexts as well, especially where the existing theory of Agency has had limited success in demonstrating its applicability. The studies in Table 2.2 show limited success in reinforcing the predictions of the simple agency model, for example.

It is next necessary to undertake two procedures. The first is to develop a methodology through which the workings of the extended conceptualisation (i.e., SERA) can be demonstrated and applied more thoroughly and succinctly. The second is to develop a detailed formulation of how this extended conceptualisation informs agent behaviour. The formulation presented up until now has been quite general in stating that the principal-agent relationship is one of instrumental mutual dependence where institutional affiliation and interaction assist, direct, support and constrain agent behaviour. What needs to be formulated further is the process through which such assistance, support, direction and constraint are transmitted. Both these procedures will be undertaken in the following two chapters respectively.
5. Research Methodology and The Object Orientated (OO) Approach

This research aims to extend and reformulate the existing conceptualisation and formulation of agent behaviour in the theory of Agency. In doing so, it will both deepen and widen the scope of the existing research by looking beyond the narrow definitions of self-interested rationalist (SIR) behaviour and incorporate the context of the agent. Consequently, there will be a redirection from focusing traditionally on the universal assumption that all individuals can be inherently self-interested and similarly formaliseable to incorporating a relativist perspective whereby, the focus will be on the context within which the behaviour is transacted, specifically the agent’s institutional affiliations and interactions. Such a focus will, however, require the adoption of a non-traditional research methodology. This methodology focuses on examining the object and its context (i.e., the agent and its environment), and not just on the defined predictive capability of the object’s (agent's) behaviour. A methodology that adopts this approach is the object-orientated (OO) methodology. This chapter will describe the OO approach and its application to the current research. The chapter therefore answers the question of what is an appropriate method of research.

5.1 Design of the Research

The principal agent problem has been extensively developed in a particular paradigm, one influenced by positivism (refer to Section 2.3). The positive-agency literature has generally been empirically orientated, focusing essentially on predictability. This approach has dominated research in the theory of Agency (Jensen and Smith, 1985: 2; Chapter 2, section 2.3.1). For example, a substantial portion of the literature in agency has focused on the predictive capability and objectivity as criteria for judging the usefulness of the theory. The context in which a theory is formulated is little considered. Consequently, research into Agency theory has progressed without

---

1 In the social sciences these often are the types of arguments about the importance of social context (Hodgson and Willett, 1993: 12).
expressed concern as to the adequacy of the theory or to the central assumption that individuals are all SIRs. The problem is only sometimes acknowledged. Reasons are rarely, if ever, advanced for the limited success in predictive capacity of the theory of Agency. Current approaches, therefore, involve a specific and a simplistic interpretation of the agency relationship where objectivity takes precedence.

A theme of the more radical viewpoints in philosophy like hermeneutics (Rorty, 1980) and critical theory (Habermas, 1974) is the suggestion that research should abandon the traditional scientific foundations of methodology at least in social areas and replace them with alternatives like contextual analysis and self reflection (Hodgson and Willett, 1993: 13). In order to obtain a broader and deeper understanding of the theory of Agency, the proposed research will adopt an alternative approach, a slightly different and non-traditional methodology in examining agent behaviour. The use of this method intends to demonstrate that through seeking some more adequate framing and a deeper understanding of the agent behaviour a broader and deeper explanation of the agency relationship can be attained, which is expected to provide greater insights and practical implications.

5.1.1 Organisation of the Research

Research has traditionally been classified into two types: pure and applied. Pure research is experimental and theoretical work is undertaken to acquire new knowledge without looking for long-term benefits other than the advancement of knowledge (Ticehurst and Veal (1999)). Applied research, on the other hand, is original work undertaken primarily to acquire new knowledge with a specific application in view (ibid). It is undertaken either to determine possible uses for the findings of basic research or to determine new ways of achieving some specific and predetermined objectives (ibid). The research to be undertaken is both pure and applied. It is pure in the sense that it involves a conceptual study advancing new theory on agent behaviour through an extended conceptualisation and reformulation. It is also applied in the sense that this newly acquired knowledge will be applied to a specific case (that of EU financial accounting harmonisation). The extended conceptualisation and reformulation of agent behaviour is argued to provide a more
adequate and robust understanding of agency and the means for addressing firm and societal problems.

Phillips and Pugh (2000) state that this classification is too rigid to characterise what happens in most academic disciplines. Consequently, Phillips and Pugh (2000) suggest a threefold classification of research: exploratory research, testing-out research and problem-solving research, which apply to both quantitative and qualitative research. Phillips and Pugh (2000: 50-51) characterise each approach as follows:

1. **Exploratory Research** is the type of research that is involved in “tackling a new problem/issue/topic about which little is known, so the research idea cannot at the beginning be formulated very well. The problem may come from any part of the discipline; it may be a theoretical research puzzle (more pure) or have an empirical basis (more applied). The research work will need to examine what theories and concepts are appropriate, developing new ones if necessary, and examine which existing specifications can be used. It involves pushing out the frontiers of knowledge in the hope that something useful will be discovered”.

2. **Testing-Out Research** the researcher is “trying to find the limits of previously proposed generalisations… [T]his is a basic research activity (more pure) … The amount of testing out to be done is endless and continuous, because in this way we are able to improve (by specifying, modifying, clarifying) the important, but dangerous, generalisations by which our discipline develops”.

3. **Problem-Solving Research** “starts from a particular problem ‘in the real world’, and brings together all the intellectual resources that can brought to bear on its solution. The problem has to be defined (more pure) and the method of solution has to be discovered (more applied). The person working in this way may have to create and identify original problem solutions every step of the way. This will usually involve a variety of theories and methods, often ranging across more than one discipline since real-world problems are likely to be ‘messy’ and not soluble within the narrow confines of an academic discipline”.

Chapter 5: Research Methodology and the Object Orientated (OO) Approach

The traditional pure/applied focus dichotomy (as discussed by Ticehurst and Veal (1999)) can be combined with the classification of Phillips and Pugh (2000). A working specification is provided in the Table 5.1 below. Research efforts are spread across each of the six types of activity (or research domains) with suitable convergences and consistencies sought through a core modelling approach, one that is object-oriented (as is discussed in section 5.2) and will bridge the two dichotomies. One set of tests will involve examining the workings of the extended conceptualisation and reformulation of agent behaviour through a general simulation of the principal-agent relationship (pure research). The second set of tests will apply the extended conceptualisation and reformulation of agent behaviour to a specific simulation, the EU case of financial accounting harmonisation (applied research).

<table>
<thead>
<tr>
<th>Orientation</th>
<th>Exploratory of Ideas</th>
<th>Testing Out Ideas as Formed and Linked</th>
<th>Problem solving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pure Research (more abstract and conceptual)</td>
<td>Developing more general concepts and articulating embedded assumptions</td>
<td>Critically developing general formulations</td>
<td>Simulations of potential (types of) behaviour and outcomes</td>
</tr>
<tr>
<td>Applied Research (more particular and as constructed)</td>
<td>Specifying particular articulations of the case situation and their applicability to the reconceptualised agent behaviour</td>
<td>Trying alternative specifications of the case situation to the reformulated agent behaviour</td>
<td>Analytically using the applied case situation to determine applicability</td>
</tr>
</tbody>
</table>

Source: Table 1.1

This research, in other words, is more about hypothesis-generation than hypothesis-testing and results from the lack of a sufficient cumulative basis in Agency theory from which to work. Within this dissertation a new issue in agency is being investigated. This is the context within which the agency relationship occurs, about which little is known. The proposed research work will thus reconceptualise and
reformulate notions within agency to incorporate this aspect. The research will therefore be a conceptual and theoretical study with an extended application. It exhibits a number of characteristics which were discussed in Chapter 1, section 1.3. These collectively seek to address the six research objectives and research questions stated in Chapter 1 section 1.3.

The question now is: what research method will bridge the link between the research domains and the six research objectives and research questions?

### 5.1.2 Methodology and Requirements

The goal of a methodology is to provide a structured path or an approach for designers to follow so that the development process is less haphazard and more predictable and the factors influencing the resulting product are more controllable (Edwards, 1992: 18). In essence, it will permit more effective communication about a problem and its solution. It should also enable people to think more incisively about the nature of the problem and solution, hopefully leading to ‘better’ solutions, and aiding in the documentation of a solution (Edwards, 1992: 53).

In light of this research an approach that would be suitable is one that aids the:

1. Conceptualisation of the object’s concepts,
2. Development of a model of the constructs of the conceptualisation, i.e., a frame of application, and
3. Implementation and evaluation of the conceptualisation of the object.

A methodology that would perform the above mentioned aids is the Object-Orientated Methodology/Approach. Although it is not a research method as per say, it is a method for undertaking research which involves the use of designing and implementing computational systems examining particular objects of interest.
5.2 Object-Oriented (OO) Methodology/Approach

The Object-Oriented (OO) Approach differs significantly from the traditional research methodology. The focus of an OO methodology is not on developing a means through which to derive empirical content and test research but rather like its title suggests focusing on the objects of the research, notably on describing and understanding the object(s) that would generate or lead to the reported outcomes. An outcome is the result of an action by an object or interaction amongst objects. In other words, a better conceptualisation of the objects underlying the theory could result in a better understanding of the outcomes. The closer the researcher gets to the phenomenon, the more clearly it is understood (Carson and Coviello, 1996: 55; Merriam, 1988: 68). Thus previously unknown relationships can be expected to emerge leading to a rethinking of the phenomenon being studied (Stake, 1994: 147; Perry, Riege and Brown, 1999: 21). For example, through obtaining a deeper understanding of the rationalisation underlying agent behaviour (the object), this could ensure better predictive capability of the theory of Agency. An OO methodology is an appropriate approach for this study.

5.2.1 Components of a OO Methodology

Monarchi and Puhr (1992) state that there are four components to an OO methodology in general: the problem domain analysis process; the solution domain design process; analysis and design representations (including choosing representational concepts); and complexity management techniques (Monarchi and Puhr (1992)). The association of these components to the current research appears to be quite cumbersome, i.e., they are broad terms with techniques that are difficult to relate to the process desired. Edwards (1992: 54), on the other hand, redefines these four components to present the OO methodology in a simpler view as consisting of three major components, which appears to be more suitable and more practical to the process desired here. These three major components consist of:
Chapter 5: Research Methodology and the Object Orientated (OO) Approach

1. **Model.** The model (actually a meta-model) is a set of concepts which are used to construct a model of the problem. A model of the extended conceptualisation of agent behaviour labelled the socio-environmental rationalist agent framework (SERA) is presented in Chapter 6. It builds from concepts in previous Chapters.

2. **Notation/representation.** A notation may be a textual, graphical or combination of both. It is a means of expressing the model. The notation should provide a concise and minimalist approach to expressing models, but should be comprehensible. The notation to be used in expressing the model is also presented in Chapter 6 and is denoted LORA (Logic of Rational Agents). LORA is in SERA frame.

3. **Process.** The process is the steps, phases or activities required to construct a system. The process should include guidelines, heuristics and techniques to aid the designer in the search for ‘good’ models. The process through which the notation will be translated to construct a concrete computational model is also presented in Chapter 6. It is a specified LORA in a SERA frame.

These three components construct a complete OO model within an OO methodology. This frames and operationalises (to a limited extent) the extended conceptualisation and reformulation of agent behaviour and makes it available for application. With regards to the model implementation component (not addressed by Edwards because it is dependent upon researcher selectivity) there is a diversity of methods that can be used including: simulation, programming language research, database design, information systems research, conceptual modelling and software engineering (Booch, 1991: 34). Simulation via the use of artificial intelligence (i.e., computer software such as NetLogo) is the chosen method through which the extended conceptualisation and reformulation of agent behaviour will be implemented (undertaken in Chapter 7 and 8). The following section briefly introduces and discusses the system of OO model construction.
5.2.2 Model Construction

A model is "a compact representation of a real phenomenon which can generate a behaviour comparable with some behaviour of interest in the real system and moreover, a vehicle to make more evident key characteristics of an object under study" (Elzas, Oren and Zeigler, 1986: 6). Model construction and comprehension is therefore about formalising and constructing an executable model of some reality (Edwards, 1992: 18), and comparing the results obtained therein to those present in reality.

This model development process (i.e., model construction and comprehension) involves the stages of:

1. **Problem Perception**: to develop a conception of what one expects to find as a solution. A review of the literature ascertained the existence of a problem within the Agency literature, i.e., the limited and simplistic assumptions upon which agent behaviour are based (refer to Chapter 2).

2. **Model Conceptualisations**: to use this conception to guide one in seeking, selecting and assign meaning to facts. An extended conceptualisation and reformulation of agent behaviour was ascertained (refer to Chapter 2 and 3) and will be further specified as the research progresses (refer to Chapter 6) to assist in the understanding of agent behaviour.

3. **Model Implementation**: to continually develop new, more adequate conceptions as problem solution proceeds (Edwards, 1992: 17; Elzas, Oren and Zeigler, 1986: 4). This involves the use of simulation, which seeks to provide a more informed understanding of agent behaviour, the principal-agent problem and agency relationships (refer to Chapter 7 and 8).
Chapter 5: Research Methodology and the Object Orientated (OO) Approach

Such a process is recursive in its pathways and iterative in terms of the development of specifics. It is a formal description of the approach that human beings follow in the process of discovery. As such it is not rigid in its use of complex processes, but rather is creative and intuitive in nature, representing the exploratory nature of the model construction process. A formal description and depiction of this modelling process is presented in Appendix 2 section A2.1.

In terms of the six research domains (centred around the distinct types of research activity discussed in section 5.2.1), the OO Approach serves as a communications link bridging the various domains. An approach is a process of discovery as is the process of moving between pure and applied research. This is illustrated in Table 5.2 below. A good approach can be seen as articulating “well” between the various domains. A general approach articulates between all. Effective articulation involves appropriate points of contact, consistent linking and coherent interfacing. What the OO approach does through its bridge like structure is to help incorporate elements of both pure and applied research and all elements of orientation, through which a better articulation of the principal-agent relationship is possible. The details of which are presented in Table 5.2.
Table 5.2 - Positioning a Methodology Between Research Domains

<table>
<thead>
<tr>
<th>Orientation</th>
<th>Exploratory of Ideas</th>
<th>Testing Out Ideas as Formed and Linked</th>
<th>Problem solving</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pure Research</strong></td>
<td>Developing more general <strong>concepts</strong> and articulating embedded assumptions (i.e., reconceptualising generally self-interested rationalist agent and socio-environmental rationalist agent)</td>
<td>Critically developing general <strong>formulations</strong> (i.e., formulating the conception and expressing the socio-environmental rationalist agent)</td>
<td><strong>Simulations</strong> of potential (types of) behaviour and outcomes (i.e., performing a general simulation of the socio-environmental rationalist agent)</td>
</tr>
<tr>
<td><strong>Object-Oriented (OO) Approach</strong></td>
<td><strong>Object-Oriented (OO) Approach</strong> to act as a bridge, consistently linking the various aspects of the research through a suite of methods. (i.e., developing and detailing an approach in its various manifestations)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Applied Research</strong></td>
<td>(i.e., application of reconceptualisation) Specifying particular <strong>articulations</strong> of the case situation and their applicability to the reconceptualised agent behaviour</td>
<td>(i.e., application of reformulation) Trying alternative <strong>specifications</strong> of the case situation to the reformulated agent behaviour</td>
<td>(i.e., evaluating a particular simulation) Analytically using the applied <strong>case</strong> situation to determine applicability</td>
</tr>
</tbody>
</table>

Source: Table 5.1


Chapter 5: Research Methodology and the Object Orientated (OO) Approach

5.3 Simulation

Simulation modelling involves constructing a dynamic model of a real system for the purpose of experimentation (Edwards, 1992: 45). Simulation is usually employed when experimentation with the real system is impossible (Neelamkavil (1987)). For example, there may be difficulty in absorbing and communicating facts, theories and other knowledge to the "brain" of a general problem solver, and there may be problems in communicating the resulting conclusions back to the end users (Elzas, Oren and Zeigler, 1986: 5). An artificial model of the real system is thus constructed for experimentation, and the results obtained therein are used to obtain an applied understanding of the real system. The research is thus also experimental in nature as the data is generated by a computational system through simulation.

5.3.1 Simulation of Agency

Experimentation with the real system of agent behaviour within the principal-agent relationship is quite complex. It would be, for example, difficult to incorporate both the influences of the internal environment (e.g., an agent’s perceptions and beliefs) and the external environment (i.e., institutional affiliations and interactions) upon the agent in a realistic manner due to the sheer complexity of the inter-relationship and the inability of quantifying the influence upon the inter-relationship.

Fortunately, through simulation it is possible to isolate a "micro-world" out of the larger set of knowledge. In such a micro-world, knowledge about a clearly limited subject area can be isolated from other more general knowledge and reasoning strategies (Elzas, Oren and Zeigler, 1986: 5). Such models often exhibit properties that are strikingly similar to the actual social world, e.g., cooperation, social norms, and social stratification into different classes, and provide a unique window into understanding such phenomena (Gilbert and Troitzsch (1999)). A separability assumption is then present. It is important, therefore, that the simulation model accurately reflects those factors in the real system of interest to the experimenter (Edwards, 1992: 45).
Chapter 5: Research Methodology and the Object Orientated (OO) Approach

The need to mould the simulation model to the real system may, however, have inadvertently created differences in the type of simulations that are and can be carried out. These can best be clarified by using a combination of the functions of goals for simulation studies (Elzas, Oren and Zeigler, 1986: 7). Elzas, Oren and Zeigler (1986) suggest two main classifications. The first involves the extent of reference to the real system, and the second involves classification on the basis of functions. Six classes then result and these are listed below.

1. Simulation without requiring knowledge about the structure of the real system:
   a. Understanding by imitation (Mimicry-mode),
   b. Generating adequate behaviour based on whatever suitable principle one can find (Generative-mode), or
   c. Testing theories based on analogies (Theory-mode).

2. Simulation requiring some knowledge of the structure of the real system:
   a. Compute behaviour based on input data (Analysis-mode),
   b. Identify structure based on I/O trajectory pairs (Synthesis-mode), or
   c. Prescribe necessary input trajectory for required behaviour (Control-mode).

The first group has a more pure focus while the second is more applied suggesting a match between this specification of a ‘simulation model’ and the six research domains previously identified.

The simulation experience has mainly been concentrated in Class 1 (Elzas, Oren and Zeigler, 1986: 7). That is, the simulated data come from a rigorously specified set of assumptions regarding an actual or proposed system of interest rather than direct measurements of the real world (Axtell (2005)). In recent years, however, the focus of simulation has shifted from being concentrated on theoretical confirmation to prediction and evaluation (Gilbert and Terna (1999)). This has become increasingly so with the ongoing developments in simulation (Tesfatsion (2005))
In recent years the use of simulation as a research tool has grown exponentially, particularly in the social sciences and business field (Gilbert and Terna, 1999: 5). Simulation as a research tool is no longer solely a tool for scientific exploration. An expansive community has developed examining Agent-Based Computational Economics (ACE) (Tesfatsion (2005); Gilbert and Troitzsch (1999)). This growth in simulation within the social sciences has been for two reasons. First, there has been the development of agent-based simulations (Gilbert and Terna, 1999: 5). Second, the value of computer programs as models for discovery, understanding and formalisation has been better appreciated (Gilbert and Terna, 1999: 5). Using simulation methods, previously inaccessible, yet fundamental, questions are now becoming amenable to analysis through controlled computational experiments (Tesfatsion (2005); Axtell (2005); Gilbert and Troitzsch (1999)).

For this particular study a Class 2a simulation procedure, an analysis-mode, will be adopted. To be able to extend the conceptualisation of the agent behaviour there will need to be some knowledge of the structure of the real system, i.e., some understanding as to how the agent will interact with and within its environment. Considering that the study will incorporate the influence of the context of the agency relationship the analysis-mode (i.e., computing behaviour based on input data) of simulation is deemed to be appropriate. In order to reach such a level of simulation, however, simulation procedures 1a through to 1c need to be performed as a prerequisite to the simulation procedure 2a, i.e., how can a computed behaviour be applied without an understanding, generation or testing of that behaviour on its own assumptions or fundamentals. A general model of agent behaviour in the principal-agent relationship will, therefore, be simulated, which will then be applied to a specific case and hence, denoting a pure and applied research approach.

By developing models of the real world and simulating the real world under different experimental conditions, and after validation of the simulated model, the researcher may infer not only about the behaviour but also about the structure of the real system.
The agency relationship is a state of the real world that will be portrayed through the process of simulation. The context of the relationship will be manipulated to explore and infer about agent behaviour in the relationship and the contextual influence itself. This analysis will be conducted through the use of artificial intelligence.

5.3.2 Artificial Intelligence (AI)

Artificial intelligence is a branch of computer science that is concerned with trying to model knowledge through a programmable machine to ‘behave intelligently’ (Elzas, Oren and Zeigler, 1986: 3). The field is closely related to conceptual modelling and simulation in trying to derive fundamental conceptual structures from which computer implementations can be developed (Edwards, 1992: 49). A major part of this area of research is concerned with knowledge representations and computer representations of that knowledge (Edwards, 1992: 49). Artificial intelligence is thus a form of computational modelling. Computational modelling, involves representing a model as a computer program (Gilbert and Terna, 1999: 3). Computer programs can be used to model either quantitative theories or qualitative ones (Gilbert and Terna, 1999: 3). The logic entailed in doing so is not very different from the logic used for the more familiar statistical models (Gilbert and Terna, 1999: 3).

There are a number of software tools available in specific domains to cover the entire process of model comprehension and construction, for example Elklogic in the domain of Ecology, Borland’s JBuilder, InteRAD’s build-IT 3.1, Santa Fe Institute’s Swarm 2.1.1 and other simulation packages in the domain of simulation models (Edwards, 1992: 18). The chosen software package for this research is NetLogo, which is introduced in Chapter 7.

Artificial intelligence is chosen to simulate agent behaviour in a principal-agent relationship. This can support analysis and understanding via the use of several system components, including a (Elzas, Oren and Zeigler, 1986: 15):
a. **Query System**: with which the socio-environmental rationalist agent (SERA) could be queried about its behaviour, and about its properties with reference to a specific problem.

b. **Modelling System**: within which facilities are offered to help create models for a specific agency problem in an already known domain. This provides an ability to apply the model across cases. A model processing facility that allows symbolic manipulation of models to suit the context is present.

c. **Behaviour Processing System**: within which behaviour display and analysis can be facilitated for an agent in a principal-agent relationship.

Consider for example a scenario where the artificial intelligence system is constructed to "know about" a class of objects, or relations within the agency relationship/model, and has an internal representation for the class which enables it to operate on objects in this class and to communicate with others about such operations. An artificial intelligence system knowing about the decomposition of the system just discussed would have to have a scheme for representing decompositions of the type employed in designing the program (Elzas, Oren and Zeigler, 1986: 16). It would be able to accept a description of such a decomposition, generate its own internal representation of it, change this internal representation when receiving new information about the decomposition, and answer questions about the decomposition (Elzas, Oren and Zeigler, 1986: 16). Hence, this would enable the modelling of the agent behaviour in different contexts and in effect analyse the behaviour of an agent.

Simulation within artificial intelligence, therefore, begins with a graphical representation of a formal object-orientated specification language for conceptual modelling purposes (as demonstrated in Appendix 2 section A2.1). After having defined a finite set of behavioural patterns through this process, a mapping from these patterns to software components in a given software development environment is undertaken. Once all the relevant system information has been inputted, data can be manipulated and the applied workings of the agent behaviour in a principal-agent relationship can be investigated.
Chapter 5: Research Methodology and the Object Orientated (OO) Approach

The question now is what to simulate. NetLogo simulation software will be used to simulate two cases:

1. A general case, a principal-agent relationship (a single object case), and
2. A specific case, the EU financial accounting harmonisation process (a multiple object case).

The simulation of the general case will be used to exemplify the extended conceptualisation and to test the reformulation of agent behaviour in a more theoretical situation with particular attention to the influences of institutional differences in micro-level agent behaviour in agency relationships. This will involve a simulation of SERA against the workings of the existing conceptualisation and formulation in Agency theory, i.e., SIR.

The specific simulation, on the other hand, will be to apply the extended conceptualisation and reformulation of agent behaviour to a specific case. This specific case relates to the EU financial accounting harmonisation process, a case of a dual party multi-agent principal-agent relationship (as demonstrated in Chapter 4). It will examine macro behaviour. That is, it will determine whether the behaviours exhibited at the micro level are exhibited and transmitted in joint interaction. The following section will now discuss the reasons for using case analysis for the specific simulation as a method of analysis.
5.4 Method of Analysis: Qualitative Case Research

There are two basic methods of analysis in research, and these are: quantitative research techniques, and qualitative research techniques (Ticehurst and Veal (1999); Patton (1990)). A review of the Agency literature to date has indicated that a quantitative approach is commonly adopted and still applied despite the limited success of a large portion of the research to replicate the initial formulations of Agency theory. A qualitative approach is thus chosen to undertake this research, and this is the qualitative research technique of case studies.

5.4.1 Case Methods

Benbasat, Goldstein and Mead (1987) demonstrated that the goals of the researcher and the nature of the research topic influence the selection of the method. Case research is particularly appropriate for certain types of problems: those which research and theory are at their early formative stages, and "sticky, practiced problems where the experiences of the indictors are important and the context of action is critical" (Benbasat, Goldstein and Mead, 1987: 369). Bonoma (1985: 27) also supports this notion in arguing that case-study research is suitable where a phenomenon is broad and complex, where the existing body of knowledge is insufficient to permit the posing of causal questions and when a phenomenon cannot be studied outside the context in which it occurs. A review of the Agency literature has demonstrated that this is certainly the case. Agency theory is yet in its early stages, its infancy with the context of the agency relationship yet to be examined.

There are three reasons why the extended conceptualisation and reformulation of agent behaviour in agency relationships will be applied to a case. These are as follows:

1. The research can be conducted in a natural setting, i.e., in the context of its occurrence, this is necessary to develop and expand the existing research in agency (Yin (1994). After all, case study research is concerned with describing
real world phenomena rather than developing normative decision models (Perry, 1998: 787).

2. The case method allows the researcher to answer "how" and "why" questions, that is, understand the nature and complexity of the processes taking place, i.e., the nature of the exchange between the parties of agency relationship (Yin (1994)). The goal is to obtain a rich set of data surrounding the specific research issue, as well as capturing the contextual complexity.

3. A case approach is an appropriate way to research an area in which few previous studies have been carried out or where there is an aspect of the research that is yet to be exploited or where the research phenomena is not supported by a strong theoretical case, and this is the case with agency and its context of subsistence ((Yin 1994)).

Table 5.3 contains a list of additional characteristics exhibited by case study research, which also prove to be useful and suitable for examining the context of agency. Use of a case is thus appropriate in the present study.

<table>
<thead>
<tr>
<th>Table 5.3 - Key Characteristics of Case Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Phenomenon is examined in a natural setting.</td>
</tr>
<tr>
<td>2. Data are collected by multiple means.</td>
</tr>
<tr>
<td>3. One or few entities (person, group, or organization) are examined.</td>
</tr>
<tr>
<td>4. The complexity of the unit is studied intensively.</td>
</tr>
<tr>
<td>5. Case studies are more suitable for exploration, classification and hypothesis development stages of the knowledge building process; the investigator should have a receptive attitude towards exploration.</td>
</tr>
<tr>
<td>6. No experimental controls or manipulation are involved.</td>
</tr>
<tr>
<td>7. The investigator may not specify the set of independent and dependent variables in advance.</td>
</tr>
<tr>
<td>8. The results derived depend heavily on the integrative powers of the investigator.</td>
</tr>
<tr>
<td>9. Changes in site selection and data collection methods could take place as the investigator develops new hypotheses.</td>
</tr>
<tr>
<td>10. Case research is useful in the study of 'why' and 'how' questions because these deal with operational links to be traced over time rather than with frequency or incidence.</td>
</tr>
<tr>
<td>11. The focus is on contemporary events.</td>
</tr>
</tbody>
</table>

The goal of data collection in case research is not quantification or even enumeration but rather (1) description, (2) classification (typology development), (3) theory development, and (4) limited theory testing (Bonoma, 1985: 206; Yin (1994)). In a few words, the goal is understanding that the breadth or representativeness of large-n research is not of focal importance, but rather the depth of the examination. The risks of low data integrity are traded for the currency and contextual richness of what is learned. Once researchers are confident of their understanding of phenomenon explored with case research, other and more deductive approaches may be applied to the problem if enough theory has been developed to allow them. This presents opportunities for future research (Bonoma, 1985: 206).

5.4.2 Validity of Simulation and Case Research

There is an extensive range of techniques/methods available for research. Figure 5.1 below positions various research methods and a few illustrative knowledge-acrual devices within a two-dimensional space. The axes of the figure are defined in terms of two primary objectives of research. The vertical axis, labelled ‘data integrity’, refers to those characteristics of research that affect error and bias in research results (Bonoma, 1985: 200). It is an amalgam of what is variously referred to as ‘internal validity’ (Campbell and Stanley 1963), ‘statistical conclusion validity’ (Cook and Campbell 1979), and ‘reliability’ (Guilford 1954, Sellitz et al. 1959). The horizontal axis, labelled ‘currency’ uses that term in the sense of ‘has currency’, and pertains to generalisability of results (Bonoma, 1985: 200). Specifically, it refers to the characteristics of research that affect the contextual relevance of findings across measures, methods, persons, settings, and time (Bonoma, 1985: 200). It is an amalgam of what is variously termed ‘external validity’ (Cook and Campbell 1979, Cronbach and Meehl 1955) and ‘pragmatic’ or ‘ecological validity’ (Brunswik 1952, Sellitz et al. 1959).
Figure 5.1 - A Knowledge-Accrual Triangle

This figure is not available online. Please consult the hardcopy thesis available from the QUT Library.

Source: Bonoma, 1985: 200

Figure 5.1 suggests that when researchers make methods’ choices they often must trade one desideratum of research for another. For example, a study which seeks a high degree of data integrity requires a precise operationalisation of the research variables, a relatively large sample size and quantitative data for statistical power, and the ability to exercise control over persons, settings, and other factors to prevent causal contamination (Bonomo, 1985: 200). In contrast, a study which seeks high currency typically demands situationally unconstrained operationalisations of variables to allow cross-setting generalisation, and observations within natural, ecologically valid settings - ‘noisy’ settings - where large samples, quantitative measures, and control are more difficult to achieve (Bonomo, 1985: 200). According to Bonoma (1985) a researcher can simultaneously pursue high levels of data validity and generalisability by adopting triangulation strategies which provide replication and/or corroboration of findings across methods within a single research project. For
example, by applying case research to simulation it is possible to pursue a higher level of generalisability (currency) through the in-depth study of a phenomenon from multiple perspectives, approaches and data (i.e. qualitative and quantitative data) (Benbasat, Goldstein and Mead, 1987: 370). Simulation of the extended conceptualisation and reformulation of agent behaviour in a case setting can, therefore, provide a deeper understanding, a fuller contextual sense of the phenomena under study, and also an explicit provocation toward theory building.

It is also important to note that the different types of studies engage research tensions differently (Bonoma, 1985: 201). One common listing of the points along the research continuum might be: description, classification, comparison, measurement/estimation, establishing association, and determining cause and effect (Bonoma, 1985: 201). In this sense, studies toward the description end of the continuum might be associated more frequently with theory building and hence are qualitative (as is the case with this research), whereas those near the cause-and-effect end are more frequently used for theory disconfirmation and hence are quantitative (Bonoma, 1985: 201).

However, when researchers' interests or phenomenon requirements dictate theory building rather than verification or extension, the tasks of description, classification, and comparison become relevant (Bonoma, 1985: 201), as is the case with this research. Then methods oriented toward the lower-right apex of Figure 5.1 may be more appropriate and efficient than others. Case research, for example, is then more appropriate than surveys. If simulation is applied in a case setting, research by this method can provide a deeper understanding, a fuller contextual sense of the phenomena under study, and also an explicit provocation toward theory building. This is often missing from both simple descriptive work and most cause-and-effect research (van Maanen 1982).

Once sufficient basis and understanding has been obtained it is then appropriate to move up the hierarchy of study types toward causal confirmation and/or to use other methods from the upper-left apex of Figure 5.1, such as simulation. In this research, simulation will be undertaken to test the workings of the extended conceptualisation
and reformulation of agent behaviour in agency relationships; a novel theory that
developed out of the limited success of the existing conceptualisation and formulation
of agent behaviour in traditional Agency theory.

5.4.3 The Case Research Process

When case development is undertaken for research purposes, Bonoma (1985)
suggests the use of a theory/data/theory revision cycle. Theory reflects into data
analysis which reflects back into theory, and so on in a recursive manner.
Accompanying this case research protocol is a four-stage process constructed to guide
and explain qualitative applications of case method in research. The four stages in the
process are labelled drift, design, prediction, and disconfirmation (Bonoma, 1985:
204; refer to Figure 5.2). Only the first two stages have been used for the current
study. The last two which relate more to hypothesis-testing will be used in future
research.

Figure 5.2 - A Process Model for Case

This figure is not available online.
Please consult the hardcopy thesis
available from the QUT Library

Source: Bonoma, 1985: 205
Regardless of the research objective, in the beginning stages of case research the investigator and the investigation are in the drift mode (Bonoma, 1985: 204). This *drift stage* consists of the investigator's attempts to learn the concepts, locale, and jargon of the phenomenon as it occurs ‘in the field’, and to begin preliminary integration from literature, a priori notions about the phenomenon's operation, and critical components of practice as observed (Bonoma, 1985: 204). This is a "soaking in" stage in which contexts are observed to get a better perspective on modifications necessary to the basic research question in order to ensure fruitful investigation (van Maanen 1982). With respect to the current research this relates to the review of the existing literature, in which the concepts and jargon are being learnt and the context of the agency relationship is being examined.

The drift stage becomes the *design stage* with the development of a tentative explanation of the divergent observations so far collected (Bonoma, 1985: 205). For this study this will be development of a tentative object-model of the extended conceptualisation and reformulation of agent behaviour in agency relationships. In the design stage, the object of data collection is to assess and refine major areas of inquiry suggested by the preliminary model (Bonoma, 1985: 205). In other words, the design stage is one of ‘fleshing out’ a beginning conceptualisation of events. The critical skill for the researcher at this point is to be willing to let further data ‘recycle’ his/her thinking back to the drift stage if beginning conceptualisations do not hold up against new situations or as better conceptualisations suggest themselves (Bonoma, 1985: 205). Simulation of agent behaviours in different contexts is the design project. A working operationalisation will be achieved via the use of artificial intelligence. Simulation across multiple cases will enable an evaluation of the extended conceptualisation and reformulation of agency.
5.4.4 Case Selection

When the research is highly exploratory, a single case may be useful as a pilot study. The goal will then be to determine the appropriate unit and familiarize the researcher with the phenomenon in its context (Benbasat, Goldstein and Mead, 1987: 373). Single-case study projects are most useful at the outset of theory generation and late in theory testing (Benbasat, Goldstein and Mead, 1987: 373). A general case of a principal-agent relationship will, therefore, be simulated at the outset to test the workings of the extended conceptualisation and reformulation of agent behaviour in agency relationships.

A single case for exploration may, however, be followed by a multiple-case study further strengthening theory formation and testing. They are desirable when the intent of the research is description, and further theory building, or theory testing (Benbasat, Goldstein and Mead, 1987: 373). Thus, it is appropriate to also adopt a multiple-case design for this study, which would also allow for cross-case analysis. The comparison between cases enables an in-depth examination and test of the theory in differing contexts. In this research the multiple-case involves the EU case of financial accounting harmonisation. The multiple cases are of member nations (multiple-agents) in their differing accounting contexts.

The simulation of this multiple-case will enable an in-depth test of the model of extended conceptualisation and reformulation of agent behaviour from multiple perspectives, approaches and data. The data to be utilised in this application process will consist of secondary data, which may exhibit both quantitative and qualitative characteristics. Examples of data that will be utilised in the application process include: legal standards and requirements, parliamentarian debates, speeches written agreements (refer to Chapter 4 section 4.4 and 4.5, and Chapter 6 section 6.6). Results generated from the simulation, i.e., simulation data, as a result of the data imputed above will also constitute research data. Results obtained from the simulation will be both visual and quantitative, in nature and are examined further in Chapter 7 and 8.
5.5 Limitations of Methodology

The methodology to be used within this research, like all methodologies, possesses some limitations. Firstly, a limitation of this research rests with the particular methodology adopted (i.e., OO methodology) and the method of analysis to be used. It represents a significant departure from the traditional research method used within the existing Agency theory. The study is itself an exploratory one in this direction. When such a departure from current knowledge (before the dimensionality of the problem and the major variables can be defined) is undertaken, positivism and mathematics seems to be limited in ability in solving these problems (Jensen, 1983: 25). By its nature, much institutional evidence (the pivotal component of the research) cannot be summarized by measures using real numbers (Jensen, 1983: 23). Institutional evidence consists of non-commensurable items which have no known formal weight and thus cannot be simply counted or added up (Jensen, 1983: 17). In addition, the use of mathematics does not prevent the commission of errors, even egregious ones (Jensen, 1983: 17). Propositions can be logically rigorous without being mathematical, and analysis does not have to take the form of symbols and equations (Jensen, 1983: 17). The English sentence and paragraph will do quite well for many analytical purposes (Jensen, 1983: 17). While such a methodology is not commonly employed in Agency research it appears to present its benefits given the areas of the research.

The use of an OO methodology has implied that no empirical data will be collected and hence, no empirical data will be analysed. Instead the data to be analysed will be based on results obtained from a simulation, modelled and conceptualised by the researcher, which may introduce bias. The simulation undertaken will be based on the researcher’s understanding of the theory, their process of conceptualisation and formulation, and their choice of objects for analysis. In other words, the data to be simulated will be compiled by the researcher and not from some external source, which will be demonstrated in Chapter 6 in sections 6.7 and 6.8. This may affect the validity and reliability of the study and any results obtained. Undertaking a comprehensive literature review where all resources are exhausted in their entirety,
and through seeking the advice of other researchers and experts will ensure that these effects are minimised as and is possible.

Criticism may also arise as to the use of simulation data which is derived from non-empirical data. How well will this reflect reality? The data obtained in the initial simulation will compliment the data obtained from the simulation of a multi-case. The extended conceptualisation and reformulation of agent behaviour will be applied to a real case scenario (i.e., the EU case of financial accounting harmonisation) and then simulated. The results obtained from this case simulation will be compared to the case’s actual present day situation as a source of evaluation. These results also provide the grounding for the research to which some form of external data is incorporated. The comparison of the results obtained from the simulated cases with the results in the existing theory of Agency provides additional evidence, which can be used to triangulate the external validity of the research (Perry, 1998: 786). It is important to note that this study is a conceptual study with an extended case application to which empirical data plays a relatively minor role. This limitation thus is of minimal concern at this stage, and will be addressed in future research.

While the extended conceptualisation and reformulation of agent behaviour is only being applied to a single area of investigation (i.e., the EU). This is not necessarily a limitation. Representativeness to the population is not the goal of the research (as is in statistical analysis). Analytical generalization is (Stake, 1994). The investigator is striving to generalise a particular set of results to a broader theory (Yin, 1994, p. 36), rather than to a population. To generalise to a theory is to provide some evidence that supports a theory but not necessarily proves it definitively (Firestone, 1993; Perry, 1998: 790). The selection of cases is purposeful and involves using replication logic and largely depends on the conceptual framework developed from prior theory. Whatever the case selection strategy and basis\textsuperscript{2} used, the underlying principle that is common to all of these strategies is selecting information rich cases, that is, cases

\begin{itemize}
  \item[1.] Predicts similar results for predictable reasons (that is, literal replication); or
  \item[2.] Produces contrary results for predictable reasons (that is, theoretical replication) (Yin, 1994; Perry, 1998: 792).
\end{itemize}

The former method (i.e., theoretical replication) is the method of case selection chosen in this research to confirm the validity of the extended conceptualisation and formulation of agent behaviour.
worthy of in-depth study (Patton, 1990: 181; Perry, 1998: 793). Such is the EU case, which represents one case with multiple embedded cases for investigation and analysis. These multiple cases will allow cross-case analysis for richer theory building (Perry, 1998: 792).

Lastly, while simulation provides many advantages over traditional experimental methods, they also have several problems. In particular, the actual process of writing simulation is a complicated technical task with much room for error. Ultimately, the use of artificial intelligence for simulation requires the researcher to have some understanding of computer programming. Even if this is achieved, custom-built simulations tend to be very specific, a dense tangle of code that is understandable only to those who wrote it (Minar, Burkhart, Langton and Askenazi, 1996: 2). Simulation software contains a large number of implicit assumptions. Accidents in the way the particular code is written (researcher error) that have nothing to do with the actual model could also substantially affect the results of the study (Minar, Burkhart, Langton and Askenazi, 1996: 3). The use of a standardised technique, a description of the process in detail, and repeats of all simulations performed will ensure that researcher error is kept to a bare minimum.

Alternative avenues of research will be explored as a part of future research, where the extended conceptualisation and reformulation of agent behaviour can be subject to empirical investigation. Whenever it is feasible, it is desirable to obtain quantitative predictions of a form amenable to the usual testing procedures (Jensen, 1983: 23).
5.6 Conclusion

The goals and the objectives of this research neither replicate nor are identical to that of the existing research in agency. Consequently, this has informed the selection of a non-traditional research methodology and technique (non-traditional in comparison to that used in the existing research) for this research. This methodology is experimental in nature and utilises the Object-Orientated (OO) Approach.

The focus of an OO methodology is the object of the research, that is, the agent. It is through developing a model of the extended conceptualisation and reformulation of agent behaviour in an agency relationship and then, simulating it using artificial intelligence techniques that a more informed understanding of agent behaviour, the principal-agent problem and the agency relationship may be obtained.

This research is, thus, a conceptual study seeking to demonstrate its workings through case application. The cases to be simulated are a general principal-agent relationship (a single case with comparisons of the current and suggested agent formulations), and a specific case (the EU financial accounting harmonisation process, a case with multiple instances).
Chapter 6: Formulating the Agent

6. Formulating the Agent

This chapter addresses the question of how to utilise an OO approach to develop a framework that models the extended conceptualisation and reformulation of agent behaviour. The goal in this Chapter is to design an agent that includes an explicit model of structured and rational actions. Previous chapters have examined Agency theory and have extended the conceptualisation of agent behaviour to a socio-environmental rationalist form. In order to apply this conceptualisation a general reformulation of the transacting process was described with more traditional formulations viewed as being insufficient to the designs of the extended conceptualisation of agent behaviour (SERA). A further formulation describing the transacting process in greater detail is now necessary (as was discussed in the conclusion to Chapter 4). By the end of this Chapter a detailed multi-part case formulation within the socio-environmental rationalist agent (SERA) framework will have been discussed and detailed. Simulations based on this are the focus of Chapters following.

6.1 Agent Design

There is no universal definition of the term agent, and there are currently many notions of agency (as discussed in sections 2.2.1 and Wooldridge and Jennings 1995; Shoham and Tennenholtz, 1995: 608). People or individuals are often considered as agents. However, it can be beneficial to view other entities such as corporations, national governments, associations (such as the EU Commission) or computer systems, as agents as well, as long as similar concepts can be fruitfully used to analyse their past and future behaviour (Traum, 1997: 2). The concept of ‘agent’ has wide applicability.

---

1 As discussed in Chapters 2 and 3, traditional formulations view the transacting process as an asymmetric (informed by information asymmetry) mutually dependent form where agent behaviour, if not constrained by contractual restrictions and rewards, is informed by self-interested rationalism (refer to Chapter 2).
For example, in computer systems theory, an agent is a computer system situated in a particular environment capable of autonomous action in this environment in order to meet its design objectives (Luck, 2002: 3; Romano and Merelli, 2002: 19; Wooldridge and Jennings 1995; Traum 1997; Wooldridge, 2002: 15). This is in agreement with the approach in the business literature. Hence, an agent is also autonomous and thus, is able to perform those activities that maximise its own utility. Utility is similar to the agent’s design objectives in computer systems theory.

In both literatures an agent is situated in an environment. This environment in the business literature is, however, commonly assumed to be static, something of a vacuum immune from external forces (as discussed in Chapter 3, section 3.3.1). Theoretical investigation has demonstrated that agents do not operate in isolation; they are situated in dynamic environments (section 3.3.2 and Wooldridge and Parsons, 1999: 4). A SERA is influenced by their environment, and thus is through their institutional affiliations and interactions. An agent is thus seen as a mixed entity with its own attributes apart from the environment and those that it shares collectively with the environment. How can SERA be designed to incorporate the influential nature of institutional affiliation and interaction in supporting, directing, assisting and constraining agent behaviour while also ‘appropriately’ maintaining its own attributes? Such a question can be interpreted in various ways, and ‘appropriately’ involves interpretation. As a general question it has challenged humanity for millennia. A much less ambitious goal is set here. How can a socio-environmental rational decision making process be structured and segmented both as a formulation in its own right and as a basis for operational development. This is the design challenge.

In designing the socio-environmental rationalist agent several steps will be used that incorporate the agent’s properties with those that are collectively shared with the environment. These steps include:

1. **Stratifying** the agent: breaking it up into different layers appropriate to some constructor-envisaged usage. For example, when determining how the agent reasons over its actions, stratification is of the agent as a BDI (Beliefs-Desires-Intentions) set. Influences by institutional affiliation and interaction, for example, are allocated to whether they relate to envisaging (beliefs), wanting and choosing
goals (desires), or acting towards goals (intentions). Each is in turn is a filter and a focus. This is examined in section 6.2 for the single agent and in section 6.5 for multiple agents.

2. **Structuring** the agent: setting up durable parts of the agent, each part having a nominated role. There is an apportionment in accord with the prior stratifying. As discussed in section 6.2 and earlier, these are the four internal processes of practical reasoning: perception, deliberation, reaction and communication. The external processes involve the agent’s interaction with their principal and recursive interaction with institutions as demonstrated in Figure 6.5 and Figure 3.5 earlier.

3. **Sequencing** the agent: establishing an order of presences of each part of the structure and its relation to the others. Linkages are made explicit in the practical reasoning process, as detailed in sections 6.2 to 6.4.

4. **Selecting** within the agent sequences: usage is made of linkages with flows envisaged and effects consequent. This is the causal or coincidental choice, of what leads to what (and sometimes in what quantities) based upon an assumption of durable linkage (‘always’ go together) or happenstance correspondence (‘this time’ they were both coincident). This is developed in section 6.4 and applied throughout sections 6.5 and 6.6.

5. **Simulating** the agent: the flows and like interactions are allowed to run to some completion. Examined in section 6.7 and 6.8.

6. **Solving** the agent: the final state is compared with the initial (in comparative statics) or otherwise evaluated with key ‘new’ attributes denominated and discussed. The ‘solution’ has arisen from successive selections. A ‘successful’ solution requires ‘good correspondence’ between the modelled and observed states. Examined in section 6.7 and 6.8.

Thus, the agent is designed through several abstracted steps. The Belief-Desire-Intention (BDI) model of rational action forms a central component of this abstraction. The BDI model is the stratum upon which behaviour and actions are cast, ‘decided’, and resolved.
6.2 A Belief-Desire-Intention (BDI) Model of Rational Action

The BDI theory of human rational action was originally developed by Michael Bratman in 1987 (Wooldridge, 2000: 7). It is a theory of practical reasoning\(^2\), which initially focused on the role that intentions play on such reasoning. Since its introduction Bratman and others who have adopted it have expanded its focus to a tripartite mental model that applies the cognitive notions of beliefs (involving information that the agent has and receives about its environment), desires (states that the agent wants to achieve) and intentions (commitments for the states the agent will try to achieve) (Bratman, Israel and Pollack 1988, Pollack 1992, Georgeff et al. 1998). The name the Beliefs-Desires-Intentions (BDI) Model’ follows (Freedman, 2000: 2). Wooldridge and Jennings (1995) note that beliefs are then informational attitudes while desires and intentions are pro-attitudes. A further brief account of their meanings, relativity and importance is presented in Appendix 3 section A3.1. In essence, Bratman’s (1987) theory of practical reasoning fostered the development of the BDI Model (Wooldridge and Parsons, 1999: 1).

6.2.1 The Theory of Practical Reasoning

Practical reasoning is reasoning directed towards informed actions, the process of figuring out what to do (Wooldridge, 2002: 65). Practical reasoning involves an intricate process and appears to consist of at least two distinct sets of activities. The first of these involves deciding what state of affairs an individual wants to achieve, and is termed deliberation (Wooldridge, 2000: 21; Wooldridge, 2002: 66). Here the agent continually executes a cycle of observing the world. A process of perception is interlinked with deciding what intention to achieve (Wooldridge, 2000: 26). This perception of the world strongly influences the individual’s beliefs, desires and intentions, which informs the deliberation process as to what state of affairs to achieve. The second process involves deciding how an individual will achieve these states of affairs, and is termed means-ends reasoning (Wooldridge, 2000: 21). It is a

\(^2\)Bratman (1987) uses the term “practical reasoning” to describe how humans reason about practical matters to determine what actions should be executed to pursue some goal (Van Eck and Wieringa, 2001: 8). This is of great relevance to Agency theory and this research given that both examine the motivations underlying agent behaviour in ‘practical’ situations.
process of reaction to the agent’s initial perceptions. The end result of which is a plan that communicates how the agent’s desired state of affairs will be achieved (Wooldridge, 2000: 22; Wooldridge, 2002: 66). The agent will then attempt to execute the plan, in order to bring about the chosen state of affairs (Wooldridge, 2002: 66). Figure 6.1 formulates and depicts this entire, basic process of practical reasoning. Deliberation is explicitly step 3 which is pre-informed by steps 1 and 2. The how is explicitly in steps 4 and 5. The Figure demonstrates the crucial role that BDI plays in conveying the perceptual influence received from the environment through to resolve and finally action. It is this primary influence that determines the fate of agent practical reasoning: the what and the how.

Figure 6.1 - A Sequencing Framework of Agent Practical Reasoning

```
Algorithm: Practical Reasoning Version 1
while agent true
1. observe the world;
2. update internal world model;
3. deliberate about what intention to achieve next;
4. use means-ends reasoning to get a plan for the intention;
5. execute implementation of the plan;
end while
```

Source: adapted from Wooldridge, 2000: 26

A Depiction of Agent Practical Reasoning

Source: developed from Wooldridge, 2000: 26
The processes of deliberation and means-ends reasoning are not instantaneous, there is a time cost associated with the accomplishment of each process. These processes are thus predicated on an assumption of calculative rationality. This is an assumption that the world will not change in any significant way while the agent is deciding what to do, and that the chosen action which is rational when decision making begins will be rational when it concludes (Wooldridge, 2002: 54). Given this reasoning is sound (assuming that the agent’s environment cooperates sufficiently and is sufficiently static), the set plan is executed, and the chosen state of affairs is achieved.

Such a practical reasoning process appears straightforward, and in an ideal world it might be. Such simplicity in reasoning can be used to describe the reasoning process of the agent in the traditional Agency literature. Wherein an agent’s perceptive focus is assumed to rest on notions of self-interest with the belief that the attainment and maximisation of one’s own utility is of great importance. Such a basis then informs both the processes of deliberation and means-ends reasoning. In a static environment this initial perceptive focus of self-interest would ‘adequately’ form the basis of further planning and communication. The agent then executing the plan attains the chosen state of affairs of self utility maximisation. Such is agent reasoning in the existing literature. How often agents operate in such static environments is an important question? Further clarification is, therefore, needed concerning the reasoning of agents and the state of their environment.
6.2.2 Practical Reasoning, Statism and Environmental Dynamism

Environments in the existing Agency theory are generally assumed to be accessible\(^3\), deterministic\(^4\), static (i.e. unvarying or unchanging) and discrete\(^5\) (Wooldridge, 2002: 16). Such environments are preferable for agent theorist, because in an accessible, deterministic, static and discrete environment actions and behaviour are simple to define and will always be determinable as appropriate or not. For example, an agent needs only to collect information pertaining to the environment once. Reconsideration of environmental consistency is not needed because the environment is assumed not to vary and the agent is the only source of disruption within it (Agre, 1995:8). Environmental properties thus determine the complexity of agent reasoning, and hence, the simplicity of traditional agent reasoning (such as the notion of self-interested rationalism demonstrated in section 5.3.1).

\(^3\) An accessible environment is one in which the agent can obtain complete, accurate, up-to-date information about the environment states (Wooldridge, 2002: 18). Realistic environments are not accessible in this sense.

\(^4\) A deterministic environment is one in which any action has a single guaranteed effect – there is no uncertainty about the state that will result from performing an action (Wooldridge, 2002: 18). Non-determinism is closely related to dynamism (Wooldridge, 2002: 19).

\(^5\) An environment is discrete if there are a fixed, finite number of actions and precepts in it (Wooldridge, 2002: 18). Traditional Agency theory assumes this to be so, i.e., the principal-agent relationship is a one period model, the goal is satisfied and relationship then ceases to exist (Bendor, Glazer and Hammond, 2001: 267). In a 1-period world, there can be no enforcement of contracts through a wage revision process imposed by the managerial labour market (Fama, 1980: 304). Hence, there are no avenues for the principal to seek recompense for the loss suffered from the agent’s utility maximising behaviour. Rational cooperation may, however, be possible if the principal-agent relationship is ongoing with successive rounds of interaction (Wooldridge, 2002: 118-119). If the parties know that they will be interacting with each other over a long period of play, then they are more likely to use strategies that involve offers of cooperation in the rational hope that such offers will be reciprocated, making both parties better off. This sort of cooperation is rationally based and is a reasoned response to the task environment (Jones, 1999: 317).

In the real world, many delegation issues recur. In general, repeated interaction yields the possibility of stick-and-carrot strategies of conditional cooperation. For delegation, this means that both the principal and the agent are more able to deter each other from cheating (Bendor, Glazer and Hammond, 2001: 256). As repetition may reduce the harsh separation between what is individually rational and what is collectively optimal (Bendor, Glazer and Hammond, 2001: 256). There is, therefore, the idea that delegation and decentralised effort may be maintained by long term reciprocity between principal and agent. Game theorists have constructed models of organisations populated by overlapping generations of finitely lived members to demonstrate the applicability of this notion (Bendor, Glazer and Hammond, 2001: 257). Even if the generations overlap, however, nothing can be done about players in their last period. Because they are in the End Game, they are certain to shirk. Thus, full cooperation is unattainable unless anyone shirking in later periods is punished (Bendor, Glazer and Hammond, 2001: 257).
The environment, however, is rarely ever static. Reasoning is also not always informed by such self-interest. In many practical situations uncertainty is inherently present. Complication and unpredictability form the norm (Wooldridge, 2002: 18; Beer, 1995: 188). Such a world is complex and dynamic, a place where chaos is the norm, not the exception (Georgeff, et al, 1998: 3). Environments within which agents act will be dynamic, they will not remain static long enough for an agent to determine from the first process whether an optimal course of action was undertaken given its initial beliefs, desires and intentions (Wooldridge, 2000: 28). Assumptions to the contrary are over committed to statism, never stopping to reconsider a plan and/or action until it is fully executed, even if changes occur. Given that such constancy rarely occurs in reality, agents need to be reactive to the changes in their environment. Such dynamism can affect the assumptions that underpin the approach or behaviour chosen in attaining a goal (Webber et al (1995); Wooldridge, 2002: 21).

An example can illustrate. Figure 6.2 presents a simple example of interdependence between the states of the agent and environment. The agent and its environment are depicted as a one-dimensional dynamical system (Beer, 1995: 185) in which the behaviour and interaction of an agent and its environment can be modelled in terms of the trajectories (Agre, 1995: 38). As the state of the environment ($X_E$) moves up and down, the state of the agent ($X_A$) must move back and forth accordingly so that the trajectory of the coupled system remains within the attainable behavioural space (Beer, 1995: 185). The path shows a set of linked states and a bounded range of possible combinations.
A significant fraction of behaviour, would then arise not from the agent itself (i.e., from considered self-interest), but from the ongoing interaction between an agent and its environment (Beer, 1995: 175-183). The environment has a kind of structure that makes a difference to the workings of the agent (Agre, 1995: 18). Such a view is reinforced from perceptual psychology, where Gibson proposed an ‘ecological’ theory of perception that stressed the role of the environment in forming an agent’s perceptions (Horswill, 1995: 372). Gibson argued that the structure of the environment determines a set of invariants in the energy flowing through the environment and that these invariants can be directly picked up by the perceptual apparatus of the organisms via a process akin to resonance (Horswill, 1995: 372). Environmental dynamism, therefore, needs to be incorporated into the process of practical reasoning if it is to be realistic.
6.2.3 Environmental Reconsideration

Should environmental dynamism be incorporated into the practical reasoning process it would necessitate some re-examination of the state of the world. Upon any perception of change and/or new information, this would necessitate a reconsideration of beliefs, desires and intentions (re-deliberation) in terms of this new environmental state. As a result, the plan may be revised. The plan is now sound given the agent’s re-examination of the current state of the world. If the agent determines that this revised plan is no longer appropriate in order to achieve the current intention, then the agent will once again engage in further means-ends reasoning in order to form an alternative plan (Wooldridge, 2000: 35). This revision of behaviour implies a great degree of socio-environmental reactivity. As would be expected in a social-environmental rationalist agent (SERA). This entire process is formulated and depicted in Figure 6.3. The dotted arrows labelled B3 depicts a possible point at which recursion occurs in the agent’s reasoning as result of the dynamism in the environment. This recursion continues through to the point at which the agent’s reasoning is reinformed (labelled 4* in Figure 6.3) and the plan revised (labelled 5* in Figure 6.3). It is however point 3* which assumes primary importance in determining the effect of environmental dynamism. A change in the environment may not result in a perceptual change adjusting an agent’s BDI. A partial part of the plan may thus be executed and completed only after some reconsideration; reconsideration that is not consequential to adjusting BDI. This Figure effectively demonstrates the conditional nature of the agent’s practical reasoning process. A slight change in the agent’s initial BDI is crucial to redefining the fate of agent practical reasoning: the what and the how.
Algorithm: Practical Reasoning Version 2

while agent true
1. observe the world;
2. update internal world model;
   B1 establish initial beliefs;
3. deliberate about what intention to achieve next;
   B2 reconsider beliefs;
   3* if necessary, re-deliberate the initial intention;
4. use means-ends reasoning to get a plan for the intention;
   B3 re-examine plan to ensure representation of beliefs and intentions;
   4* if necessary, re-reason the plan
5. finalise plan
   5* if sound, execute the plan;
end while

Note: B involves making beliefs explicit
* Indicates contingency or contextual reflection, that is, consideration of relevant environmental influences and states, and of changes in these.

Source: adapted from Wooldridge, 2000: 26

A Depiction of Practical Reasoning with Dynamism and Reactivity
6.2.4 Consideration of Time

Real-time\textsuperscript{6} task environments are, however, problematic because there is limited time to perform such reconsideration. If an agent is to operate successfully then it must be efficient in reconsideration, and perform the action within a specified time (Wooldridge, 2002: 22). An agent cannot reconsider indefinitely about what course of action to pursue. There, therefore, needs to be a balance struck between the amount of time spent on reconsideration and the time spent in executing the plan (Wooldridge and Parsons, 1999: 8).

An agent can not be too bold or too cautious. Otherwise a dilemma will be presented where:

- An agent that does not stop to reconsider its intentions sufficiently, will often continue attempting to achieve its intentions even after it is clear that they cannot be achieved, or that there is no longer any reason for achieving them (Wooldridge, 2000: 37; Wooldridge, 2002: 78). This defines the conventional task-oriented approach to reasoning where the agent here is labelled as being ‘bold’ (Georgeff et al, 1998: 4). Static environments – in which the rate of world change is low – tend to favour such bold agents (Wooldridge and Parsons, 1999:2; Wooldridge, 2002: 80).

- An agent that constantly reconsiders its intentions may spend insufficient time actually working to achieve them, and hence run the risk of never actually achieving them (Wooldridge, 2000: 37; Wooldridge, 2002: 78). This defines the reasoning of a ‘cautious agent’, an agent that replans at every change, and is prescribed by classical decision theory (Georgeff et al, 1998: 4). Dynamic environments – in which the rate of world change is high – thus tend to favour such cautious agents (Wooldridge and Parsons, 1999: 2; Wooldridge, 2002: 80).

\textsuperscript{6} If time is not an issue, then an agent can deliberate and reconsider for as long as required to obtain the best course of action given the environmental settings present (Wooldridge, 2002: 22) In realistic environments this is rarely ever the case.
In an ideal situation an agent should be able to avoid both extremes and through some mechanism ‘eventually’ commit to achieving the desired states of affairs. Resources for achieving the ends would be an allocation in accordance with priorities and as both the internal state and external situation command.

Figure 6.4 below graphs three types of agents: the aforementioned bold and cautious agents (at the extremes) and a normal agent. The bold agent is substantially more efficient in consideration than the cautious agent even in highly dynamic times, as no time is spent on adjusting for these changes (as does the cautious agent). This does not, however, demonstrate the effectiveness or appropriateness of the bold agent’s strategy given the level of dynamism. Neither the bold nor cautious agent need attain behaviour that is optimal. A balance of the two needs to be struck. A normal agent would attain the efficiency of boldness, and the sensitivity and attention of cautiousness (and could be drawn as a middle line between the two extremes in Figure 6.4. Although in Figure 6.4 it draws closer association to the bold agent). As a normal agent, the agent commits to the adopted plans but is capable of reconsidering it at appropriate (crucial) moments (Georgeff et al, 1998: 4).

**Figure 6.4 - Rational Commitment to Planning**

This figure is not available online. Please consult the hardcopy thesis available from the QUT Library

Source: Georgeff et al, 1998: 5
Chapter 6: Formulating the Agent

The important thing is to focus on the interaction between agents and their environments (Agre, 1995: 7). The appropriate or crucial moments will therefore be relative to the agent. When the agent perceives there to be a change in the environment the agent will act accordingly after some delay. For example, in reference to Table 6.1 an agent within an environment of no change does not need to reconsider its intentions, as any re-observation of the environment is not going to markedly change its perception and hence reaction. Thus choosing not to reconsider in this static environment is optimal for the agent. In an environment of mild change an agent choosing to reconsider but does not adjust its perception and hence, reaction is sub-optimal behaviour. As, the time emaciated generated no returns in difference to the initial consideration. The change in the environment has not been adequate to affect perception or behaviour. It is through adequate and accurate interpretation and evaluation of the environment, and reacting accordingly at these crucial moments that optimal reconsideration is attained (further demonstrated Table 6.1 below).

Table 6.1 - Practical Reasoning Situations and Optimality of Reconsideration

<table>
<thead>
<tr>
<th>Environmental Situation</th>
<th>Chose to Redeliberate?</th>
<th>Changed Perception &amp; Hence Reaction?</th>
<th>If the Agent Had of Reconsidered Would it have Changed Perception &amp; Reaction?</th>
<th>Reconsideration Optimal? (in terms of Efficiency)?</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Change</td>
<td>No</td>
<td>–</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Mild Change</td>
<td>No</td>
<td>–</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Mild Change</td>
<td>Yes</td>
<td>No</td>
<td>–</td>
<td>No</td>
</tr>
<tr>
<td>Extreme Change</td>
<td>Yes</td>
<td>Yes</td>
<td>–</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Source: Adapted from Wooldridge, 2002: 79 and Wooldridge and Parsons, 1999: 10

6.2.5 BDI Components and Application to Current Research

In applying the above framework of Figure 6.3 to the current research, the focus will be particularly on the role that beliefs play in influencing the desires and intentions and ultimately, the actions of agents. The BDI framework examined, however, does not nominate what external force(s) influence the agent’s perceptions, and, in turn, their beliefs. Traditionally this has been labelled as being the ‘world’ (Traum, 1997:
2). Here institutions are of interest. In constructing the SERA framework it is assumed that the beliefs’ of agents are influenced by the perception they receive from their institutional affiliations and interactions (refer to Chapter 3). Desires and intentions are then assumed to be influenced successively. Institutional affiliations and interactions are taken as focal external influences on the perceptions of the agent. They are then the instruments that direct, assist, support and constrain agent behaviour via agent beliefs, desires and intentions. The agent, therefore, uses its perception of the current environment through its institutional affiliations and interactions to augment its beliefs and guide its current and future behaviour (through subsequent desires and intentions). This process is depicted in Figure 6.5 below through the sequence of arrows. The dotted arrows represent reactions following from the contingency of environmental change.

An example of this modelling is presented. For example, an agent may believe that the cost of shirking is minimal in comparison to the benefits. The agent may have obtained this belief through examining relevant legislation, i.e., evaluating their corporate liability and their chances of conviction. The agent may therefore desire to acquire a private jet or consume corporate resources. Should the agent be committed to acquiring a private jet, then it is said that the agent is committed to that desire and
has the intention of acquiring the private jet. The agent then communicates its intentions through the order of an acquisition. Should there however be an amendment to the legislations regarding CEO corporate liability and conviction this may effect the agent’s belief about the costs of shirking and hence, alter his/her desires and intentions to consume corporate resources personally. The agent then communicates its intentions through investing resources into corporate operations.

The framework presented in Figure 6.5 is tentative and rather abstract. As the analysis and design process continues the framework will become increasingly more concrete, detailed and closer to implementation. Implementation will be undertaken through simulation in the following chapters, Chapters 7 and 8.

Appendix 3 sections A3.2 and A3.3 provides additional information concerning the factors of BDI grounding and success, and the method of BDI presentation (i.e., mathematical logic), which make BDI a suitable application for this research. The interpretation and application of BDI is the focus here.

6.2.6 Summary

Through the incorporation of environmental dynamism the practical reasoning process is more representative and reflective of the SERA formulations presented in Chapters 2 and Chapters 3. Incorporating the BDI model components into this dynamical reasoning process will assist in specifying this reformulation further through its emphasis on social association and dynamism. Agents incorporating the BDI model into their reasoning in fact perform well in environments with differing degrees of change and complexity (Wooldridge, 2002: 44). BDI components, therefore, provide a set of dimensions by which agent behaviour can be constructed and analysed in a dynamic social environment (Reilly, 1997: 114).
6.3 Applying BDI to a Socio-Environmental Rationalist Agent (SEAR) Framework

Viewed overall an agent is simply a decision making object, which maps perceptual inputs to actions. An agent within the field of object-orientation, like that in the BDI model, is an entity that has behavioural capabilities (the ability to rationalise about actions in the BDI model), and its own internal state (beliefs, desires and intentions in the BDI model) that is used to deduce its steps in forming a rational decision. A multi-agent system in this field is a set of these entities and the collaborations established among them (Amandi and Price, 1997: 510). In essence both forms describe the agent’s decision making process. Figure 6.6 below depicts the decision making meta-architecture of an individual SERA.

Figure 6. 6 - The Meta-Architecture forming the SERA Framework

Source: Adapted from Amandi and Price, 1997: 510
Chapter 6: Formulating the Agent

This Figure is diagrammatically similar to the interaction depicted in Figure 6.5. The architecture depicted in Figure 6.6 concentrates on a critical and central portion of the interaction depicted in Figure 6.5. This is the influential frame of the agent, which is the agent’s BDI: the resolve for the agent’s decision making. Note that BDI does not fully fill the agent in their decision making process. Anything outside this BDI box is assumed to be uninfluenced by institutional affiliation and interaction, and typically denotes the self-interested rationalist (SIR) behaviour conceptualised and formulated in the existing theory of Agency.

The agent in this architecture (Figure 6.6) is an object which exhibits a number of capabilities other than traditional self-interested rationalism (hence the 3D oval labelled object in Figure 6.6 with depth as opposed to the surface level one dimensional examination demonstrated in traditional agency in Chapter 2, section 2.2.1). These capabilities – communication, deliberation, perception and reaction – are presented in four boxes within the 3D cube. They are consistent with practical reasoning (as demonstrated by the directional arrows in Figure 6.6) and those properties that socio-environmental rationalist agents (SERA) are expected to have (described in section 3.6 in Chapter 3). Here the agent is perceptive, and reactive to the environment; it is deliberative taking an amount of time to reason; is informative through the knowledge obtained and stored from perception and prior experiences; is proactive taking the initiative to achieve a goal through reasoning informed by perception; and is communicative with others and its environment through implementing a plan to reinforce its reaction.

Each of the capabilities are either indirectly related or directly influenced by beliefs, desires and intentions (as discussed in section 6.2.5). This is depicted in Figure 6.6 by ‘beliefs, desires and intentions’ being immersed within the 3D cube surrounding all the capabilities. It is positioned over the perception capability where the informing process begins with a singular perception of the institutional environment, the initiation depicted by the explosion and its flow of influence is represented by the directional arrows. The dotted back flow of arrows represents the dynamism of the environment, where the agent has the ability to re-examine and/or reconsider his/her initial perceptions should any changes occur in the environment. Figure 6.6, therefore, demonstrates that an agent does not operate within a vacuum of self-
interested rationalism (c.f. existing theory of Agency) but is influenced by its institutional environment.

Recall that the agent’s beliefs, desires and intentions are informed by the perception they receive from their societal affiliation and interaction. Societal institutions represent the agent’s environment, the influence they convey is represented in Figure 6.6 by the recursive arrows interacting with the smaller BDI cube within the agent. Beliefs, desires and intentions and all capabilities are fully immersed within this cube representing their subjection to its force. Any actions that follow through are the result of those beliefs, desires and intentions informed by an agent’s institutional affiliations and interactions and self reference. Beliefs, desires and intentions are, therefore, immersed in the cube, and encapsulated by the influence that societal institutions have upon them. Figure 6.6 demonstrates the influential nature of the environment.

The meta-architecture presented in Figure 6.6 provides the decision making framework of SERA. The agent’s BDI is the resolve through which institutional influences are filtered through to determining agent behaviour. BDI in essence organises the rational agent through a clear line of decision making utilising the properties agents are expected to posses.

6.4 Cases Applying the SERA Framework

It is difficult to give a complete account of the relationships that exist between an agent’s mental states and behaviour. Explaining how an agent’s mental state leads it to select and perform rational actions (i.e., a process of mapping perception to action) is a complex process. This is because the attitudes of the agent – beliefs, desires and intentions – are difficult phenomena to observe in the physical world (Wooldridge, 2000: 9). Theories examining such phenomena are hard to validate as they rely on intuition. So, how effective is the BDI model in overcoming this limitation?
Within the Agent Theories, Architectures, and Languages (ATAL) Community, the belief-desire-intention (BDI) model is possibly the best known and best studied model of practical reasoning agents (Georgeff et al, 1998: 1). The BDI model combines three important elements, which are the elements for its success. These are:

1. **A Philosophical Foundation** – It is founded upon a well-known and highly respected theory of rational action in humans (or philosophical model of human practical reasoning) originally developed by philosopher Bratman (1987).

2. **A Software Architecture** – The BDI model of agency does not prescribe a specific implementation (Van der Hoek and Wooldridge, 2003: 140). The model may be realised in many different ways, and indeed a number of different implementations of it have been successfully developed (Van der Hoek and Wooldridge, 2003: 138). It has been implemented in the Intelligent Resource-bounded Machine Architecture (IRMA)\(^7\) (Bratman, Israel and Pollack 1988) and in various Procedural Reasoning Systems (PRS)\(^8\) (Georgeff and Lansky 1987), and successfully used in a number of complex fielded applications (including the fault diagnosis system for the space shuttle, as well as:

\(^7\) IRMA was intended as a more or less direct realisation of Bratman’s theory of practical reasoning (Van der Hoek and Wooldridge, 2003: 140).

\(^8\) PRS was originally developed at Stanford Research Institute by Michael Georgoff and Amy Lansky, and was perhaps the first agent architecture to explicitly embody the belief-desire-intention (BDI) paradigm, and proved to be the most durable agent architecture developed to date (Wooldridge, 2002: 82). In essence, the PRS is a programming environment for developing complex applications that execute in dynamic environments and can best be specified using BDI concepts (Georgoff and Lansky 1987; Georgoff and Ingrand 1989). All other software frameworks descend in some way from the Procedural Reasoning System PRS (Ingrand, Georgoff & Rao, 1992; Van Eck and Wieringa, 2001: 10). The following is a short description of a number of these systems:

1. **dMARS**. The designers of the PRS system extended the original PRS system with facilities for multi-agent systems, e.g. a communication infrastructure. The new system, dMARS, was developed at the now defunct Australian Artificial Intelligence Institute (AAII). The system was mainly commercial and is no longer available (Van Eck and Wieringa, 2001: 10).

2. **UMPRS** and **JAM**. A group at the University of Michigan developed an implementation in C++ of the PRS architecture called UMPRS. A small company called Intelligent Reasoning Systems (IRS) took over the maintenance of UMPRS, markets it as a commercial product, and created an extended version in Java called JAM. JAM is available free for non-commercial use and is primarily active in the consulting business (Van Eck and Wieringa, 2001: 10).

3. **Jack**. Jack is at the same time an extension to the Java programming language and a component framework for constructing agents with a BDI architecture in Java. Jack is the major product of Agent Oriented Software (AOS), an Australian company that seems to have its roots in the Australian Artificial Intelligence Institute (AAII, the creator of dMARS) (Van Eck and Wieringa, 2001: 10). Currently, Jack is the newest and most advantaged framework available.
as factory process control systems and business process management (Georgeff and Rao 1996)).

3. **A Logical Formalisation** – The theory has been rigorously formalized in a family of BDI logics (Wooldridge, 2000: 7), which have been taken up and elaborated upon widely within the agent research community (Rao and Georgeff 1998\(^9\); Schild 1999). These logics capture the key aspects of the BDI model as a set of logical axioms (Van der Hoek and Wooldridge, 2003: 140). Appendix 3 section A3.3 to A3.5 further details the reasoning for the use of Logic in presenting BDI.

These three elements provide the necessary verification in applying the BDI model in examining the mental states of actors (agents).

Four cases of single agents interacting in relatively simple environments are now considered. Particular aspects of the agent and their institutional affiliations and interactions will be analysed in enough detail to examine the micro-level behaviour of the agent (i.e., how institutional affiliations and interactions are instrumental in influencing agent behaviour).

### 6.4.1 Four Cases Describing the SERA Framework

An agent’s beliefs, desires and intentions in any given situation are characterised by its interactions and affiliations with societal institutions (as discussed in earlier sections and Chapter 3). Recall the example used in section 6.2.5, this is the first case of application (refer to Table 6.2). The agent in this case believes that the cost of shirking is minimal in comparison to the benefits. This belief may have arisen through the agent’s interactions and affiliations with institutions such as the legal system, corporate associations, and private affiliations. The agent may therefore desire to shirk and intend in everyway (or many ways) to do so.

---

\(^9\) The primary focus of Rao and Georgeff’s (1998) was to explore the possible inter-relationships between beliefs, desires and intentions from the perspective of semantics characterisation (Van der Hoek and Wooldridge, 2003: 142).
Table 6.2 – A Socio-Environmental Rationalist Agent (SERA) Considering Shirking

<table>
<thead>
<tr>
<th>First Case</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Goal:</strong></td>
</tr>
<tr>
<td><strong>Role:</strong></td>
</tr>
<tr>
<td><strong>Structure:</strong></td>
</tr>
</tbody>
</table>

The agent in this first case has undertaken the first step of deliberation in practical reasoning and from its perception of the environment (achieved through institutional affiliations and interactions) developed a belief that the cost of shirking is minimal and hence, desiring to shirk and intending to do so reacts to this deliberation by ‘booking a holiday’ and communicates this via an arrangement ‘to take leave’. This agent has performed an activity that maximised his or her interest but this was not due to their SIR nature (as in the existing theory of Agency), but due to institutional affiliations and interactions which informed the agent of the lax legislation and hence, the minimal risk of shirking.

An alternative approach, a second case, could be investigated where the agent’s perception and hence, beliefs are founded upon alternative institutional affiliations and interactions (refer to Table 6.3). For example, the agent may have strong associations with religious institutions. His or her beliefs would thus differ and his or her desires and intentions would be consistent with altruism and philanthropy with no desire nor any intention to shirk.

Table 6.3 – A Religious SERA Considering Shirking

<table>
<thead>
<tr>
<th>Second Case</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Goal:</strong></td>
</tr>
<tr>
<td><strong>Role:</strong></td>
</tr>
<tr>
<td><strong>Structure:</strong></td>
</tr>
</tbody>
</table>
Cases one and two both demonstrate the influence of institutional affiliations and interactions upon the behaviour of rational agents and hence, presented a basic description of a SERA and its framework. Both cases one and two are based on a low level of environmental dynamism. The perception from institutional affiliations and interactions has not changed during the course of the agent’s deliberation or reaction. It thus represents a simple description of a SERA and its framework in a static environment.

Should there, however, be a change in the institutional settings? This may effect the agent's perceptions and hence, require an alteration in agent behaviour. Incorporating this environmental dynamism requires a more detailed formulation and presents the third case of application (refer to Table 6.4). For example, an amendment to the legislation may effect the agent’s perception and then reinform his or hers belief and hence, alter his or her desires and intentions, and ultimately change his or her plan of action.

Table 6.4 – A SERA Shirking given Changing Institutions

<table>
<thead>
<tr>
<th>Third Case</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Goal:</strong></td>
<td>To illustrate a situation of institutional influence in the frame of corporate management and institutional change</td>
</tr>
<tr>
<td><strong>Role:</strong></td>
<td>SERA deciding whether to shirk given changes in institutional settings</td>
</tr>
<tr>
<td><strong>Structure:</strong></td>
<td>Rational agent deliberates about performances, through perception informed by institutions, which entails a reaction to the perception and a communication thereof. A change in institutions reinforms perception and deliberation, which entails a revised reaction to the perception and revised plan of communication.</td>
</tr>
</tbody>
</table>

The third case is a situation of institutional influence derived from institutional affiliation and interaction in the frame of corporate management and institutional change. The agent in this third case begins with the initial behaviour of the agent in the first case. At some point in the agents reaction to initial perceptions or planning (or even prior to this) a certain change in the legislation develops which may increase the corporate responsibility of agents and hence, increase the costs of shirking. This change in legislation revises the agent’s perception of the environment. The agent now believes that the costs of shirking outweigh the benefits and hence, the agent no
longer desires to shirk let alone have an intention to do so. Reaction is reinformed and the agent no longer plans to shirk nor undertakes a plan to do so. The agent behaviour in this third case thus provides a thorough formulation of the SERA framework, incorporating the instrumental influence of institutional affiliations and interactions and environmental dynamism.

The traditional formulation of agency, on the other hand, would assume that the agent’s beliefs, desires and intentions through institutional affiliations and interactions are uninfluential in informing behaviour, and that it is self-interest that informs, influences and dominates behaviour. This is to the disregard of any changes in legislation or to the existence and change in institutions. The environment is static and the agent continues to act in self-interest, i.e., to maximise their own utility through shirking. This fourth case is therefore of a situation of institutional ignorance in the frame of corporate management (refer to Table 6.5).

Table 6.5  – A Self-interested Rationalist (SIR) Agent Considering Shirking

<table>
<thead>
<tr>
<th>Fourth Case</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Goal:</strong></td>
<td>To illustrate a situation of Institutional Ignorance in the Frame of Corporate Management</td>
</tr>
<tr>
<td><strong>Role:</strong></td>
<td>SIR Agent performing utility maximising behaviour</td>
</tr>
<tr>
<td><strong>Structure:</strong></td>
<td>SIR agent does not deliberate about performances, through perception informed by institutions. Their self-interest informs their reaction and plan of communication.</td>
</tr>
</tbody>
</table>

In this fourth case the agent is assumed to behave in one exact way, that is, with the view to maximising utility). The agent is therefore assumed not to deliberate, as their behaviour never varies (given the same principal-agent related situation). Nor does institutional affiliation and interaction inform their perception or behaviour. Instead it is their SIR behaviour or nature that informs their reaction. Consequently, agents always intend to perform with their self-interest as particularly cast. They plan and undertake plans that are expected to facilitate essentially in any contexts the maximisation of their utility.
Such a broad position represents a particular and (markedly) reduced description of agent behaviour unaffected by changing contexts. An informed understanding of agents and their behaviour in dynamic environments could not present in this fourth case.

### 6.4.2 Conclusions to Case Formulations

Cases 1, 2 and 3 are consistent with a SERA framework and denote the transacting process of SERA. These cases are markedly different from the fourth case of agent behaviour (SIR) in the existing theory of Agency. These variously informed and detailed representations of agent behaviour are summarised in Table 6.6. Cases 1 through to 3 adopt a relative approach and take into account the intricacies of agent behaviour. They provide both meticulous and methodical detail as to why one agent may behave differently to another in a transacting process. No two agents need be alike, even within the same case.

<table>
<thead>
<tr>
<th>Cases</th>
<th>Presents a Relative Approach</th>
<th>Responsive to Institutional Influence</th>
<th>Detailed Deliberation</th>
<th>Considers Environmental Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Case</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Second Case</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Third Case</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Fourth Case</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

The most important factor in the transacting process is the perceptual input that an agent receives. It is the singular influence on an agent’s deliberating process. The three SERA forms (Cases 1 through to 3) individually demonstrate that perceptual input from institutional affiliations and interactions inform agent behaviour whether it is through assisting, supporting, directing and constraining their deliberation and reaction, and hence, behaviour. Self-interested rationalism (demonstrated in case 4) need not be the sole influence in informing behaviour in the transacting process. It is
because of the perceptual input SERA can not be reduced to the traditional simplification, which is void of any perceptual input in the deliberation process.

Thus the broad assumption of SIR behaviour in current agency research, while applicable in many instances does limit analysis and understanding including in ways as demonstrated. Research has shown that current analysis of agency is also limited in its predictions (as discussed in Chapter 2, particularly Table 2.2). Agent behaviour is more complex and diverse than the broad simplifying assumptions of SIR behaviour. Lyons and Hendriks (1995) amongst others are of the opinion that through exploiting environmental dynamics the traditional viewpoint of an agent may be extended, enriching the agent’s action repertoire and so enabling a more adequate examination of patterns that emerge in agent behaviour. Cases 1, 2 and 3 allow a wider range of alternative responses to be explored. All four cases will be explored further, including in the simulations discussed in section 6.7.2 and the two chapters following. First however it is appropriate to extend considerations to situations of multiple agency.

6.5 SERA and Collective Mental States

The properties of individual socio-environmental rationalist agents (SERAs) have been examined in the previous sections. In this section the properties of socio-environmental rationalist multi-agent communities (SERC)\(^\text{10}\) will be considered. Multi-agent communities like individual agents also have a principal for whom they undertake actions and from whom they are delegated decisions. Multi-agent communities, however, are formed with the goal of undertaking joint plans to bring about some world state (a common goal) that the principal has requested but which a singular agent cannot achieve alone. A singular agent must solicit the joint-assistance of others, develop mutual interests and share them collectively to achieve the common goal.

\(^{10}\) All socio-environmental rational agents (SERAs) within the multi-agent community also exhibit the properties of individual socio-environmental rationalist agents (SERAs) mentioned in section 6.1 the only difference being they share a common environment and goal.
6.5.1 Mutual Interests and Multi-Agent Communities

Existing Agency theory continues to apply the notion of SIR behaviour through to multi-agent communities (Wooldridge, 2002: 9). While agents within the community share a common goal (i.e., mutual interests) they do so with their own welfare or utility in mind, only committing to join a multi-agent community to maximise their own utility and departing from it upon a deterioration of that utility (Wooldridge, 2002: 9).

How do mutual interests then affect SERA? Through agreeing to undertake team work, an individual SERA is making their own beliefs, desires and intentions subservient to those of other agents for the duration of the cooperative act (Reilly, 1997: 116). This is with little exception to individual interests unless they are in the best interests of the community. Thus, beliefs, desires and intentions although initiated by an individual, through the process of communication and cooperation (i.e., team work) are no longer specific to the individual agent but are mutual to the group11.

6.5.2 Multi-Agents & the SERA Framework

How do mutual interests affect SERA framework, which depicts the practical reasoning process and behaviour of an individual SERA? A SERC is simply a collection of individual socio-environmental rationalist agents (SERAs) acting collectively to achieve a common/collective effort or goal. The impact of mutual interests on the framework is, therefore, relatively small, as demonstrated in Figure 6.7 below. Substantial adjustments are not necessary. Additional agents were simply added to the framework to represent the multiple agents present in the group. These are the multiple 3D ovals, labelled ‘Agent 1 … Agent 5’, positioned below the 3D cube of societal institutional influence in Figure 6.7. They are all connected through to this 3D cube of BDI-institutional influence through Agent 1, the initiating agent,

11 Initial BDI models gave no architectural consideration to modelling multi-agent behaviour (Georgeff et al, 1998: 2). Wooldridge (2000) recently expanded the BDI model to incorporate multi-agent behaviour through the development of mutual beliefs, desires and intentions.
which is a larger 3D oval to which the smaller 3D ovals for Agent 2 through to Agent 5 are all placed over and within.

Figure 6.7 - The SERA Framework for Multi-Agent Communities

This containment demonstrates the transmission of an initiating agent’s (Agent 1 in Figure 6.7) beliefs, desires and intentions to the group. They are no longer specific to the initiating agent 1 but are mutual to the group. This is demonstrated by the label of mutual beliefs, desires and intentions positioned over the perception capability and the multiple agent containment within the 3D oval Agent 1. By being contained within Agent 1, Agents 2 through to 5 all possess the same 3D cube of BDI-institutional influence indicating that they also possess the capabilities, and adherence to the processes contained therein. It is important to note that these contained agents
are not one dimensional they are also 3D ovals. They therefore do not fully blend into Agent 1 demonstrating that they still possess their own individual identity and their ability to use their own BDI-institutional influence. The association with the 3D cube of BDI-institutional influence is then both individual at one plane and mutual at another.

For example, the group may have a mutual belief that a certain state exists, i.e., an individual agent (initiating agent) has made a request. There then may be a mutual desire to achieve that state and hence, the intention of setting it as a goal. Each agent, however, will continue to also consider the perception received from their own affiliations and interactions that inform their beliefs, desires and intentions about a state (the requested state). Should the agents then continue to accept the request after this, the individuals’ mental states have become mutual to the group, and the group has collectively deliberated on what to achieve through the request of the initiating agent and the influences of their institutional environment. This figure (Figure 6.7) now represents the SERA framework for the multi-agent community.

In conjunction with the addition of multiple agents, a more detailed explanation of the deliberation to reaction and communication process needs to be undertaken. This is the process of deliberating about whether to commit to achieving the collective effort or goal, and then planning on how to achieve it collectively. Recall that an individual agent primarily initiates a request requiring group behaviour or collective effort. In doing so, the perception process has already occurred on the part of the initiating agent, and was covered thoroughly in sections 6.3 to 6.4. It is the remaining process – now termed the collective deliberation through to the collective communication process – in multi-agent communities that is yet to be achieved and requires the assistance of others.

The multi-agent group now needs to decide upon a course of action to take in achieving the task, and this is undertaken in the post deliberation through to the communication process (labelled as collective reaction in Figure 6.7 above). At any time an agent may refer back to their preceptive forces (i.e., institutional affiliations and interactions) to reconfirm and/or reinforce their behaviour on the collective effort or goal. This is present in Figure 6.7 by the dotted back flow of arrows. The
following sections will demonstrate the applications of SERA to multi-agent communities\textsuperscript{12}. The multi-agent community to be examined here pertains to the EU. Figure 6.8 below demonstrates how the socio-environmental rationalist multi-agent community (SERC) framework fits within the scheme of the EU principal-agent interaction and relationship. The framework in essence is the member nation’s (agents) BDI cube in Figure 6.8, which is the nation’s influential frame and resolve for decision making in the interaction.

\textbf{Figure 6.8 - Framing EU-Nation Interaction as an SERA Relationship}

The focus is upon describing the achievement of mutual states, and the collective deliberation through to the collective communication process, which is termed cooperative problem solving and represents the remaining processes of the SERA framework for multi-agent communities (additional information on cooperative problem solving is provided in Appendix 3 section A3.5). That is, how will the agents collectively react to collective deliberation and achieve the desired and

\textsuperscript{12} The existing theory of Agency has also applied its notion of SIR behaviour to multi-agent communities but with limited success (refer to Table 2.2).
Chapter 6: Formulating the Agent

intended collective goal? While the desired goal may be evident (i.e., collective deliberation has occurred about what to achieve), the process through which to achieve it may not be apparent and hence, the notion of cooperative problem solving.

6.6 Formulating an Example of a Socio-Environmental Rational Multi-Agent Community (SERC)

Some researchers have inferred from the uniqueness of the EU that there is a need for a specialised theory of European integration, others have analysed the EU with standard theories from established fields in political science and economics (Jupille and Caporaso, 1999: 429). However, no single-stranded approach satisfactorily explains the creation, change, and operation of the EU (Jupille and Caporaso, 1999: 429). Studies have focused on the ways in which sovereign states have come together and, through "conventional statecraft" (Moravcsik 1991), created a set of rules permitting them collectively to achieve outcomes unavailable to them individually. The EU, from this perspective, is a functional transaction cost regime, an international organisation not qualitatively different from others insofar as states create, control, and can exit it (Jupille and Caporaso, 1999: 430). What appears to matter more, however, is that politics occurs within a framework of mutually understood principles, norms, rules, or procedures, i.e., within an institutional context, and this has not been examined.

A thorough examination of the EU financial accounting harmonisation process exacted in terms of Agency theory demonstrated that the EU case of financial accounting harmonisation can be seen as approximating an example of a socio-environmental rationalist multi-agent community (SERC). The initial nations (later to become fifteen nations and now 25 nations) had unified their markets with a goal of undertaking collective effort to unify financial accounting regulations for the benefit of EU citizens, the principals. This could have not been achieved alone but through the joint process of harmonisation. Chapter 4 demonstrated that each select member nation within an accounting system harmonised their financial accounting regulations not in accordance with the existing notions of Agency theory (i.e., their own utility maximisation) but in accordance with the extended conceptualisation of agent
behaviour (i.e., their institutional affiliations and interactions). The following sections in this Chapter will demonstrate whether the micro level behaviour of agents (member nations) are also transmitted through to wider associations (i.e., the EU) and hence, examine the macro level behaviour of agents.

6.6.1 Describing the EU Case: An Example of a SERC

The process of EU accounting harmonisation will be described and formulated through the stages of cooperative problem solving, which describes/formulates the perception through to communication process of the multi-agent socio-environmental rationalist framework. Recall that each of the EU member nations represents an agent within the multi-agent community, the multi-agent community being the EU.

Cooperative problem solving can be analysed and achieved through four stages; each of these stages is iterative (Wooldridge, 2000: 148; Wooldridge, 2002: 209; Wooldridge and Jennings 1994, 1999) and can be used not only to describe and formulate the post collective deliberation through to collective communication process of the multi-agent socio-environmental rationalist agent (SERA) framework, but also the initial perceptive stage of the initiating agent. According to Wooldridge (2000; 2002) the stages are:

1. **Recognition** – an agent within a multi-agent community recognises the potential for cooperative action.
2. **Team Formation** – the agent that recognised the potential for action solicits the assistance through communicative acts (e.g., inform and request).
3. **Plan Formation** – all agents attempt to negotiate a joint plan that will achieve the desired goal.
4. **Team Action** – the agreed plan of joint action is executed by the agents and is the means by which multi-agents communicate their efforts towards achieving the collective goal or effort.

Each of these stages will be applied to the EU financial accounting harmonisation process.
Chapter 6: Formulating the Agent

Stage 1: Recognition for Cooperative Action

The initial stage for cooperative problem solving rests with an agent recognising the need for cooperative action or collective effort. With regards to the EU harmonisation process this is not clear cut and requires an examination of the events leading up to the signing of the Treaty of Rome 1957. The Treaty of Rome 1957 is the initiator of corporate harmonisation whose principles were formalised through the issuance of Directives (the legislative instruments of harmonisation) (see section 4.2.1).

Following the end of the Second World War (WWII) the European continent had undergone serious devastation. Economically, structurally and humanitarianly the European continent was shattered (Harris, 2000: 42). While the origins of bookkeeping can be traced back to Italy and the first phase of accounting harmonisation is attributable to the Napoleonic Wars (refer to section 4.2.1), it was from the desolation and destruction of the German-led war and the external threat of ‘supra-powers’ that the idea of European corporate unification arose. National borders were no longer going to present challenges to the development of the continent. The role of France proved to be crucial as the driving force for this notion and for cooperation to emerge (Harris, 2000: 43). Through the integrative efforts of France to bring Germany and its resources further inline with Europe, European cooperation materialised from the unification of the coal and steel industries and extended through to the harmonisation of corporate regulations such as, financial accounting standards.

This discussion indicates that France (i.e., the French Government) was the initiating agent who recognised the potential for collective effort. Collective effort was in the sense of the removal of national boundaries and unification. How did France come to such a deliberation? An examination of the national institutions following WWII presents an explanation of universalism in France. The destruction therein that national rivalry had caused lead to the belief that unification was necessary if Europe was to prosper. The French Government could not, however, achieve this unification in isolation, as it required the collective effort of other continental European nations if it was to be achieved. That is, there is a belief on the part of the French Government

185
(the initiating agent) that there is potential for the collective effort of unification to be achieved. It is now up to the French Government to initiate this potential.

Stage 2: Team Formation

The French Government having recognised the potential for unification solicits the assistance from other European national governments. Initial solicitation began with the process of informing and this was initiated by the 1950 Schuman Plan developed by the French Foreign Minister Robert Schuman with Jean Monnet (Harris, 2000: 45). The 1950 Schuman Plan proposed the benefits of pooling French and West German coal and steel production, controlled by a common High Authority. This was intended not only to exercise control over any West German rearmament but also to promote joint prosperity and lay the basis for establishing an economic community or union (Harris, 2000: 45). This was a formal request for unification on the part of the French Government through the action of membership.

European national governments acknowledging the requests of the French Government and referring back to their own institutional settings were of the perception and hence, the belief that: given the current conditions joint prosperity would be promoted through unification. France, West Germany, Italy, Belgium, Luxembourg and Holland desiring and intending to obtain the benefits of unification became signatories to this agreement and formed the European Coal and Steel Community (ECSC).

This initial commitment on the part of the six members was minimal, i.e., it related solely to the unification of coal and steel industries. The ECSC, however, later laid the basis for the subsequent developments towards the present-day European Union (EU) (Harris, 2000: 45). Through further investigations and requests on the part of the six member nations, additional treaties were established promoting and requesting further economic growth and social cohesion resulting in the expansion of

---

13 The aim of this plan was to make another war between France and Germany impossible through integrating an important element of a country’s ability to wage war, e.g., a nation’s heavy industries (Harris, 2000: 45). Schuman’s long-term objective was to achieve reconciliation between France and Germany and increasing European integration, with the ultimate goal of a European federation or unification. The 1950 Schuman Plan is, thus, considered to be one of the founding fathers of European integration/unification (Harris, 2000: 45).
Chapter 6: Formulating the Agent

membership (Denmark, UK, and Ireland joined in 1973). These new members, like the initial six members, examined the information and the requests that these treaties delivered and then consulting their institutional systems deliberated about joining. With these additional communicative acts (i.e., the informing and requesting initiated by Treaties) came a strengthened commitment towards the unification of Europe.

Unification, however, no longer involved just the unification of national coal and steel industries but also the unification of markets creating a single market for goods, services, labour and capital across member states (Treaty of Rome 1958). It is the capital component that is of interest to this research. As it is with the interests of increasing the mobility of capital that interests in financial accounting harmonisation emerged. The remaining stages will, therefore, focus on demonstrating and formulating this specific component of the unification process, i.e., the harmonisation of financial accounting standards.

Stage 3: Plan Formation

The agreement to harmonise corporate regulations were initially recognised in the Treaty of Rome 1957 Article 52 to 58, and especially Article 54(3)(g)). Formal arrangements to harmonise corporate regulations such as financial standards, were initiated in the early 70s through a series of Company Law Directives approved by the European Commission (the principal). Recall that it is the Fourth and Seventh Directives that deal exclusively with financial accounting issues and standards, and thus they will be the focus of analysis and discussion. These Directives can be likened to a plan detailing the time at which they are to be implemented, the aims of its execution, and the method and the procedures to be followed to attain financial accounting harmonisation.

The first EU proposals for the Fourth and Seventh Directives were initiated in 1971 and 1973 respectively, and were dominated by the Latin and Germanic approaches to

---

14 Later applications for membership were received from other European nations. For the purpose of analysing EU accounting harmonisation, however, it is the above nine members that are of relevance as they played a crucial role in the development of financial accounting Directives, the instruments of the financial accounting harmonisation process. Greece joined in 1981, Portugal and Spain joined in 1986, and Finland, Austria and Sweden joined in 1995 (Harris (2000)). These other six members simply implemented the existing standards upon membership and thus, have less of relevance in the initial phases of collective action.
accounting, the approaches of the founding members. Following the formal recognition of the membership of Denmark, UK and Ireland in 1973\textsuperscript{15} negotiations were reinitiated to accommodate the arrival of the United Kingdom (UK) and Ireland as new members in the EU (Walton, Haller and Raffournier, 1998: 14; Walton 1997; Diggle and Nobes 1994; Nobes, 1993: 165). Negotiations persisted for quite sometime. Only after each member nation being content with the proposals did the European Commission (the principal) formally approve the Fourth and Seventh Directives in 1978 and 1983 respectively as legislative requirements to be implemented in national accounting regulations by 1991. It was a joint attempt by member nations through the action of membership to reach a proposed plan that will implement the Directives, which will achieve the desired goal of unification through financial accounting harmonisation.

It is important to note that with the acceptance of Denmark, UK and Ireland as new members, ongoing negotiations proceeded their membership. This resulted in a redrafting of the initial proposals for the Directives to give preference to the Anglo-Saxon approach with the initial proposals, reflecting the Germanic and Latin approach, redrafted as optional requirements. This demonstrates the agents’ or member nations’ abilities to bring about their own preferences in negotiations. Chapter 4 demonstrates that this is fostered through the institutional systems in place within each member state to which they have an affiliation and interaction with. Given the UK’s, Denmark’s and Ireland’s institutional system being at significant variance to that of the founding members (Belgium, France, Germany, Holland, Italy and Luxembourg) this informed the demand for such dual drafting.

At this stage while plan formation was successful – members having agreed to the means by which they pursue one aspect of unification and when it will be achieved – it was extremely lengthy and the commitment to achieving complete unification may well have been tarnished by their own preferences informed through their institutional settings.

\textsuperscript{15} Up until this point in time Denmark, UK and Ireland played a passive role in European unification, acting as supportive figures given the rejection of their first application for membership in 1963.
Chapter 6: Formulating the Agent

Stage 4: Team Action

In this final stage, the member nations are required to execute the agreed plan of Directive implementation within the required time, i.e., by 1991. The process expended the whole decade of the 1980s to gradually implement the Fourth and Seventh Directives throughout the nine member states, e.g., implementation of the Fourth Directive began with Denmark and the UK in 1981 and ended with Italy in 1991 (Elnathan and Krilich, 1992: 48). Table 6.7 lists the time periods in which the Fourth and Seventh Directives were incorporated within each of the nine member states’ national legislation.\(^\text{16}\)

<table>
<thead>
<tr>
<th></th>
<th>Fourth Directive</th>
<th>Seventh Directive</th>
</tr>
</thead>
<tbody>
<tr>
<td>First EU Proposal</td>
<td>1971</td>
<td>1973</td>
</tr>
<tr>
<td>Directive enacted by EU</td>
<td>1978</td>
<td>1983</td>
</tr>
<tr>
<td>Directive enacted by nine member states</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belgium</td>
<td>1983</td>
<td>1990</td>
</tr>
<tr>
<td>Denmark</td>
<td>1981</td>
<td>1990</td>
</tr>
<tr>
<td>France</td>
<td>1983</td>
<td>1986</td>
</tr>
<tr>
<td>Germany</td>
<td>1985</td>
<td>1985</td>
</tr>
<tr>
<td>Ireland</td>
<td>1986</td>
<td>1992</td>
</tr>
<tr>
<td>Italy</td>
<td>1991</td>
<td>1991</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>1983</td>
<td>1986</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>1983</td>
<td>1988</td>
</tr>
<tr>
<td>UK</td>
<td>1981</td>
<td>1989</td>
</tr>
</tbody>
</table>

Source: Adapted from Flower and Lefebvre, 1997: 25, and Table 4.1.

Through the implementation of the Directives all nine member states kept their responsibility to the team, that is, to unify via the harmonisation of their financial accounting standards. The process towards achieving the collective effort or goal of unification has been completed. Member nations have successfully jointly implemented the Directives within the time stipulated. The question is to what extent was the common goal of unification via harmonisation attained?

\(^\text{16}\) European nations who were accepted for membership following the enactment of the Directives by the European Commission (Austria, Finland, Greece, Portugal, Spain and Sweden) have not been included in the analysis here. As they played no influential role in the development or the lead up to the development of the Directives, the legislative instruments of harmonisation. These nations simply implemented the Directives upon membership. They are, therefore, not of relevance at this particular stage, but will be considered later.
Chapter 6: Formulating the Agent

While the Directives had been implemented, and this also applies to the later joining six members (Austria, Finland, Greece, Portugal, Spain and Sweden), financial accounting harmonisation in the EU to date has not been achieved. Diversity in EU financial accounting continues to persist at this present moment, and this was demonstrated in Chapter 4. Therefore, the goal towards unification via harmonisation was achieved with blind social commitment and minimal convention towards unification. It is blind in the sense that, the Directives were implemented with reference to institutional affiliations and interactions (introduced in Chapter 4) and not with the original goal of harmonisation in mind. It is minimal in the sense that, as long as the Directives were implemented within the specified time the specifics were not of significance.

This case demonstrates that even in multi-agent settings with strict processes in place institutional affiliations and interactions inform and can reinforce behaviour adjusting an agent’s initial commitments towards the common goal and hindering the maintenance of mutual mental states (developed by the initiating agent) which is conducive to achieving the collective effort or goal. This is especially so when there are variations in institutional systems, as these can re-influence an agents’ mental states, and this was demonstrated in the EU case.

6.6.2 Summary

In summary, member states form preferences for cooperation or policy coordination at the EU level, partly as a result of their position in the international political economy. States aggregate societal interests and thereby demand some level of European cooperation. Armed with these preferences, state executives bargain in the EU arena, attempting to supply their constituents with the desired outcomes. States then choose outcomes that maximise the credibility of their commitment to cooperate. The credibility of which may be redefined by their institutional context. Institutions shape not only strategies, but also the states’ underlying goals, providing information and alternatives under conditions of uncertainty and consequently, effectively socialising member states into national norms of behaviour. Institutions provide information and options that SIR states would otherwise lack.
Chapter 6: Formulating the Agent

There is broad agreement that the institutions of EU member states have great authority in influencing the direction of European integration (Moravcsik 1998). So contrary to the view that institutions have minimal effects on state interests (Gilpin 1981, Mearsheimer 1994/1995), the above case (in accordance with similar research: Keohane 1984; Keohane and Martin 1995; Goldgeier and Tetlock, 2001: 79) demonstrates that institutions can alter state interests over time as domestic political actors learn the value of continued participation in the international regime. Additionally, contrary to Tarrow (2001) the era of strong states is not ending (Tarrow, 2001: 1). States while seeking to play a transnational role still control their borders and exercise legal dominion within them. The above case demonstrates this that European states and their affiliations and interactions with institutions succeed remarkably in circumscribing and controlling the level of their commitment with the broader community. These developments, like Jacobson (2000) suggests, have serious implications for the future of the EU, i.e., for European integration.

The above case also demonstrates that the practical reasoning processes underlying multiple agent communities is just as complex as that of individual agents and can not be fully expressed as a function of self-interested rationalism without limitations in description. While mutual interests and collective goals maybe set, these may not be fully realised not solely because of the inability to maximise utility (assumption of the existing Agency literature) but because of the institutional affiliations and interactions of agents which support, direct, assist and constrain their behaviour. The EU case demonstrates the significance and importance that variations in institutional systems can have upon the outcomes of collective efforts, and presents a specific formulation of SERAs in a multi-agent community. This case also demonstrates that having multiple agents increases the complexity of the agency problem if they have similar preferences which differ greatly from the principal and from one another. Thus, delegating to multiple agents with heterogeneous preferences and no mutual interests is a complex problem and undertaking.
6.7 Developing the Workings of the Framework and Cases

Cases of a SERA in an individual and multi-agent setting have now been presented along with one for SIR agent. However, it is not sufficient in applied research to just specify cases formulations and reach conclusions regarding the workings of the conceptualisations within the cases. Ideally, the workings of the conceptualisation must also be demonstrated. This is a complex undertaking given the factors involved in the conceptualisation and framework. It will now be discussed in terms of computational models, which provide an experimental tool for modelling and examining such specifications of human societies and their behaviour (Wooldridge, 2002: 11).

6.7.1 From Abstract Specification to Concrete Model

A system now needs to be developed and implemented that builds from the specifications now developed. The move from abstract case specification (of SERA) to a concrete computational model is now discussed. There are at least three possibilities for achieving this transformation (Wooldridge, 2000: 165; Wooldridge, 2002: 291)\(^{17}\). These are to:

1. Manually refine the specification into an executable form via some principled but informal refinement process;
2. Directly execute or animate the abstract specification; or

Manual refinement is the process to be adopted here. As Wooldridge (2000: 164) states, it is difficult to go from specification of a framework in terms of beliefs, desires and intentions to a concrete computational system. Computational systems have practical limitations, which limit the information they can access and the

\(^{17}\) Lahiri (2003) classifies these three possibilities further as the two different computational methods: one which refines and the other which is not amendable to refinement. The former provides a more accurate representation of the specification and the later computational simplicity (Lahiri, 2003: 1).
computations they can perform (Georgeff et al, 1998: 3). Conventional software systems are designed for static worlds with perfect knowledge (*ibid*). This research on the other hand is interested in environments that are dynamic and uncertain (or chaotic), and where the computational system only has a local view of the world (as when the agent has limited access to information). These constraints have certain fundamental implications for the design of the underlying computational architecture. This rules out the potential method three.

Similarly, Wooldridge (2000: 164) mentions that given a concrete computational system, there is generally no way to determine which beliefs, desires and intentions are suitable to implement. In computational terms, beliefs are just some way of representing the state of the world, be it as the value of a variable, a relational database, or symbolic expressions in predicate calculus (Georgeff et al, 1998: 3). Desires in computational terms may simply be the value of those variables, record structure, or a symbolic expression in some logic that is desired to be attained (*ibid*: 4). Computationally, intentions may simply be a set of executing threads to achieve those variables, relational database or symbolic expression (*ibid*: 5). Nothing is said here about the way in which these components are controlled and managed, which is of course crucial to the way in which BDI agents cope with uncertainty and change. Thus the second potential method is also ruled out.

Therefore, refining the specification into an executable form via some principled but informal refinement process remains of the three mentioned above. How is such a refinement process to be undertaken? Kinny, Georgeff and Rao (1996: 3) proposes a four-stage informal refinement process for specifications that use BDI$^{18}$. The process may be specified as follows:

1. Identify the **relevant roles** in the application domain, and on the basis of these, develop an agent class hierarchy. Roles can be organisational or functional, they can be directly related to the application, or required by the system.

$^{18}$ Future research work will entail the use of agent-based software engineering methodologies such as Prometheus, Gaia, etc. These are the recent developments in methodologies for BDI system informal specification.
implementation. For example, a weather monitor where agent $i$ informs agent $j$ of weather conditions every hour.

2. Identify **responsibilities** associated with each role, and then determine the **goals** associated with each service, e.g., find out current weather and make agent $j$ aware of it.

3. For **each goal** determine the **plans** that may be used to achieve it (i.e., communicative acts required and their information content), and the context under which each plan is appropriate (i.e., identify events and conditions to be noticed, actions to be performed, and other information requirements), e.g., send message to agent $j$ when weather changes.

4. Determine the belief structure of the system, that is, the **information requirements for each plan and goal**, e.g., wind speed.

This process will be used in refining the specifications developed earlier to form a computational model of an individual SERA, an individual SIR agent, and a socio-environmental rationalist multi-agent community (SERC).

### 6.7.2 Refinement and Specification of the SERA Computational Model (Simulation One)

Simulation One is a general simulation of the SERA and the SIR agent. It aims to show how institutional affiliations and interactions can, even in static and dynamic environments, influence the behaviour of agents and hence their commitment towards achieving the goals of the principal. How the individual SERA is run in conjunction with the SIR agent is now discussed.

The informal four-stage refinement process for SERA is presented in Table 6.8. The refinement process works from the model of SERA (Figure 6.6), which will be used to simulate SERA and the SIR agent. Stages 1 through to 3 develop the grounding of the refinement process, they form the basis from which the information requirements in stage 4 are derived. It is the fourth stage of the refinement process that is crucial for the simulation, as it is the information requirements identified in stage 4 that will
used to construct the simulation. That is, information is required in each of the four stage 4 cells.

Table 6.8 - Informal Four stage Refinement Process for the SERA Framework

<table>
<thead>
<tr>
<th>Stage in the Refinement process</th>
<th>Application Domain: SERA Framework</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stage 1: Role Identification</strong></td>
<td>Roles involve the utilisation of the capabilities present within the SERA framework</td>
</tr>
<tr>
<td>Preceptive, and reactive to the environment</td>
<td>Deliberative in reasoning, and informative through perceptive knowledge and change</td>
</tr>
<tr>
<td>Proactive in goals through perceptive reasoning</td>
<td>Communicative through plan implementation</td>
</tr>
<tr>
<td><strong>Stage 2: Responsibilities of each role and goal to attain</strong></td>
<td></td>
</tr>
<tr>
<td>Develop perception of environment</td>
<td>Deliberate given BDI and attained knowledge through experience or changes</td>
</tr>
<tr>
<td>Decide what state of affairs to achieve, and reinform deliberation upon evidence of change</td>
<td>React to initial perceptions</td>
</tr>
<tr>
<td>Decide what to do given changes</td>
<td>Communicate resolve</td>
</tr>
<tr>
<td>Observe the environment and attain an initial perception</td>
<td></td>
</tr>
<tr>
<td>Upon initiation of principal-agent relationship</td>
<td></td>
</tr>
<tr>
<td>Once perception established and given existing knowledge and dynamics in environment.</td>
<td></td>
</tr>
<tr>
<td>Once stance determined</td>
<td></td>
</tr>
<tr>
<td><strong>Stage 3: Determine plans for each goal and the context for application</strong></td>
<td></td>
</tr>
<tr>
<td>Environmental factors: institutional weightings of power (a) and uncertainty (b). Agent factor: indicating level of contribution e.g., commitment towards attaining principal’s goal (c).</td>
<td>Environmental factors: probability of institutional change (a), and affects upon agent behaviour: the benefits (b) and costs (c). Agent factor: perception of the environmental factors above (d, e, f) determine stance.</td>
</tr>
<tr>
<td><strong>Stage 4: Information requirements for each plan and goal</strong></td>
<td></td>
</tr>
<tr>
<td>Environmental factors: institutional weightings of power (a) and uncertainty (b). Agent factor: indicating level of contribution e.g., commitment towards attaining principal’s goal (c).</td>
<td>Environmental factors: probability of institutional change (a), and affects upon agent behaviour: the benefits (b) and costs (c). Agent factor: perception of the environmental factors above (d, e, f) determine stance.</td>
</tr>
</tbody>
</table>

*Note: (P) Chiefly is Perception; (D) Chiefly is Deliberation; (R) Chiefly is Reaction; and (C) Chiefly is Communication of Commitment.
In computational terms the information requirements in stage 4 represent a state of the world and a state in agent behaviour. Therefore, they may be set as the value of a variable, a record structure, a symbolic expression in some logic that is desired to be attained or a set of executing threads to achieve the set plans and goals. Table 6.9 presents the variables to be used in expressing the information requirements.

### Table 6.9 - Model Variables of Simulations One and Two Drawn from Table 6.8

<table>
<thead>
<tr>
<th>Information Requirement</th>
<th>Agent Attribute</th>
<th>Property</th>
<th>Model Variable</th>
<th>Specificity of Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pa</td>
<td>X</td>
<td>Power of Perceptual Input</td>
<td>InstrPow</td>
<td>Institution Specific</td>
</tr>
<tr>
<td>Pb</td>
<td>X</td>
<td>Variability of Perceptual Input</td>
<td>InstrUncern</td>
<td>Institution Specific</td>
</tr>
<tr>
<td>Pc</td>
<td>X</td>
<td>Default/Initial Commitment of Agent</td>
<td>defaultcomm</td>
<td>Agent Specific &amp; Principal Referential (Initial)</td>
</tr>
<tr>
<td>Da</td>
<td>X</td>
<td>Benefit of being Informed by Institutional Influence</td>
<td>benefitinform</td>
<td>Relationship Specific</td>
</tr>
<tr>
<td>Db</td>
<td>X</td>
<td>Cost of being Informed by Institutional Influence</td>
<td>costinform</td>
<td>Relationship Specific</td>
</tr>
<tr>
<td>Dc</td>
<td>X</td>
<td>Probability of being Informed by Institutional Influence</td>
<td>probinform</td>
<td>Relationship Specific</td>
</tr>
<tr>
<td>Dd</td>
<td>X</td>
<td>Agent’s Perception of the Benefit of being Informed</td>
<td>perceivepo</td>
<td>Agent Specific</td>
</tr>
<tr>
<td>De</td>
<td>X</td>
<td>Agent’s Perception of the Cost of being Informed</td>
<td>perceivevene</td>
<td>Agent Specific</td>
</tr>
<tr>
<td>Df</td>
<td>X</td>
<td>Agent’s Perception of the Probability of being Informed</td>
<td>perceivepbn</td>
<td>Agent Specific</td>
</tr>
<tr>
<td>Dg</td>
<td>X(^\d)</td>
<td>Relative importance of Institutional Influence(^\d)</td>
<td>InstrAsso</td>
<td>Agent Specific &amp; Institutional Referential</td>
</tr>
<tr>
<td>Ra</td>
<td>X</td>
<td>Reaction based on Prior Knowledge</td>
<td>Reaction0</td>
<td>Agent Specific</td>
</tr>
<tr>
<td>Rb</td>
<td>X</td>
<td>Positive Reaction Towards Commitment</td>
<td>Reaction1</td>
<td>Agent Specific</td>
</tr>
<tr>
<td>Rc</td>
<td>X</td>
<td>Negative Reaction Towards Commitment</td>
<td>Reaction2</td>
<td>Agent Specific</td>
</tr>
<tr>
<td>Rd</td>
<td>X</td>
<td>SIR Negative Reaction Towards Commitment</td>
<td>Reaction3</td>
<td>Agent Specific</td>
</tr>
<tr>
<td>Ca</td>
<td>X</td>
<td>Final Commitment of Agent</td>
<td>finalcomm</td>
<td>Agent Specific &amp; Principal Referential (Final)</td>
</tr>
</tbody>
</table>

\(^\d\)Applicable Solely for Simulation of SERC
mentioned above and specifically in Table 6.8. The first column indicates the information requirement, by SERA capability, to which the variable seeks to address. The second column indicates the agent types that possess the listed properties (column 3).

It is important to mention that in the operationalisation of the framework the principal as such has no specific focus or role. The principal’s interests are, however, represented in the relationship through the agent’s commitment to achieving the principal’s goal. The success of which is measured by the agent’s level of commitment at the beginning and end of the relationship, which is represented in Table 6.9 as being the initial commitment and final commitment and both are principal referential (i.e., information requirements 1c and 4a).

The use of these variables in Table 6.9 in addressing the information requirements and in simulating SERA and SIR agent is demonstrated in Figure 6.9 below. The details of which are discussed in the following sections 6.8.1 and 6.8.2.

Figure 6.9 - Modelling the Information Requirements (Variables) of Simulation 1

Source: Figure 6.5 and Table 6.9
6.7.3 Refinement and Specification of the SERC (Simulation Two)

The informal four-stage refinement process for the socio-environmental rationalist multi-agent community (SERC) is presented in Table 6.10 below. The refinement process works from the model of the socio-environmental rationalist multi-agent community (SERC) (Figure 6.7), which will be used to simulate the socio-environmental rationalist multi-agent community (SERC) (the EU). It is similar to simulation one with some differences to account for the multi-agent component. Multiple SERA groups are constructed with their parameters (i.e., defaultcomm (Pc) and InstnAsso (Dg)) set differently to create variance instances of SERA.

The last stage of the process is also crucial for simulation two. As it is the information requirements identified in stage 4 that will used to construct the simulation. These information requirements are quite similar to those of the first simulation and therefore use similar variables. Table 6.9 also presents the variables to be used in expressing the information requirements mentioned above for simulation two. The only difference pertains to one variable and that is the variable measuring the relative importance of institutional influence (InstnAsso or Dg), which is necessary to distinguish amongst agents in a multi-agent setting, which is noted in the Table. The principal’s interests are also represented in the relationship through the multiple agents’ commitment to achieving the principal’s goal (as per simulation one).
### Table 6.10 - Informal Four stage Refinement Process for the SERC

<table>
<thead>
<tr>
<th>Stage in the Refinement process</th>
<th>Application Domain: SERC Framework</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stage 1:</strong> Role Identification</td>
<td>Roles involve the utilisation of the capabilities present within the socio-environmental rationalist multi-agent community (SERC) framework</td>
</tr>
<tr>
<td></td>
<td>Preceptive, and reactive to the environment and peers</td>
</tr>
<tr>
<td></td>
<td>Deliberative in reasoning about common goal(s) and Informative through perceptive knowledge and change</td>
</tr>
<tr>
<td></td>
<td>Proactive in developing mutual interests to achieve goal(s)</td>
</tr>
<tr>
<td></td>
<td>Communicative through plan implementation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage 2: Responsibilities of each role and goal to attain</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Develop perception of environment and peers</td>
</tr>
<tr>
<td></td>
<td>Deliberate about collective action given BDI and attained knowledge through experience or changes</td>
</tr>
<tr>
<td></td>
<td>React to initial perceptions</td>
</tr>
<tr>
<td></td>
<td>Communicate resolve</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage 3: Determine plans for each goal and the context for application</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Observe the environment and attain an initial perception about common goal(s)</td>
</tr>
<tr>
<td></td>
<td>Develop a stance towards attaining common goal(s)</td>
</tr>
<tr>
<td></td>
<td>React by directing efforts towards achieving common goal(s)</td>
</tr>
<tr>
<td></td>
<td>Convey resolve for common goal(s)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage 4: Information requirements for each plan and goal</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Environmental factors: institutional weightings of power and uncertainty.</td>
</tr>
<tr>
<td></td>
<td>Agent factor: indicating level of contribution e.g., commitment towards attaining common goal(s) (Pc)</td>
</tr>
<tr>
<td></td>
<td>Environmental factors: probability of institutional change and probability of affecting agent behaviour.</td>
</tr>
<tr>
<td></td>
<td>Institutional factors: relative importance of institutional influence accounts for differences amongst agents in multi-agent setting (Dg)</td>
</tr>
<tr>
<td></td>
<td>Agent factor: perception of these and their influence determine stance</td>
</tr>
<tr>
<td></td>
<td>Varied stances require varied reaction:</td>
</tr>
<tr>
<td></td>
<td>1. no affect stationery commitment,</td>
</tr>
<tr>
<td></td>
<td>2. positive affect increasing commitment,</td>
</tr>
<tr>
<td></td>
<td>3. negative affect decreasing commitment</td>
</tr>
<tr>
<td></td>
<td>Agent factor: indicating final level of contribution towards attaining the common goal(s) (Ca)</td>
</tr>
</tbody>
</table>

Note: Changes for SERC is shown in bold. Only these changed information attributes are labelled.
Chapter 6: Formulating the Agent

The use of these variables in Table 6.9 in addressing the information requirements and in simulating the socio-environmental rationalist multi-agent community (SERC) is demonstrated in Figure 6.10 below. The details of which are discussed in the following section 6.8.3.

Figure 6.10 - Modelling the Information Requirements (Variables) of Simulation 2
6.8 Information Requirements and Simulation

The four sets of capabilities: Perception (P), Deliberation (d), Reaction (R) and Communication (C) are now to be interfaced so as to provide linkages between Perception (initial perception, Pa) and communication of commitment (final commitment, Ca) via SERA, SIR, and SERC Deliberation (D) and associated Reactions (R). This is one of several possible developments.

6.8.1 Information Requirements and Simulation for SERA

Perception(s), P

The first information requirement to be simulated is derived from an observation of the environment and that achieved from an initial perception of the relationship. The environment is evaluated through an observation of the influential nature of its institutions. This influence is measured by the level of institutional power and uncertainty. Power pertains to the intensity of institutional influence, with the variable InstnPow assessed a value which can be low to high (0 to 100). Uncertainty pertains to the variability of its influence, with the variable InstnUncern assessed a value which can be nil to large (0 to 100). Two institution specific variables for simulation are thus introduced: the institutional power of its influence (InstnPow or Pa) and the institutional uncertainty of its influence (InstnUncern or Pb).

With regards to the initial perception of the relationship, each SERA is assumed to have a pre-conceived perception of the relationship and hence, a predetermined level to which they will commitment their effort. This is labelled as the default commitment (defaultcomm… or Pc). It is agent specific but is also referential of the principal’s interests. A random value of zero (0) to one (1) will be assigned to represent the agent’s commitment. It is made random as no exact value for this agent's default commitment level can be ascertained due to the heterogeneity of SERA. It is a positive default commitment value because it is initially assumed that the agent desires to meet his or her commitment in accordance with the principal's interest, but to what extent it is not known. This may be with minimal effort or full
effort and hence, a random positive value of zero (0) to one (1) is assigned. This finalises the first of the information requirements to be simulated.

**Deliberation(s), D**

The second information requirement to be simulated introduces the role of institutional influence, environmental change and knowledge to reinforce agent behaviour. A socio-environmental rationalist agent’s (SERA’s) commitment during the relationship is effected by the influence they receive from their institutional affiliation and interaction, which will determine their stance towards the attaining the goals of the relationship. Whether institutional influence heightens or reduces the initial level of commitment is known as the benefit of informing ($benefitInform$ or $Da$), and the cost of informing ($costInform$ or $Db$) respectively. These variables are relationship specific, and it may or may not happen with every institutional affiliation and interaction the agent experiences. There is thus a probability of this influence occurring, known as the probability of informing ($probInform$ or $Dc$). The influence is likely to be stronger in times of high probability than in times of low probability (0 to 100). This also is a relationship specific variable to be simulated. Collectively these represent the given state of the relationship.

The agent’s knowledge of the above variables, through institutional affiliation and interaction, affects their commitment to the relationship. This is determined by the influential power of institutions ($instnPow$ or $Pa$), and the variations in institutional influence ($instnUncern$ $Pb$). The result of which is an informed perception of the relationship. Variables regarding this are labelled $perceivePb$ (perception of $probInform$ or $Df$), $perceivePo$ (perception of $benefitInform$ or $Dd$) and $perceiveVe$ (perception of $costInform$ or $De$). Collectively these represent the informed state of the relationship. It is these variables that are influenced by institutionally specific variables and it is these variables that reinforce agent behaviour. There is thus a given state and the informed state for the relationship. This can be likened to observing the state of a nation’s economy prior to an election. There are the given economic indicators and statistics, and then there is the informed understanding of the implications of those indicators and statistics through the interpretations of relevant institutions such as political groups and governmental organisations. The
interpretation considered and valued by an individual ultimately informs their knowledge and their behaviour in voting. Existing knowledge also informs behaviour when the probability of institutional influence is less than probable (i.e., less than 50 per cent). This finalises the second of the information requirements to be simulated.

**Reaction(s), R**

The third information requirement addresses the agent’s reaction to the stance adopted towards his or her commitment to the relationship. SERA reacts to the changes in the environment when the agent's perception of the probability of informing is greater than 50 per cent (0.5). Should this probability be greater than 0.5 then the agent can either act positively (increasing their commitment towards the relationship) or negatively (decreasing their commitment towards the relationship). This is labelled as $reaction1$ (Rb) and $reaction2$ (Rc) respectively. Should the probability be less than 0.5 then the agent does not react and uses their existing knowledge continuing to exhibit a level of commitment equivalent to that upon initiation of the relationship. This is labelled as $reaction0$ (Ra). This finalises the third of the information requirements to be simulated.

**Communication, C, of Commitment**

The last information requirement addresses the agent’s resolve towards the principal-agent relationship. This is agent specific and is labelled the final commitment ($finalcomm$ or Ca). Institutional affiliations and interactions reinforce the perceptions of a SERA which may reinfluence their behaviour and hence their commitment. This may or may not be in accordance with the principal's interests and hence, their commitment may be a positive or negative value. It is calculated by increasing or decreasing the default commitment by the value of the perception, i.e., $perceivepo$ (Dd) or $perceivene$ (De) respectively which ever is greater. This finalises the last of the information requirements to be simulated.
The workings of the simulation one can be summarised by a relationship:

\[ C \sim R(P) \text{ given } D\#
\]

That is, the communication of final commitment is dependent upon an agent’s reactions to perceptions given their deliberations.

The above has demonstrated the information requirements necessary to simulate the SERA model. Collectively executed as a set of threads of required behaviour they simulate the workings of SERA. A demonstration of which is presented in Chapter 7 with discussions of the tool of the simulation, NetLogo.

### 6.8.2 Simulating SERA and SIR

Compared to SERA, a SIR (a self-interested rationalist) agent has information requirements that differ with respect to the:

- **P.** Perception component of the first information requirement. SIR agents are assumed to be homogenous in acting so as to maximise their own utility regardless of the principal’s goal(s). This may well be contrary to the principal's interest (also in zero sum game) and would represent an initial negative commitment towards achieving the principal's goal. This is the assumed situation in the simulation, and in much of agency (section 2.3.5). Other situations could be simulated, as will be discussed in the final chapter.

- **D.** Role of institutional influence, environmental change and knowledge. The SIR agent is not influenced by these factors. As, this agent's behaviour in the relationship is influenced by his or her need to maximise his or her own utility.

- **R.** Reaction to the stance adopted towards his/her commitment to the relationship.

- **C.** An agent’s resolve towards the principal-agent relationship.
These differences are captured in the simulation by:

1. A random commitment value towards achieving the principal's goal is thus assigned ranging from negative one (-1) to zero (0) is assigned. As, the level of commitment exerted may be with minimal negative effort or substantial negative effort. This is labelled as the default commitment (defaultcomm… or Pc) and is the agent specific variable to be simulated.

2. An agent that does not engage in any perceptive or deliberative reasoning but rather continues to react with self-interest regardless of the influential probability of institutional affiliation and interaction, i.e., only reacting to behaviour favouring a negative commitment.

3. Commitment continues to be a negative regardless of any changes in the institutional environment. This is labelled as reaction3 or Rd.

4. The agent’s resolve towards the principal-agent relationship is labelled the final commitment (finalcomm or Ca). It is calculated through deducting the costinform or Db value from the default commitment value of the SIR agent. This provides a negative commitment value which reinforces the uncooperative behaviour of the self-interested rational (SIR) agent.

The SIR agent is thus simulated similarly to a SERA with the variables relating to institutional influence (variables Da through to Dc) set to zero. The SIR agent is a special case of agent behaviour (i.e. there is no institutional influence). SERA, on the other hand, represents a broader and general model of agent behaviour, one that is inclusive of institutional influence.

Such are the information requirements necessary to simulate SERA in conjunction with the SIR agent (SIR). In simulation one both will be executed simultaneously as a set of threads of required behaviour for each type. A demonstration to be presented in Chapter 7.
6.8.3 SERC Information Requirements and Simulation

Perception(s), P

The first information requirement to be simulated is derived from an observation of the environment and that achieved from an initial perception about the common goal established by the informing agent within their environment. The environment is evaluated through the influential nature of its institutions. The influence of which is measured by the level of influential power and uncertainty. The first pertains to the intensity of its influence, which can be low or high (0 to 100). The other pertains to the variability of its influence, which can be nil or large (0 to 100). This therefore introduces two institution specific variables for simulation: the institutional power of its influence (InstnPow or Pa) and the institutional uncertainty of its influence (InstnUncern or Pb).

With regards to the initial perception of the common goal each SERA group within the multi-agent community has a pre-conceived perception of the common goal and hence, a predetermined level to which they will execute effort in attaining the common goal. This is labelled as the default commitment (defaultcomm… or Pc) and is agent specific referential of principal(s) interests. Each of the initial nine EU members and additional six EU members are classified according to their accounting systems into one of the four socio-environmental rationalist agent groups. A default commitment value is assigned to each agent group. This value is the same for all agents in their agent group; nations (agents) within the groups are similarly developed and have similar accounting systems and thus, are likely to be able to decide to commit at similar levels. The default commitment level for all agent groups will vary between zero (0) and one (1). The set commitment levels are positive and are based on their initial reaction to the Directives and harmonisation process. Table 6.11 presents the assigned commitment values.

---

19 The titles of the accounting systems coincide with that of the socio-environmental rationalist agent groups. For example, a nation within the Anglo-Saxon accounting system, i.e., the UK, is classified as an Anglo-Saxon socio-environmental rationalist agent.
Table 6.11 – Assigned Default Commitment Values of Member Nations

<table>
<thead>
<tr>
<th>Agent Group</th>
<th>Commitment Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anglo-Saxon Agent Group</td>
<td>0.25</td>
</tr>
<tr>
<td>Germanic Agent Group</td>
<td>0.50</td>
</tr>
<tr>
<td>Latin Agent Group</td>
<td>1.00</td>
</tr>
<tr>
<td>Nordic Agent Group</td>
<td>0.75</td>
</tr>
</tbody>
</table>

The Anglo Saxon agent group is assigned a low commitment value, as this particular group joined in the later stages of Directive development and with it, it brought its own agenda reforming the Directive formation process. This detracting from collective effort implied a low commitment to developing collective effort to attain the common goal. The Germanic agent group is assigned a neutral value as their incentive for collective effort arose from the pressure of the aftermath of WWII. Their commitment being out of necessity rather than sheer desire implied the assignment of a neutral commitment value. The Latin agent group is assigned the highest commitment value, as it was the initiator of the unification process. The Nordic agent group is assigned a high default commitment value. This group while not playing a primary role in initiating the unification process was very much interested in unifying and committing towards collective effort. Hence, the assignment of a high but lesser in value to that of the initiating group (the Latin group). This finalises the first of the information requirements to be simulated.

*Deliberation(s), D*

The second information requirement introduces the role of institutional influence, environmental change and knowledge to reinforce agent behaviour. A socio-environmental rationalist agent’s (SERA’s) group commitment during the relationship is effected by the influence they receive from their institutional affiliation and interaction, which will determine their stance towards the attaining the goals of the relationship. The extent of this is primarily determined by relative importance that institutional influence plays upon agent group behaviour.
Each agent group is given a weighting on the relative importance of this institutional influence (\textit{InstnAsso} or Dg). The weighting varies between zero (0) denoting no level of influential importance and one (1) denoting an extreme level of influential importance. The assignment of weightings is based on the institutional analysis provided in Chapter 4, the weightings of which are presented in Table 6.12 below.

<table>
<thead>
<tr>
<th>Agent Group</th>
<th>Weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anglo-Saxon Agent Group</td>
<td>0.75</td>
</tr>
<tr>
<td>Germanic Agent Group</td>
<td>1.00</td>
</tr>
<tr>
<td>Latin Agent Group</td>
<td>0.50</td>
</tr>
<tr>
<td>Nordic Agent Group</td>
<td>0.25</td>
</tr>
</tbody>
</table>

The Anglo Saxon agent group is assigned a high weighting as this group enforced its own accounting processes that were informed by its institutions upon the Directive formation process. The controlling influence demonstrated through this enforcement indicates that a high level of institutional importance is appropriate. The Germanic agent group is assigned a very high weighting because the strength of its institutions ensured that its own system was kept in operation even with the implementation of Directives in opposition to the system being used. The control evident by the opposition to the directives demonstrates that an extreme level of institutional importance is appropriate. The Latin agent group is assigned a neutral weighting as even though the initiation originated with this group and with their system, they were open to influence from other systems. The indecisive nature between the sources of influence (i.e., nationally or externally) demonstrates that a reduced level of importance in comparison to the other two agent group mentioned above is appropriate. The Nordic agent group is assigned a low weighting. The Nordic system while having several differences to the enforced Directives, which are heavily Anglo Saxon based, experienced relatively little difficulty in adopting the new system. This implies that the Nordic institutional system is relatively weak in stance and hence, provides the basis for the low weighting assignment.
Whether institutional influence heightens or reduces the initial level of commitment is known as the benefit of informing (benefitInform or Da), and the cost of informing (costInform or Db) respectively. These variables are relationship specific, and it may or may not happen with every institutional affiliation and interaction the agent experiences. There is thus a probability of this influence occurring, known as the probability of informing (probinform or Dc). The influence is likely to be stronger in times of high probability than in times of low probability (0 to 100). This also is a relationship specific variable to be simulated. Collectively these represent the given state of the relationship.

The agent’s knowledge of these variables through institutional affiliation and interaction affects their commitment to the attainment of the common goal(s). This is determined by the influential power of institutions (instnpow or Pa), and the variations in institutional influence (instnuncern or Pb). The result of which is an informed perception of about their commitment to the common goal. Variables regarding this are labelled perceivepb (perception of probinform or Df), perceivepo (perception of benefitInform or Dd) and perceivene (perception of costInform or De). Collectively these represent the informed state of the commitment to attaining the common goal(s). It is these variables that are influenced by institutionally specific variables and it is these variables that reinform multi-agent behaviour. There is thus a given state and the informed state for each relationship. Existing knowledge also informs behaviour when the probability of influence is less than probable. This finalises the second of the information requirements to be simulated.

Reaction(s), R

The third information requirement addresses the agent groups’ reaction to the stance adopted towards his or her commitment to the relationship. Each SERA group reacts to the changes in the environment when the agent groups’ perception of the probability of informing is greater than 50 per cent (0.5). Should this probability be greater than 0.5 then the agent group can either act positively (increasing their commitment towards the relationship) or negatively (decreasing their commitment towards the relationship). This is labelled as reaction1 or Rb and reaction2 or Rc respectively. Should the probability be less than 0.5 then the agent group does not
react and continues to exhibit a level of commitment equivalent to that upon initiation of the relationship. This is labelled as reaction0 or Ra. This finalises the third of the information requirements to be simulated.

**Communication, C**

The last information requirement addresses the agent’s resolve towards the multi-agent community. This is agent group specific and is labelled the final commitment \((\text{finalcomm}) \text{ or Ca}\). Institutional affiliations and interactions reinform the perceptions of SERA groups which may reinfluence their behaviour and hence their commitment. This may or may not be in accordance with attaining the common goal and/or the principal's interests and hence, their commitment may be a positive or negative value. It is calculated by increasing or decreasing the default commitment by the value of the perception, i.e., \(\text{perceivepo} \) (Dd) or \(\text{perceivevene} \) (De) respectively which ever is greater. This finalises the last of the information requirements to be simulated.

The workings of the simulation one can also be summarised by a relationship:

\[
C \sim R(P) \text{ given } D\# \land Dg
\]

That is, the communication of final commitment is dependent upon reactions to perceptions given deliberations and relative importance of institutional influence.

The above has demonstrated the information requirements necessary to simulate the socio-environmental rationalist multi-agent community (SERC) model. Collectively executed as a set of threads of required behaviour they simulate the workings of the socio-environmental rationalist multi-agent community (SERC), the second simulation. A demonstration of which is presented in Chapter 8.
6.9 Conclusion

This Chapter expounded upon the general reformulation of the transacting process presented in Chapter 3 to demonstrate agent behaviour as being instrumentally mutually dependent where institutional affiliations and interactions support, direct, assist and constrain agent behaviour. A framework developed to assist in this matter was labelled the SERA framework. The reformulation used at the individual and multi-agent community level concluded that a more informed understanding of agent behaviour can be obtained (c.f. formulation of the existing agent literature). The cases arrange important factors in influencing individual agent behaviour and link the perceptual input they receive from their institutional affiliations and interactions to final communication of commitment. With respect to the multi-agent community, the EU case demonstrates the importance of institutional variations in influencing agent behaviour towards achieving the collective goal or effort.

However, it is not sufficient to just specify cases and reach conclusions regarding the workings of the cases. These specifications were refined to develop a computational model of an individual SERA and a SERC. The workings of the conceptualisation have to be demonstrated, and this will be undertaken in the following two chapters through the computational simulation of the individual SERA with the SIR agent, and the SERC.
7. Socio-Environmental Rationalist Agent: Analysis and Simulation

The preceding chapter specified the formulations of the self-interested rationalist (SIR) agent and the socio-environmental rationalist agent (SERA). The operation of these formulated conceptualisations will now be demonstrated through a computational simulation of both an individual SERA and an individual SIR. The following sections will describe a computational simulation tool, NetLogo, which will be used to construct a simulation. A demonstration of the simulation is presented and examined. This will be performed in conjunction with an analysis of the results from the simulation. The analysis will be of both a visual and statistical nature. This will both demonstrate some of the usability and provide further support for the extended conceptualisation and formulation of agent behaviour. Other possibilities will also be apparent, as will be discussed in the final chapter. This chapter addresses the question of what behaviour is to be expected from the simulation of a SERA. Before the simulation is presented it is necessary to describe the computational simulation tool, NetLogo.

7.1 Modelling Agents and Simulation using NetLogo

NetLogo is an agent-based parallel modelling and simulation environment produced by the Centre for Connected Learning and Computer-based modelling at Northwestern University (Evans, Heuvelink and Nettle, 2003: 1). It is a programmable modelling environment for simulating complex natural and social phenomena developing or emerging over time (Wilensky, 1999: 1; Johnson, 2001: 165). Appendix 4 section A4.1 provides the protocols concerning the use of NetLogo.

7.1.1 Simulations in NetLogo

NetLogo simulations allow experimentation with a system in a rapid and flexible way that would be difficult to do in a real world situation or in a laboratory experiment (Wilensky, 1999: 1; Johnson, 2001: 166; Appell, 2002: 1). For example, certain
parameters may have to be kept constant and others may have to be varied systematically in order to study the effects of those parameters on the whole system, and this may prove to be difficult using traditional research techniques, as certain parameters are beyond the influence of the researcher (Strippgen, 1997: 474). This is particularly the case with attempting to experiment with the institutional affiliations and interactions of the agent in a dynamic environment. The sheer difficulty in performing this task is heightened even further when applied to the EU case. This case is simply too complex and large to be realistically examined and modelled using traditional research techniques such as laboratory experiments, surveys or interviews.

NetLogo modelling also enables the opportunity to observe a situation or circumstance with potentially less prejudice, as the underlying dynamics of a situation can be examined, such as the underlying motivations of agent behaviour. How is this possible? Within simulations hundreds and thousands of agents can be constructed and instructed to perform tasks in parallel with one another under various conditions to highlight the motivation of agent behaviour. Patterns of behaviour are programmed so that the emergent behaviour can be examined (Johnson, 2001: 168; Strippgen, 1997: 475). This makes it possible to explore the connection between the micro-level behaviour of individuals (i.e., BDI perceptual changes) and the macro-level patterns that emerge from the interaction of many individuals (i.e., communication and cooperation) in a dynamic environment. With respect to the current research this modelling program, therefore, provides an ideal environment for simulating and examining both individual and multi-agent socio-environmental rationalist behaviour.

There are however disadvantages of social simulations as stated by Gilbert and Terna (1999) and Gilbert and Troitzsch (1999). Firstly, simulations of complex social processes involve the estimation of many parameters and adequate data for making the estimates can be difficult to come by. Secondly, a problem which has to be faced in all simulation work is the difficulty of validating the model. Sometimes a statistical solution to these problems is advocated, but in practice it is hard to abide by the kinds of assumptions which conventional statistical tests require. Lastly, they are mainly task-oriented, rather than model-oriented, and make it difficult to understand the difficulties found in translating conceptual to computational models. The first and the third disadvantages are addressed in section 6.7 of Chapter 6 in developing the
workings of the simulation. The second disadvantage is addressed in this Chapter and the next through visual and statistical analysis of the results produced.

### 7.1.2 Requirements and Attributes of NetLogo

In NetLogo the world consists of three types of actors: turtles, patches, and the observer (Wilensky, 1999: 56).

- **Turtles** are agents that move around and interact in the world. Agents can be programmed with closer properties and behaviours. The world is two dimensional and is divided up into a grid of patches. Scenes can be set, such as an investor operating in a financial market or an agent operating in an institutionalised setting.

- Each **patch** is a square piece of "ground" which can not move but over which turtles can move. In other words, the patch is a component of the world that the turtle interacts with, e.g., the financial market or institutionalised setting within which the investor or agent are active in.

- The **observer** doesn't have a location but looks over the world of turtles and patches manipulating and controlling their behaviour. The observer, in other words, is the researcher specifying agents, adjusting variables and ensuring the smooth operation of the simulation. For example, this would involve the observer controlling and adjusting the variable pertaining to market or institutional volatility and the variable pertaining to the sensitivity of the investor (agent) to changes in the environment.

The NetLogo interface tab enables the observer to perform his or her role. Figure 7.1 below provides an example of the interface tab in a NetLogo modelling environment. This interface tab is part of simulation one. In it, agents are presented with variations in their institutional environment affecting their level of commitment towards achieving the principal’s goal. This model, therefore, includes two kinds of agents, the SERA and the SIR agent. It demonstrates how these two different strategies perform when operating in an environment of change.
Chapter 7 – Socio-Environmental Rationalist Agent: Analysis and Simulation

Figure 7.1 - NetLogo Modelling Environment: Interface Tab of Simulation One

Note: Key settings are four slider bars in the north-west quadrant. The rest of the interface tab is output from the simulation at the stage of its run.
The Interface tab within a NetLogo Model contains buttons, switches (visual representation for true and false variables), sliders (global variables), monitors (display the value of any expression) and the graphics window setting (depicts the turtles and patches interacting). Sliders and switches alter model settings and allow the researcher to interact with the model (Wilensky, 1999: 16). An example of a slider in Figure 7.1 is the InstnPow slider, which is positioned under the heading of ‘variables affecting institutional affiliation and interaction’. By altering the settings of the slider and then running the model, the observer can see how agents react to the change. This can present a deeper understanding of the phenomena being modelled, which in this case is commitment towards attaining the principal’s goal (Wilensky, 1999: 18).

The settings within the model, therefore, give the opportunity to work out different scenarios. The effectiveness of this flexibility is further enhanced through the use of a behavioural space. This allows the researcher to explore the model's "space" of possible behaviours and determine which combinations of slider values cause the behaviours of interest (Wilensky, 1999: 84). This BehaviourSpace is represented in Figure 7.1 by the Command Centre, located at the south-east quadrant labelled as ‘output of full run’. The command centre shows variable values at the stage of the run. In this case there are four variables commanding the simulation: two institutional variables (InstnPow and InstnUncern) and two calculated commitment values.

A full run of the simulation entails the specification of a subset of values from the ranges of each slider. The model is then run with each possible combination of those values and, the results from the run are recorded (Wilensky, 1999: 84). The results are presented numerically and visually. In its raw form, this data is a long series of numbers which is difficult to interpret it is partially visible in the command centre. This data is transferred to statistical software packages for analysis, such as MAPLE and SPSS.

Graphically the run data is presented as a behaviour plot in an evaluation window. This is demonstrated in Figure 7.1 by the plot of ‘average commitment’ over ‘each time-step’. Each time step represents a discrete event of agent and institutional interaction where the agent encounters variations in the dimensions of the relationship.
in meeting their commitment towards attaining the principal’s goal. The particular run shown in Figure 7.1 has been completed. It is each calculated commitment value that is the output used for analysis.

The simulation represents a replication of the world to which conditions are set by sliders. Given the set conditions the simulation is programmed to generate a possible reflection of what may result if the set condition occurred in the world. The results obtained therein are compared and contrasted to those obtained in existing research and the situation of the case in the real world. This is demonstrated in Figure 7.2. In the figure the depicted simulation frame encapsulates the agent operating within an institutional environment. The conditions of the environment are set by the research and hence, it is partially positioned outside the simulation frame. Such conditions include the influential institutional power (InstnPow), the influential institutional variability (InstnUncern) and relative importance of institutional influential (InstnAsso). The agent has conditions imposed upon by the simulation (the state of the relationship) and that by the institutional environment (the perception of the environment) and hence, the agent is positioned between the two. The programmed run (demonstrated by the wavy arrow passing through the institutional environment and then the agent in Figure 7.2) produces a simulated version of the agent’s behaviour in the real world. This is their simulated commitment towards achieving the principal’s goal. The results from this are compared and contrasted to the agent’s actual behaviour in the real world (demonstrated by the directional arrow feeding forward to the real world). This is their existing commitment towards achieving the principal’s goal given the state of their real world. A simulation is thus a model representation of a real phenomenon which can generate a behaviour comparable with some behaviour of interest in the real world, and this being agent behaviour in a principal-agent relationship.
NetLogo is an appropriate simulation device for this research. It provides the necessary modelling environment in simulating the individual and multi-agent socio-environmental rational behaviour and the necessary techniques to analyse such behaviour. Its use will, therefore, assist in examining the resultant behaviour of SERA. Appendix 4 section A4.2 provides a review of an existing NetLogo simulation examining the rational behaviour of agents. Details of findings and limitations are discussed therein.

### 7.2 Demonstration of Simulation One

The simulation is now discussed in detail with relevant snapshots of its workings. Figure 7.1 represented a screen shot of the interface tab for simulation one. This interface tab reveals the reactions of SERA and the SIR agent to the changes in model settings.

There are therefore two types of agents in this model - the SERA (coloured blue) and the SIR agent (coloured red). Each is assigned divergent levels of default commitment (defaultcomm (Pc)) (discussed in section 6.8.1 and section 6.8.2). They
live in a 2D grid-world consisting of 361 (19 x 19) patches (as presented in the north-east corner of Figure 7.1). Each patch represents a 'relationship' with a principal. A 'relationship' representing the initial exchange between the principal and the agent in which the agent is committed to achieving the principal's goal. The dimensions of the patch will thus capture the agent’s deliberating process (D set) in meeting their commitment towards the principal. Each relationship (patch) has a:

1. Probability of being informed by institutional affiliations and interactions (probinform\textsuperscript{1} or Dc, ranging from 0 to 1). This is the first dimension.
2. Benefit of informing which heightens their commitment (benefitinform or Da, ranging from 0.1 to 10 commitment points). This is the second dimension.
3. Cost of informing which reduces their commitment (costinform or Db, ranging from -0.1 to -10 commitment points). This is the third dimension.

Patches are coloured in one of the five shades of yellow which is demonstrated in the graphical monitor of Figure 7.1. The colour of the patch is determined by the probability of informing (probinform Da) in increments of 0-20, 20-40, 40-60, 60-80 and 80-100; the shade of yellow darkens as the values of the increments increase. The darker shaded patches represent more difficult relationships, i.e., where the agent's behaviour is highly influenced by factors other than the principal's interests such as institutional influence, which may or may not be to the betterment of the principal’s interest. Should the agent be on a darker shaded patch the probinform (Da) is therefore greater than 60 per cent (>0.6). Alternatively, should the agent be on a lighter shaded patch the probinform (Da) is therefore less than 40 per cent (<0.4).

Each agent as they move across the 2D grid-world randomly they encounter a change in the dimensions of their relationship through their move to a different patch (denoted as a time-step). This happens ten times with a single run of the simulation where the values for InstnPow (Pa) and InstnUncern (Pb) are fixed during the single run and then the value for InstnUncern (Pb) is changed for the next 10 single runs to account for the 11 combinations with InstnPow (Pa) fixed. This represents one combination set and this needs to be undertaken another 10 times whereupon the

\textsuperscript{1} Table 6.9 contains the full variable set.
value of \textit{InstnPow} (Pa) changes for each combination set. A full run therefore accounts for 11 single runs applied for 11 combination sets\textsuperscript{2}.

Each time-step represents a discrete event with differentiated patch dimension values. This movement in patches (i.e., the series of ten time-steps) depicts the workings of a dynamic environment accustomed to change. It is with every time-step that the agent reconsiders his or her initial commitment (\textit{defaultcomm} or \textit{Pc}) as the dimensions have changed. The effect of the reconsideration is recorded as his or her \textit{finalcomm} (Ca) at the end of each time-step in every single run. The only time the initial commitment (\textit{defaultcomm} (Pc)) is carried forward is when the probability of institutional influence is less than likely (i.e. when \textit{probinform} or Da is set <0.50)

\textit{Probinform} (Da), \textit{benefitinform} (Db) and \textit{costinform} (Dc) are dimensions of the patch that agents are on at any given time. These dimensions collectively represent the given state, each of which will change with every time step (depicted by a movement of patches). The interface tab within Figure 7.1 gives an average value of each given state’s dimensions at each time step for all agents, e.g., in Figure 7.1 \textit{probinform} (Da) is 0.04. It is the agent’s perception of these dimensions that determines the level of their influence upon his or her behaviour. These are labelled:

1. \textit{perceivepb} (Df) to represent the agent’s perception of the dimension of \textit{probinform} (Da), and is the fourth dimension.
2. \textit{perceivepo} (Dd) to represent the agent’s perception of the dimension of \textit{benefitinform} (Db), and is the fifth dimension.
3. \textit{perceivene} (De) to represent the agent’s perception of the dimension of \textit{perceivene} (Dc), and is the sixth dimension.

\textsuperscript{2} In a single run \textit{InstnPow} (Da) is set at 0 and \textit{InstnUncern} (Db) is set at 0 and this is run 10 times, i.e., the agent moves to 10 different patches given the set Institutional variables. In the next single run \textit{InstnPow} (Da) is set at 0 and \textit{InstnUncern} (Db) is set at 10 and this is run 10 times. This will continue another 9 times until all values of \textit{InstnUncern} (Db) are explored given that \textit{InstnPow} (Da) is set at 0. This is one combination set. In the next combination set \textit{InstnPow} (Da) is set at 10 and \textit{InstnUncern} (Db) varied for each single run. This continues another 9 times until \textit{InstnPow} (Da) is set at 100 and \textit{InstnUncern} (Db) varied. Hence, there are 11 single runs applied for 11 combination sets.
These dimensions collectively represent the informed state which will also change with every time step (also depicted by a movement of patches) and vary across every agent because the agent is a heterogenous actor with their own perceptions that inform their beliefs, desires and intentions and eventually their behaviour. The interface tab within Figure 7.1 gives an average value for each of the informed state’s dimensions at each time step for all agents, e.g., in Figure 7.1 perceivepb (Df) is 0.654.

There is thus a given state and the informed state for each relationship. Neither of these states will be the same value at any given time step. As, the informed state is dependent upon the perception the agent receives from their institutional influence and hence, is at variance form the uninfluential given state. The given and informed states are both relevant to the SERA whose behaviour is influenced by their environment (i.e., institutional affiliation and interaction). While the SIR agent is aware of the given state (i.e., the presence of institutions), the informed state (i.e., the role of institutions) are not influential to the SIR agent's behaviour. As, this agent's behaviour in the relationship is influenced by his or her need to maximise his or her own utility, an institutional structure of self-absorption that is dissimilar to that of the given and informed states which incorporate the environment (i.e., institutional affiliation and interaction).

The influential level that the informed state has upon the behaviour of the SERA is determined by the influential power of institutions (instnpow (Pa) slider as shown in Figure 7.1) and the variations in institutional influence (instnuncern (Pb) slider as shown in Figure 7.1). The values of which can be set by the respective sliders on the interface tab. The influential power of institutions can vary from 0 (no influence) to 100 (substantial influence) denoting the level of involvement of institutions, i.e., the higher the value the greater their involvement and hence, the influential power of institutions. This is set at 30 in Figure 7.1; a low value. The instnpow (Pa) slider, therefore, affects the agent's perception of probinform (i.e., perceivepb (Df)), i.e., the greater the influential power the higher the probability that the agent's behaviour will be influenced by institutional affiliation and interaction. There can also be variations in institutional influence from 0 (no variation) to 100 (complete variation) denoting the variation from the agent's initial perceptions, i.e., the higher the value the greater the variation of subsequent perceptions in comparison to the agent's original
perceptions. This is set at 50 in Figure 7.1; a neutral value. The instnuncern slider, therefore, affects the agent's perception of benefitinform (i.e., perceivepo (Dd)) and perception of costinform (i.e., perceivene (De)), i.e., the greater the value the greater the chances that a variation in perceptions could result in an increased commitment or a decreased commitment towards the attainment of the principal's goal.

Both the above moderators (InstnPow (Pa) and InstnUncern (Pb)) determine the standard deviation used for the normal distribution of which the mean is the true value of probinform (Da), benefitinform (Db) and costinform (Dc) of the patch. A value within the deviation to the mean is the value for the informed dimensions of perceivepb (Df), perceivepo (Dd) and perceivene (De). It is a random number because each agent is an individual, interpreting and reacting differently to a given situation (Lamper and Johnson, 2002: 1) and hence, a precise number is inappropriate. The greater the value of these two sliders, the greater the deviation and hence, the influence of institutional affiliation and interaction in informing the agent's behaviour, and subsequently in adjusting their commitment towards attaining the principal's goal.

How is each agent presented with these states?

Agents within the simulation are depicted as persons. One person for each type of agent is present. This is depicted in the interface tab of Figure 7.1 both visually through the monitor and numerically through the setting of agent number sliders. These agents move across patches with every time step, and thus are presented with a relationship of different conditions (i.e., a patch with different values for probinform (Da), benefitinform (Db) and costinform (Dc)) with their principal at every time step. At each time step every agent must decide how to react to the relationship presented, i.e., whether to commit further or not from the default commitment (defaultcomm (Pc)) presented. This decision is made according to the agent's process of deliberation or reasoning. The two types of agents have different deliberating processes:
Chapter 7 – Socio-Environmental Rationalist Agent: Analysis and Simulation

1. The SERA (presented as a blue person in Figure 7.1) engages in perceptive and deliberative reasoning derived from being informed by institutional affiliation and interaction. Therefore, the agent only reacts when the probability of informing (probinform (Da)) exceeds that of not informing. When this is not the case his or her final commitment level (finalcomm (Ca)) is not altered from that of the default commitment value (defaultcomm (Pc)), and the agent proceeds with his or her behaviour uninfluenced by the low probability of institutional affiliation and interaction.

2. The SIR agent (presented as a red person in Figure 7.1) does not engage in any perceptive or deliberative reasoning but rather continues to react with self-interest regardless of the influential probability of institutional affiliation and interaction, i.e., only reacting to uncooperative behaviour favouring a negative commitment.

How then is this reaction calculated and the commitment level determined? Figure 7.3 depicts the procedures tab which demonstrates a snapshot of the programming language of simulation one, and Appendix 4 section A4.3 provides the full details of the programming language of simulation one in English-Like commands. Put in simple terminology, SERA reacts when the agent's perception of the probability of informing (probinform (Da)) is greater than 50 per cent (0.5). Should this probability be greater than 0.5 then the value for the default agent's commitment (defaultcomm (Pc)) is increased or decreased by the value of the perception, i.e., perceivepo (Dd) or perceiveve (De) respectively which ever is greater. The result is the agent's final commitment (finalcomm (Ca)).
Figure 7.3 - A Snap Shot of the Programming for Simulation One

```plaintext
; to setup
  clear-all-plots
clear-graphics
setup-persons
setup-globals
setup-patches
  set clicks i
end

; to setup-globals
  ifelse (display? = true)
    (display)
    (no-display)
  set average-commitment (sum values-from [sociocultural] commitment) / (count sociocultural)
  set average-commitment-selfinterest (sum values-from [selfinterest] commitment) / (count selfinterest)
  set average-prohibit-sociocultural (sum values-from [sociocultural] prohibit) / (count sociocultural)
  set average-benefit-sociocultural (sum values-from [sociocultural] benefit) / (count sociocultural) / 10
  set average-perceive-sociocultural (sum values-from [sociocultural] perceive) / (count sociocultural)
  set average-perceive-sociocultural (sum values-from [sociocultural] perceive) / (count sociocultural)
end

; to setup-persons
  set-default-shape turtles "person" ;; applies to both breeds
  create-sociocultural [sociocultural]
  create-selfinterest [selfinterest]
  end turtles |
  if (breed = selfinterest) [set defaultcolor selfinterest random-int-or-float 1.0]
  if (breed = sociocultural) [set defaultcolor sociocultural random-int-or-float 1.0]
  set pricelevel 0
  set percent 0
  set traction 0
  if (breed = sociocultural) [set color blue]
  if (breed = selfinterest) [set color red]
  set heading random-int-or-float 360
  jump random-int-or-float 50
end

to setup-patches
  end patches |
    set prohibit-sociocultural random-int-or-float 1.0
    if prohibit-sociocultural <> 0 [set prohibit-sociocultural 0]
    set price (randomform 1 5) + 43
    set benefit-sociocultural random-int-or-float 10
    if benefit-sociocultural < 0 [set benefit-sociocultural 0.1]
    set continue-sociocultural random-int-or-float 10
    if continue-sociocultural <> 0 [set continue-sociocultural 0.1]
end
```
Should the probability be less than 0.5 then the agent does not react and the final commitment value \((\text{final comm}(\text{Ca}))\) remains as the default commitment value. This final commitment value \((\text{final comm}(\text{Ca}))\) is presented in the interface tab of Figure 7.1 graphically and through the average output. In Figure 7.1 this is a negative final commitment \((\text{final comm}(\text{Ca}))\) value of -0.557. With regards to the SIR agent his or her commitment continues to be a negative regardless of any changes in the institutional environment. This is attained through deducting the \(\text{costinform}(\text{Dc})\) value from the default commitment value \((\text{default comm}(\text{Pc}))\) of the SIR agent. This provides a negative final commitment \((\text{final comm}(\text{Ca}))\) value which reinforces the uncooperative behaviour of the self-interested rational (SIR) agent. This final commitment value \((\text{final comm}(\text{Ca}))\) is presented in the interface tab of Figure 7.1 graphically and through the average output. In Figure 7.1 this is a negative final commitment \((\text{final comm}(\text{Ca}))\) value of -0.399.

It is important to remember that this is not the only simulation model that can be constructed demonstrating SERA and SIR intention. As there is no unique model for agent-based systems. There are many ways to construct a simulation that exhibits the dynamics in question. The variables used in the simulation model are just one approach to undertake. In general as an underlying foundation models should share the following common elements:

1. Population of heterogenous agents,
2. Strategies upon which agents base their actions, and
3. A method of aggregating agent behaviour into a global outcome (Lamper and Johnson, 2002: 5).

Simulations One exhibits such elements. It consists of heterogeneous agents, strategies which determine their actions, and a global outcome of commitment. The simulation demonstrates the rationalisation process of an individual SERA in comparison and contrasts to the self-interested rational (SIR) agent with sole emphasis on the process of institutional influence. The above sections discussed and demonstrated the process through which the first simulation was designed and performed (i.e., the strategy). The following section will now discuss the results attained from the simulation and their analysis.
7.3 Analysis of Results for Simulation One

7.3.1 Simulation and Output

A full run of the simulation entails that the program is run 11 times to account for every possible combination of the `instnpow` slider (i.e., value ranges from 0 to 100 in 10 value increments) and `instnuncern` slider (i.e., value ranges from 0 to 100 in 10 value increments). Recall that a single run lasts 10 time steps. For every time step a final commitment (`finalcomm (Ca)`) value is recorded in the command centre. This implies that there are 1210 (i.e., 11 combination sets x 11 single runs x 10 time steps) measurements of final commitment (`finalcomm (Ca)`) for each agent, and hence there are a total of 2420 (1210 measurements x 2 agent types) values to be analysed.

A full run of the simulation, therefore, provides a long series of numbers for both the SERA and the self-interested rationalist agent (SIR). These numbers represent the final commitment (`finalcomm (Ca)`) values of the SERA and the SIR agent in varying degrees of institutional influence. Analysis of the results produced from the simulation consists of two types. The first is visual and the second is statistical.

7.3.2 Visual Analysis: the Process

The long series of numbers produced by a full run of the simulation, mentioned above, in its raw form is difficult to interpret. A visualisation\(^3\) of this data is one method of presentation, statistical analysis is another. The method of visualisation to be used is a 3D contour graph. With the multiple data set produced by the simulation (i.e., data for the SERA and data for the SIR agent) a 3D surface graph can assists in the simultaneous analysis and comparison through the sequencing of images. Maple 9.5, a mathematical software tool, will be used to prepare the 3D contour graphs.

\(^3\) The visualisation of data encodes digital information into analogue form for easy access by the user. This can be likened to transforming tabulated data into graphical visualizations. Information can be visualised in a variety of ways, using traditional devices such as pie charts, scatter graphs, line charts usually held within a two-dimensional data rectangle; and/or using computer graphics that allow more sophisticated approaches, such as multiple three-dimensional graphs, animated graphs, and real time monitoring. Different formats are suitable for different purposes. For example, a scatter graph allows clustering of large sets of data. A line graph, on the other hand, can allow comparison of two or more sets of data as they change in value.
Appendix 2 section A2.2 provides further information on the process, benefits and limitations of visualisation and 3D contour graphs. The following section will now analyse the simulation data using 3D contour graphs.

7.4 Visual Analysis: the Results

7.4.1 SERA Outputs and Presentation

Figure 7.4 below presents a 3D contour graph of the socio-environmental rationalist agent’s (SERA) commitment values for their intersecting InstnPow (Pa) and InstrUncern (Pb) Values respectively. It is presented within a box plot with a zero plot to distinguish between the positive and negative sections of the contour graph, and axis ranging from zero to one hundred (0-100) increasing in increments of ten. Figure 7.4 contains a top and bottom view of the contour graphs for the socio-environmental rationalist agent’s (SERA’s) commitment values given InstnPow (Pa) and InstrUncern (Pb) coordinates. Both perspectives are necessary given the contour is present within both the positive and negative sections of the box plot. The contour graph exhibits a great deal of variability; fluctuating between both positive and negative sections of the box plot. This volatility demonstrates the sensitivity to change and the influences of random processes (depicted by an agent’s movement across patches randomly, assigning themselves to differentiated dimensions throughout the simulation run). In addition, the simulation presents the movements of heterogenous agents acting within a dynamic environment; the results of which are unlikely to be static and predictable. Analysis of this complex contour graph necessitates simplification, which can be achieved through box plot division.
Figure 7.4 - 3D Contour Graph of the SERA Commitment Values at its Intersecting \( \text{InstnPow} \) (Pa) and \( \text{InstnUncern} \) (Pb) Values

Note: The Front axis of contours is labelled A (atomistic Society), U ('upheaval in society'), R (reforming society) and C ('controlled society') to highlight the reversal of axes that occurs with the change in perspective of the contour. The labels correspond to those presented in the matrix’s corners in Figures 3.3 and 7.4. A change in the perspective resulted from a flip of the contour graph to examine the bottom portion of the contour. These labels are intended as a guide for analysis and are presented in all contour graphs.
This box plot was initially introduced in Chapter 3 section 3.4 (see Figure 3.3). The contour box plots can be classified based on their \(InstnPow\) (Pa) and \(InstnUncern\) (Pb) coordinates. Recall that the variables of \(InstnPow\) (Pa) and \(InstnUncern\) (Pb) have a range from zero to one hundred. The coordinates are as follows:

1. 0 \(InstnUncern\) and 0 \(InstnPow\) pertains to a ‘atomistic society’ as there is no dimension of institutional influence whether it be in terms of the variability and/or power wielded. An example of an ‘atomistic society’ is scattered small bands of nomads traipsing sparsely populated areas, removing themselves from the traditional constructions of society and control. \((First\ Division)\)

2. 0 \(InstnUncern\) and 100 \(InstnPow\) pertains to a ‘controlled society’ as the power exhibited by institutions is unwavering and excessive. An example of a ‘controlled society’ would be Communist China in the 20\(^{th}\) Century. \((Second\ Division)\)

3. 100 \(InstnUncern\) and 0 \(InstnPow\) pertains to ‘upheaval in society’ as there is great institutional variability none of which have any influential power. An example of ‘upheaval in society’ would be post-war Iraq following occupation. \((Third\ Division)\)

4. 100 \(InstnUncern\) and 100 \(InstnPow\) pertain to a ‘reforming society’ as the uncertainty is wielded by powerful institutions that are implementing change and inadvertently creating variability. An example of a reforming society would be Russia and its move to a market economy. \((Fourth\ Division)\)

This four-part division is useful and adequate for present purposes and is presented in Figure 7.5 below. This basis will be used to assign EU nations in Chapter 8.
Figure 7.5 above presents these coordinates diagrammatically within a matrix, representing the box plot floor of the 3D contour graph at \( y = 0 \). The type of society pertaining to these coordinates is written into the corners of the square where the coordinates are located. The points towards the corners exhibit a stronger association to the assigned society type. The points towards the centre, on the other hand, exhibit a weaker association to the assigned society type. This centre of the box plot exhibits a mix of the elements of all the divisions, and therefore can not be labelled as being a particular society type but instead is labelled as the intermediate area. The effects’ of the tension between the two variables (\( \text{InstnPow} (\text{Pa}) \) and \( \text{InstnUncern} (\text{Pb}) \)) in this area are nullified as there is no significant push one way or the other. The agent in this area uses his or her own individual interpretation of the environmental situation, to act upon the commitment. As such this may be contrary to the nature of the commitment demonstrated in the labelled societies. This intermingling of divisions is demonstrated in Figure 7.5 by the shading darkening towards the centre of the square, but lightening towards each of the labelled corners. The centre point of the variables’ (\( \text{InstnPow} (\text{Pa}) \) and \( \text{InstnUncern} (\text{Pb}) \)) range (e.g., 0 to 50 to 100) is also used to divide the square into the four sections listed above, which is presented in Figure 7.5 by the dotted intersecting lines. This four section division is applied to the zero plots.
of all contour graphs to be analysed, dividing the contour into four smaller sections for analysis. As can be seen in Figure 7.4, the zero plot (shaded grey) divides the contour into four quadrants for analysis.

### 7.4.2 Visual Analysis of the Socio-Environmental Rationalist Agent Contour

Analysis of the contours for simulation one will begin with an analysis of the SERA contour presented earlier in Figure 7.4. Before analysis proceeds at this stage it is important to recall the default commitment of the SERA upon entering the relationship. This has been simulated as a positive value ranging from zero to one. For analysis purposes it is this that will determine whether changes in the variables have a positive effect on the final commitment value (i.e., whether a positive default commitment \((\text{defaultcomm}\ (\text{Pc}))\) value is maintained) or a negative effect on the final commitment value \((\text{finalcomm}\ (\text{Ca}))\) (i.e., whether the positive default commitment \((\text{defaultcomm}\ (\text{Pc}))\) reverts to a negative value).

Examining both the top view and bottom view of the contour in Figure 7.4 one clearly sees collections of peaks protruding from the plane of the zero-plot in both the top view (positive commitment volume of the box plot) and bottom view (negative commitment volume of the box plot). The presence of numerous negative peaks, and the variability of the peaks, be that positive or negative imply that changes and variations in the \(\text{InstnPow}\) and \(\text{InstnUncern}\) variables affect the level of SERA commitment in the relationship. This demonstrates that there is a relationship between institutional influence and the commitment offered by SERA. Upon closer examination the peaks form ranges in select areas (e.g., in the top right hand section of the contour) of the top and bottom views, further analysis by division (i.e., via the divisions within the matrix of institutional dimensions) will determine why this is so. Visual analysis of these ranges in the contour within the divisions will be examined in increments of 20 in both institutional variables \((\text{InstnPow}\ (\text{Pa})\) and \(\text{InstnUncern}\ (\text{Pb})\).
7.5.1.1 First Division Analysis: ‘Atomistic Society’

The first division to consider is that pertaining to the ‘atomistic society’ coordinates (i.e., 0 InstnUncern, 0 InstnPow) and the areas surrounding the coordinates. Examining the top view of this division in Figure 7.4, a range of peaks is visible. These peaks are in close vicinity to the ‘atomistic society’ coordinates (coordinates 20-40 of the InstnPow and InstnUncern axis). They demonstrate that in times of low variability in institutional influence and low influential power the SERA maintains a positive commitment towards their relationship with their principal. This is plausible as with little institutional influence, whether it be in terms of variability or power, it is unlikely to be significant enough to alter the default commitment of the agent significantly towards the negative. It may however have a slight wavering effect, evident by the variability in the peaks as the value of institutional coordinate’s increases.

Examining the bottom view of this division in Figure 7.4, on the other hand, presents an alternate view. The peaks that are present are in close vicinity to the intermediate area and far from the ‘atomistic society’ coordinates (coordinates 40-60 of the InstnPow and InstnUncern axis). They demonstrate that as the pressures increase within this first division (i.e., InstnUncern and InstnPow increase in value) this effects the agent’s commitment towards their relationship with their principal negatively, i.e., a range of negative commitment values are recorded. This is plausible as with increased institutional influence, whether it be in terms of variability or power, it is likely that a notable increase in pressure will affect the agent’s belief structure. In so far as to provide the impetus for a change towards the negative. The increase in institutional influence provides the incentive to reconsider his or her initial positive commitment. This effect may not be constant and hence, it may have a slight wavering effect, evident by the variability in the peaks.

Overall, this first division of the contour demonstrates that changes in institutional influence do effect the positive default commitment of the SERA to the point that increases in institutional values foster negative commitment. The first two coordinates (i.e., 0-20 of the InstnPow and InstnUncern axis) within this division demonstrate a
declining commitment; a commitment towards the negative. This indicates that in situations of no institutional influence the agent’s self-interest responds to the commitment. The division representing an extension of the SIR agent reaction.

### 7.5.1.2 Second Division Analysis: ‘Controlled Society’

The second division to consider is that pertaining to the ‘controlled society’ coordinates (i.e., 0 InstnUncern, 100 InstnPow) and the areas surrounding the coordinates. Examining the top view of this division in Figure 7.4, a number of peaks are visible. These peaks cluster towards the outskirts of the ‘controlled society’ region and are in closer vicinity to the intermediate area (coordinates 60-80 of the InstnPow axis and 20-40 of the InstnUncern axis). They demonstrate that in times of low variability in institutional influence and moderate levels of influential power, the SERA maintains a positive commitment towards their relationship with their principal. This is plausible as with a moderate level of institutional influence and low variability the agent does not feel constrained either way significantly to alter their default commitment towards the negative. The direction given to the agent by the moderate level of institutional power with little variability provides the agent with sufficient support for its initial commitment without the confinement of its assistance. As the institutional power increases however, the positive commitment expressed by the agent towards its commitment to achieving the principal’s goal declines.

Examining the contour from the bottom view of the division in Figure 7.4, proves that commitment declines even further. The larger peak that is present is in the vicinity of the ‘controlled society’ coordinates (coordinates 80-100 of the InstnPow and InstnUncern axis). It demonstrates that as the power of institutional influence increases (within this second division) from providing direction (i.e., InstnPow 60-80) to instigating control (i.e., InstnPow of 80-100) this effects the agent’s commitment negatively. This is plausible as with the increased institutional power and relatively no variability the agent feels constrained with no or little personal choice or input. The ensuing disgruntlement this creates, results in a reconsideration of his or her initial positive commitment and hence, develops into negative commitment.
Overall, this second division of the contour demonstrates that changes in institutional influence do effect the default commitment of the SERA to the point that increases in institutional power (InstnPow) create negative commitment.

### 7.5.1.3 Third Division Analysis: ‘Upheaval in Society’

The third division to consider is that pertaining to the ‘upheaval in society’ coordinates (i.e., 100 InstnUncern, 0 InstnPow) and the areas surrounding the coordinates. Examining the top view of this division in Figure 7.4, a number of peaks are visible; one in particular appears to be more prominent (coordinates 20-40 of the InstnPow axis and 80-100 of the InstnUncern axis). This peak in particular appears to be located towards the outskirts of the ‘upheaval in society’ region in closer vicinity to the intermediate area. This demonstrates that in a state of upheaval with high institutional uncertainty an agent can only maintain a positive commitment towards their relationship with some level of institutional power. This is highly plausible as with the high levels of variability extreme levels of uncertainty are generated within the environment. Without any sense of direction the negative resolve this uncertainty instils within the agent results in a change towards a negative final commitment. As the institutional power increases however, the positive level expressed by the agent towards its final commitment increases and the positive initial commitment value is maintained. This is the exact opposite of the commitment exhibited in a ‘controlled society’, where high levels of direction from the increasing levels of institutional power with no variability constrains the agent into negative commitment.

Examining the bottom view in Figure 7.4, proves to show an alternative scenario. Larger peaks are present within the vicinity of the ‘upheaval in society’ coordinates and intermediate area (coordinates 0-20 of the InstnPow axis and 60-100 of the InstnUncern axis). It demonstrates the power that institutional variability has in effecting the default positive commitment of agents. The increased variability with low institutional power has certainly lead to increased incidents (i.e., demonstrated by the greater number of peaks) of negative final commitment. This is plausible as the variability in institutional influence establishes no stability for the agent to maintain the positive commitment, which is only heightened by the lack of support from
powerless institutions. The effect of this uncertainty is such that even in the intermediate area, where the tension between the two variables nullifies each others’ influence. The agent uses his or her own interpretation of the situation to act, the choice on the whole is to act negatively towards his or her commitment.

Overall, this third division of the contour demonstrates that changes in institutional influence do effect the default commitment of the SERA to the point that increases in institutional variability (InstnUncern) create devastating results on the commitment of agents.

### Fourth Division Analysis: ‘Reforming Society’

The last division to consider is that pertaining to the ‘reforming society’ coordinates (i.e., 100 InstnUncern, 100 InstnPow) and the areas surrounding the coordinates. Examining the top view of this division in Figure 7.4, a number of peaks are visible; one in particular is more prominent. This peak in particular is located within close vicinity of the ‘reforming society’ coordinates and extends out towards the intermediate area to intersect with the prominent peak in the third division examined previously (coordinates 80-100 of the InstnPow and InstnUncern axis). This therefore coincides with the results in the previous division, which demonstrate that in times of high institutional variability an agent can maintain a positive commitment towards their relationship with increasing levels of institutional power. The higher levels of institutional power result in even higher levels of positive agent commitment. This is plausible as with the higher levels of variability higher levels of institutional power are necessary to provide the sense of direction to maintain optimism in commitment.

Examining the bottom view in Figure 7.4, on the other hand, proves to show an alternative scenario. Large peaks are present on the outskirts of the ‘reforming society’ region clustering around the intermediate area (coordinates 80-100 of the InstnPow axis and 60-80 of the InstnUncern axis). This demonstrates that as the variability in institutional influence decreases while the influential power of institutions remains relatively high the default commitment of the agent becomes negative. This is also plausible. As the existence of heightened institutional power
with relatively lower institutional variability is overpowering, and perhaps even is too directive and constraining given the variability exhibited. Consequently, this results in pessimism towards the final commitment.

Overall, this last division of the contour demonstrates that changes in institutional influence do effect the default commitment of SERA to the point that increases in institutional power ($\text{InstnPow}$) in times of moderate to high institutional variability ($\text{InstnUncern}$) create both positive and negative results on the agent’s commitment.

### 7.5.1.5 Summary of the Visual Analysis

An analysis of the contour graph for the socio-environmental rationalist agent’s (SERA’s) commitment values has shown that changes in the institutional settings, whether it is the influential variability ($\text{InstnUncern (Pb)}$) and/or the influential power ($\text{InstnPow (Pa)}$), affect the default commitment ($\text{defaultcomm (Pc)}$) of the agent positively and negatively. The analysis demonstrates that the recorded commitment levels are relative to the condition of occurrence, i.e., institutional settings within the divisions. These conditions and the effect of these conditions on commitment values is summarised and listed below:

1. As the pressures increase from the low levels of institutional power and variability (i.e., $\text{InstnUncern}$ and $\text{InstnPow}$ increase in value) within the first division, the agent reconsiders his or her initial positive commitment towards their relationship with their principal and acts increasingly negative.

2. In times of low institutional variability ($\text{InstnUncern (Pb)}$), a moderate level of institutional power ($\text{InstnPow (Pa)}$) (in the second division) provides the SERA with the direction in reconsideration to maintain a positive commitment towards their relationship with their principal. An increasing and excessive level of institutional power ($\text{InstnPow (Pa)}$), however, constrains the agent and affects his or her commitment towards their relationship with their principal negatively.

3. In times of high institutional variability ($\text{InstnUncern (Pb)}$) low levels of institutional power ($\text{InstnPow (Pa)}$) (in the third division) does not provide the SERA with sufficient support to maintain their positive commitment. With
increasing levels of institutional power ($\text{InstnPow (Pa)}$), sufficient support is gained and hence, the agent’s commitment towards their relationship with their principal is increasingly positive.

4. In times of moderate levels of institutional variability ($\text{InstnUncern (Pb)}$) excessive levels of institutional power ($\text{InstnPow (Pa)}$) (in the fourth division) constrain the agent and affect his or her commitment towards their relationship with their principal negatively. With excessive levels of institutional variability ($\text{InstnUncern (Pb)}$), however, excessive levels of institutional power ($\text{InstnPow (Pa)}$) actually support the agent in maintaining a positive commitment towards the relationship with their principal.

The above demonstrates just how variable the reaction of the SERA is to changes in the institutional settings. Different levels of variability in institutional influence ($\text{InstnUncern (Pa)}$) and institutional power ($\text{InstnPow (Pb)}$) have varied effects on the commitment levels of the SERA. At times this implies that the default commitment ($\text{defaultcomm (Pc)}$) value is maintained and a higher or lower commitment values may be exhibited as the final commitment ($\text{finalcomm (Ca)}$) values. Alternatively, there are instances where the default commitment ($\text{defaultcomm (Pc)}$) value is not maintained, and varied levels of negative commitment are recorded as the final commitment ($\text{finalcomm (Ca)}$) value. Their level of commitment is dependent upon the signals they receive from their environment. This adequately portrays the extended conceptualised and reformulation of agent behaviour being informed by their environment in seeking to attain the principal’s goal.

7.4.3 Visual Analysis of the Self-Interested Rationalist Agent Contour

Figure 7.6 depicts a contour graph of the SIR agent’s commitment values for their intersecting InstnPow and InstnUncern Values. It is also presented within a box plot with a zero plot to distinguish between the positive and the negative sections of the contour graph, and a four section division to aid analysis. It is quite different to the SERA as a self-interested rationalist agent (SIR) does not refer to their institutional settings for assistance, direction, support or constraint. Their own utility maximisation is the driving force of their behaviour.
Figure 7.6 above presents only a top view of the SIR agent contour graph. This is because the contour surface is confined to the negative portion of the box plot. This effectively portrays the behaviour of the SIR agent. A SIR agent will at all times, regardless of the condition, act with solely their interests in mind if not constrained by contractual requirements. This utility maximisation is not inline with the principal’s interests and hence, represents a negative commitment towards the principal’s goal. There will be times when this negative level will be more extreme in some cases and not in others. This portrays the fact that a greater degree of negative commitment (i.e., higher level of shirking) is necessary to generate the desired return or obtain the desired reward. This is depicted by the variability in the contour surface in Figure 7.6 above. This variability appears to have no association to the InstnUncern and InstnPow coordinates or to the divisions used for analysis, and simply appears to be random. The extent of the variability in negative commitment thus may be dependent upon the effort necessary to obtain the rewards. The contour adequately demonstrates the traditional conceptualisations and formulations of agent behaviour, being entirely negative if not constrained by contractual requirements⁴.

⁴ Simulation one with regards to the SIR agent is run without consideration of contractual influences, which if implemented may alter the behaviour of the agent towards positive commitment. The implications of this will be examined in future research.
7.4.4 Visual Analysis of the Socio-Environmental Rationalist Agent and Self-Interested Rationalist Agent Contours

The difference between the traditional conceptualisation and formulation of agent behaviour (i.e., the SIR agent) and that of the extended conceptualisation and reformulation of agent behaviour (i.e., SERA) can be portrayed by interlacing the contour graphs of both agents into a single box plot. This interlacing of the contour graphs is presented in three dimension (3D) and plan view in Figure 7.7. Through examining this contour, the static nature of the SIR agent’s behaviour is highlighted in comparison to the variability presented by SERA. In fact there are even times where the commitment exhibited by the SERA dips below the negative commitment of the SIR agent. There is no instance where the SIR agent’s behaviour supersedes that of the socio-environmental rationalist agent’s (SERA’s) in terms of its level of positive commitment. Socio-environmental rationalist agent’s (SERA’s) contour ranges more widely across all divisions and shows uneveness across all divisions. Self-interested rationalist (SIR) agent’s contour is on the whole negative and somewhat more uniformly patterned. Both contour graphs are thus markedly different. The sheer complexity and depth involved in understanding the socio-environmental rationalist agent’s (SERA’s) behaviour is presented effectively by the variability in its contour. It is through accounting for additional influences of behaviour in the agent’s context that the extended conceptualisation and reformulation of agent behaviour provides a more informed and detailed understanding of agent behaviour.

Statistical analysis is now necessary to complement the visual analysis performed and to provide the numerical grounding for the visual results achieved.
Figure 7.7 - 3D Contour Graph of the SERA and SIR Agent Commitment Values at their Intersecting \textit{InstnPow} (Pa) and \textit{InstnUncern} (Pb) Values

Top View

Plan Top View

Plan Bottom View
7.5 Statistical Analysis: The Process and Results

The statistical analysis to be conducted pertains to the determination and examination of relationships between the variables of the simulation. These variables are numerous and will be addressed in turn. The initial analysis will begin with the type of agent and commitment value achieved. Before any analysis proceeds it is necessary to examine the raw data.

7.5.1 Descriptives and Variance Analysis

Table 7.1 below provides frequencies of the 2420 final commitment (finalcomm (Ca)) values produced for both agent types grouped into quarter increment values starting from negative one through to zero and ending at positive one. An examination of Tables 7.1 reveals a number of interesting outcomes. The first of which pertains to the frequency of commitment levels. Most commitment values are concentrated around the negative commitment, i.e., more than 70 per cent of the 2420 values are recorded as negative commitment values. The -0.75 to -0.50 increment of commitment values has the greatest frequency of occurrence, a quarter of the values lie within this increment. Both the SERA and the SIR agent, therefore, are collectively more prone to behaviour that results in a negative commitment towards attaining the principal’s goal.

<table>
<thead>
<tr>
<th>Level of Commitment</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.00 to -0.75</td>
<td>115</td>
</tr>
<tr>
<td>-0.75 to -0.50</td>
<td>253</td>
</tr>
<tr>
<td>-0.50 to -0.25</td>
<td>151</td>
</tr>
<tr>
<td>-0.25 to 0.00</td>
<td>69</td>
</tr>
<tr>
<td>0.00 to 0.25</td>
<td>39</td>
</tr>
<tr>
<td>0.25 to 0.50</td>
<td>120</td>
</tr>
<tr>
<td>0.50 to 0.75</td>
<td>234</td>
</tr>
<tr>
<td>0.75 to 1.00</td>
<td>229</td>
</tr>
<tr>
<td>Total</td>
<td>2420</td>
</tr>
</tbody>
</table>

Pearson Chi-Square Test: $\chi^2 = 903.291$, df = 7 Significance = 0.000

0 cells (.0%) have expected count less than 5. The minimum expected count is 19.50
This initial analysis may then appear to reinforce the predictions of the existing Agency literature, i.e., that agents are on the whole are self-interested utility maximisers. Further examination of Table 7.1, however, indicates that this is not necessarily so. The commitment values of the two types of agents are concentrated around divergent areas. A greater portion of the values for the SERA lie in the positive commitment region, 622 values (i.e., 51.40 per cent) out of the 1210 values in fact. A heavier concentration is exhibited around the high commitment values (i.e., 0.50 to 0.75 and 0.75 to 1.00) as well as the high negative commitment value (i.e., -0.75 to -0.50) for the SERA. The commitment values of the SIR agent are solely negative in value which is to be expected (i.e., reinforces predictions of existing literature). Friedman’s non-parametric chi-square test\(^5\) of independence confirms that the commitment values achieved by the agents are dependent upon the agent type. A socio-environmental rationalist agent’s (SERA’s) commitment preferences are thus significant in divergence from those of a SIR agent (refer to Table 7.1).

Table 7.2 below provides basic descriptives of the measurements or values produced. Upon examination it reinforces the findings of the chi-square test above. The commitment values of a SERA are more widely dispersed around the mean than that of a SIR agent whose mean is a negative commitment value because of the sole occurrence of negative commitment. An independent samples test\(^6\) presented in Table 7.3 indicates that there is a significant difference between the commitment value means of the SERA and the SIR agent.

---

\(^5\) A chi-square statistical test has been chosen to test this, as it enables an approximate judgement to be made as to whether there is any sort of relationship between the two variables. There are other tests that enable such judgements to be performed such as, regression analysis and correlation. However, these tests require that the variable data subject to the statistical test be of ratio or ordinal nature (Ticehurst and Veal, 1999: 205). The variables here (agent type and commitment level) constitute data of nominal nature and thus, regression and correlation analyses are inappropriate. A chi-square test of independence utilises nominal data in their statistical analysis (Ticehurst and Veal, 1999: 205). In performing the chi-square tests for this study, a p-value less then a 5% level of significance indicates that the value for the \(\chi^2\) statistic is significantly large and thus, the null hypothesis is rejected and the alternate hypothesis is accepted.

\(^6\) For the independent samples t-test the sample is divided into sub-groups—for example, the first the SERA and the second the SIR agent (Ticehurst and Veal, 1999: 210). In performing the independent samples tests for this study, a p-value less then a 5% level of significance would therefore indicate that the value for the \(t\) statistic is significantly large and thus, the null hypothesis would need to be rejected and the alternate hypothesis accepted.
Table 7.2 - Descriptives of Final Commitment (finalcomm (Ca)) Values from Simulation One

<table>
<thead>
<tr>
<th>Type of Agent</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>SERA and SIR</td>
<td>-.90803</td>
<td>.98516</td>
<td>-.1937818</td>
<td>.54639510</td>
<td>.299</td>
</tr>
<tr>
<td>SERA</td>
<td>-.90329</td>
<td>.98516</td>
<td>.0631081</td>
<td>.63087775</td>
<td>.398</td>
</tr>
<tr>
<td>SIR</td>
<td>-.90803</td>
<td>-.00933</td>
<td>-.4506717</td>
<td>.25930946</td>
<td>.067</td>
</tr>
</tbody>
</table>

Table 7.3 - Independent Samples Test for Equality of Variances

<table>
<thead>
<tr>
<th>Equality of Means</th>
<th>F</th>
<th>Sig.</th>
<th>T</th>
<th>Df</th>
<th>Sig. (2-tailed)</th>
<th>Mean Difference</th>
<th>Std. Error Difference</th>
<th>95% Confidence Interval of the Difference</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equal variances assumed</td>
<td>86.296</td>
<td>.000</td>
<td>26.474</td>
<td>240</td>
<td>.000</td>
<td>.5137798</td>
<td>.01940687</td>
<td>.47555026 .55200935</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>26.474</td>
<td>152.863</td>
<td>.000</td>
<td>.5137798</td>
<td>.01940687</td>
<td>.47543951</td>
<td>.55212010</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This simulation has thus demonstrated that through the incorporation of institutional influence into an agent’s behaviour (i.e., represented by the workings of the SERA), the behaviour of an agent does vary from that of the theorised and fixed behaviour in the existing Agency literature (i.e., represented by the workings of the SIR agent). An agent’s commitment can be both positive and negative. Agents therefore are not solely self-interested utility maximisers acting negatively, efforts can be directed positively. The record of only negative commitment values for the SIR agent (demonstrated in Table 7.1) reconfirms the predictions of the existing Agency literature.

The results demonstrate the lack of contextual input (institutional influence) in the existing conceptualisations and formulations of agent behaviour. It may be the basis for the limited predictive success of the existing research within agency. Existing research in agency that has not reinforced the predictions of traditional Agency theory is no longer fruitless, but further evidence of the need for contextual input in explaining agent behaviour. Simulation one has demonstrated that it is no longer a failure of prediction if non self-interested behaviour is evidenced, but a natural occurrence attributed to the influence of their environment, i.e., their institutional affiliation and interaction, which affects their behaviour.
The next point of observation therefore pertains to the magnitude of institutional influence, i.e., to what extent does institutional affiliation and interaction affect agent behaviour. Recall that there are two variables that represent the magnitude of institutional influence within the simulation, these are instnpow and instnuncern. The later relates to the variability in the institutional influence and the former relates to the influential power that the institutions possess within the environment. Each of these variables has a range in value from zero to one hundred in increments of ten. Does a variation in these variables cause a subsequent variation in the commitment value of the agents? A correlation test of the variables with the associated commitment values will help determine this.

### 7.5.2 Correlation Analysis

Table 7.4 below presents the results of the correlation. A correlation between InstnPow and commitment values for all agents, and InstnUncern and commitment values for all agents indicates that the two variables in both correlations are uncorrelated. There is no relationship between the variables of InstnPow and commitment and Instnuncern and commitment, a variation in one does not cause a subsequent variation in the other. In this correlation test, however, there is no differentiation between the commitment values of the SIR agent and the SERA. The former of which is not intended to have an association with institutional influence. It is therefore necessary to also perform a correlation test for each agent type.

<table>
<thead>
<tr>
<th>Agent Groups</th>
<th>Pearson Correlation InstnPow (Correlation 1)</th>
<th>Pearson Correlation InstnUncern (Correlation 2)</th>
<th>Significance InstnPow (Correlation 1)</th>
<th>Significance InstnPow (Correlation 2)</th>
<th>Significance InstnUncern (Correlation 1)</th>
<th>Significance InstnUncern (Correlation 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Agent Groups</td>
<td>0.033</td>
<td>-0.019</td>
<td>0.103</td>
<td>0.354</td>
<td>0.736</td>
<td>0.944</td>
</tr>
<tr>
<td>SIR</td>
<td>0.010</td>
<td>-0.002</td>
<td>0.736</td>
<td>0.944</td>
<td>0.063</td>
<td>0.268</td>
</tr>
<tr>
<td>SERA</td>
<td>0.053</td>
<td>-0.032</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 7.4 also presents the results of the correlation for the SIR agent and SERA respectively. A correlation between InstnPow and the commitment values of the SIR agent, and InstnUncern and the commitment values of the SIR agent commitment values indicates that the two variables in both correlations are uncorrelated (refer to Table 7.4). There is no relationship between the variables of InstnPow and the commitment values of a SIR agent, and Instnuncern and the commitment values of a SIR agent; a variation in one does not cause a subsequent variation in the other. This is to be expected given that the behaviour of a SIR agent is programmed to be unaffected by institutional influence.

A correlation between InstnPow and the commitment values of the socio-environmental rationalist agent, and InstnUncern and the commitment values of the socio-environmental rationalist agent indicates that the two variables in both correlations are uncorrelated (refer to Table 7.4). There is no relationship between the variables of InstnPow and the commitment values of a socio-environmental rationalist agent, and Instnuncern and the commitment values of a socio-environmental rationalist agent; a variation in one does not cause a subsequent variation in the other. At first instance, this appears to be quite a contradiction of the formalised SERA behaviour, which describes the agent as being directly influenced by institutional affiliation and interaction. Upon closer examination, however, a correlation between the two is not essential or necessary. Recall that a SERA is a heterogenous actor. While the set of states (i.e., the principal-agent relationships) and the available actions (i.e., committing to the principal’s goals) are components common to all discrete events (i.e., time step), the degree to which they are instanced varies in each of the ten time steps. For example, the dimensions of the relationship (e.g., probiform (Da), benefitinform (Db), costinform (Dc)) that an agent faces in one discrete event will not be replicated in another, nor will the agent take the same action in every state instanced (i.e., defaultcomm (Pc) will vary). For this reason it is difficult for there to be any correlation in the dimensions of states if the given states and actions vary with the agent at every instance (i.e., at each time step).
While there was no correlation demonstrated, it is important to recall that the visual analysis performed earlier found that a conditional relationship does exist between the commitment levels of the SERA and the levels of institutional influence (i.e., InstnPow and InstnUncern). The combined interaction of both variables of institutional influence produced interesting visual results for the levels of commitment. The results demonstrated that a homogenous description can not be assigned to agents. Each agent is an individual, responding to differentiated circumstances variedly (demonstrated by the variability of the contour graphs). Different outcomes were therefore generated regardless of the institutional weightings. This is what is intended by the SERA. Agent behaviour is relative to the individual and yet the existing theory attempts to apply an identical framework to each and every agent which only considers one dimension of agent behaviour, the negative. With this, only a limited view of agent behaviour is ever contemplated and nothing more. Consequently, this does not accommodate for agent individuality and varied instances that naturally deliver varied behaviour. All of which is easily emulated within the conceptualisation and formulation of the SERA behaviour. By considering the full spectrum of agent behaviour it improves the levels (i.e., both positive and negative) and extent of analysis (i.e., agent BDI) of agent behaviour in relationships with principals, providing a more informed understanding of agent behaviour.

7.6 Summary of Findings in Relation to the Research Questions

The analysis of the results obtained from these simulations reinforces the predictions of the extended conceptualisation and reformulation of agent behaviour. The SERA behaves in accordance with the information they receive from their institutional affiliations and interactions. Their informed behaviour may or may not be inline with the interests of the principal. Table 7.5 below presents a summary of the results from simulation one. It demonstrates the variability in reactions of the SERA to changes in the institutional settings. Different levels of variability in institutional influence and
influential power have varied effects on the commitment levels of the individual SERA. The influences of which are conditional to the institutional environment.

<table>
<thead>
<tr>
<th>InstnPow Level</th>
<th>Low (0-40)</th>
<th>Moderate (40-60)</th>
<th>High (60-100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Positive</td>
<td>Positive</td>
<td>Negative</td>
</tr>
<tr>
<td>Moderate</td>
<td>Negative</td>
<td>Negative</td>
<td>Negative</td>
</tr>
<tr>
<td>High</td>
<td>Negative</td>
<td>Positive</td>
<td>Positive</td>
</tr>
</tbody>
</table>

What does this imply for the research objectives and questions presented in Chapter 1? The questions to be addressed were as follows:

1. **To Evaluate Existing Agency Theory.**
   RQ1. What aspects of the existing theory of Agency require a reassessment?

2. **To Redevelop and Model Concepts of Agency.**
   RQ2. How can Agency be conceived and modelled more adequately, particularly after examination of self-interested rationalist (SIR) behaviour?

3. **To Discern the Influential Factors.**
   RQ3. What factors play a role in affecting the behaviour of individuals in agency?

4. **To Review Concepts and Formulation.**
   RQ4. How effective and influential is the extended conceptualisation and reformulation of agent behaviour in various contexts?

5. **To build an Operationalisation.**
   RQ5. How can an extended conceptualisation of agent behaviour be modelled using object-oriented methods so as to provide more informative understanding of the notion of agency?

6. **To Evaluate Practical Applicability.**
   RQ6. How applicable are the concepts, developments and modelling to various situations?
With regards to simulation one research questions 1, 2, 3 and 5 are of relevance. Each of these will be addressed in turn, in demonstrating how the results obtained above resolve each question.

Chapter 2 presented a thorough examination of the Agency literature to date. A large portion of this research had simply applied the simple agency model, which focuses essentially on self-interested rationalism and efforts to counter-act such behaviour with incentive schemes. This preoccupation of the research with compensation and incentive schemes and contractual constraints obscured the need for the examination of alternative important influential aspects and fostered the limited application and success of the agency model. This is irrespective of the research area. This demonstrated the need to examine the context within which the contract is initiated. Agents do not operate within a vacuum and contracts are not prepared in such a vacuum to necessitate the lack of interest in the context of agency. This identified the need to reassess the context of agent behaviour as a goal of the research, and addressed the first research question.

Self-interested rationalism represents one simplistic, narrow explanation of behaviour but, is not in the least the underlying explanation of agent behaviours. Results presented in simulation one demonstrate this, that the behaviour of an agent is more diverse than the simple workings of the self-interested rationalist agent (SERA). Through simulating the behaviour of the SERA results demonstrate that the agent can respond to his or her commitment towards achieving the principal’s goal in both a positive and negative manner. This positive level of commitment can be obtained without the contractual restraints and benefits required to entice the SIR agent to act in accordance with the principal’s interests. Through examining the contours of simulation one the static nature of the SIR agent’s behaviour is highlighted in comparison to the variability presented by the SERA. This is also demonstrated in the frequencies of each respective agent’s commitment levels. Therefore, through the incorporation of socio-environmental rationalism in the context of agent behaviour, the theory of Agency can be more adequately examined to take into account the existing research that has had limited success in reinforcing the predictions of Agency theory. Modelling agent behaviour through socio-environmental rationalism addressed research question two.
Chapter 3 introduced the general formulation of the SERA as being one influenced by their institutional affiliations and interactions. The variability and power of their influence played a vital role in informing agent behaviour. The results analysed above demonstrate that there is no direct association positively or negatively between the institutional variables and the commitment levels portrayed by the agent. What is identified is a conditional relationship, where the commitment values reported vary depending upon the joint influence of both the institutional variables, i.e., it is conditional upon the context. This context is based upon the matrix of institutional dimensions, which are the: ‘atomistic society’, ‘controlled society’, ‘upheaval in society’, and ‘reforming society’. Within each dimension the agent presents a varied response which either maintains or does not maintain their positive default commitment ($\text{defaultcomm} (P_c)$). The results vary even more so when the environmental context approaches the intermediate area of the matrix. The SIR agent, on the other hand, is uninfluential of institutional affiliation and interaction and hence, is not affected by the adjustments in the institutional variables both visually and statistically. Therefore, the SIR agent maintains their negative default commitment $\text{defaultcomm} (P_c)$). An examination of the context of agent behaviour, that is, their institutional affiliations and interactions, addresses research question three in discerning the influential factors upon agent behaviour.

These results have been obtained through the process of simulation, using an object orientated method. Simulation has demonstrated that through constructing the SERA as a formalised model various aspects of the environment can be manipulated that are otherwise immediately unfeasible to demonstrate and obtain in reality. These are the adjustments to the institutional variables which may take several years to occur and to take effect and may not even be analysable. By presenting these variables as sliders and altering them a run of the model demonstrates how agents react to the change, which can present a deeper understanding of the phenomena being modelled, which in this case is the agent’s response to commitment given changes in the institutional environment. The settings within the model, therefore, give the opportunity to work out different scenarios. Where the model's "space" of possible behaviours can be explored, and the combinations of slider values that cause the behaviours of interest can be determined, which is not unfeasible through the use of alternative techniques.
The use of simulation and OO method addressed research question five in building an operationalisation of SERA.

The use of simulation with such malleable variables to the individual agent enables it to be used in various and diverse contexts and examples. The following chapter will demonstrate this. The discussion presented above demonstrates how this extended conceptualisation and reformulation of agent behaviour and the results obtained therein address the first three research questions and research question five established at the beginning of the dissertation.

### 7.7 Conclusion

This Chapter has discussed and presented the method through which the formalised conceptualisations of the SERA and the SIR agent were undertaken. This involved the use of NetLogo, a computer simulation tool. The results obtained from the simulation were analysed visually and statistically. Each mode of analysis was supportive of the need to consider the context in which the agent operates. The extended conceptualisation and reformulation of agent behaviour demonstrated that commitment towards the principal’s goal can be both positive and negative depending upon the influence the agent receives from his or her institutional affiliations and interactions. The extent of which is dependent upon the institutionally specific variables of institutional power and institutional variability. Each of these variables presents varied effects upon agent behaviour which is contrary to those of the static negative behaviour exhibited by the SIR agent. The discussion undertaken in analysing these results and the processes utilised to attain them address the first three research questions and research question five established at the onset of the Dissertation. Discussions will now proceed to examining the second simulation, the EU case of financial accounting harmonisation.
8. European Union (EU) Case Simulation & Analysis

The preceding chapter introduced the computational simulation of an individual socio-environmental rationalist agent (SERA) and an individual self-interested rationalist (SIR) in conjunction with visual and statistical analyses of the results. The analysis of results provided further support for the extended conceptualisation and reformulation of agent behaviour entitled socio-environmental rationalist agent (SERA).

The following sections will describe the second simulation of the research using the computational simulation tool, NetLogo. The computational simulation to be constructed is that of a socio-environmental rationalist multi-agent community (SERC), i.e., the EU in the process of financial accounting harmonisation. This will be performed in conjunction with an analysis of the results from the simulation. The analysis will be of a visual and statistical nature intending to provide further support for the extended conceptualisation and reformulation of agent behaviour. The chapter therefore answers the question of what behaviour is to be expected from the simulation of a SERC.

8.1 Demonstration of Simulation Two

The simulation is now discussed in detail with relevant snapshots of its workings. Figure 8.1 below represents a screen shot of the interface tab for simulation two. This interface tab reveals the reactions of the SERA in a multi-agent community setting.
Figure 8.1 - Simulation Two: The Socio-Environmental Rationalist Multi-Agent Community (SERC)
There is thus one type of agent in this model, and that is the SERA. There are four groups of this agent, representing each one of the accounting systems operating within Europe. These socio-environmental rationalist agent groups are the:

1. Anglo Saxon SERA group which is represented by a magenta coloured person in Figure 8.1,
2. Germanic SERA group which is represented by a cyan coloured person in Figure 8.1,
3. Latin SERA group which is represented by a red coloured person in Figure 8.1, and
4. Nordic SERA group which is represented by a blue coloured person in Figure 8.1.

The simulation consists of a minimum of nine agents: two Anglo Saxon agents, one Germanic agent, three Latin agents and three Nordic agents (refer to Figure 8.1). This minimum number represents the initial nine EU members and is labelled the pre-expansion phase in EU membership. The maximum number is 15 agents: two Anglo Saxon agents, two Germanic agents, six Latin agents and five Nordic agents. These are presented in the simulation as later nations under the setting of agent numbers in Figure 8.1. This maximum number represents the later six adjoining members and is labelled the first post-expansion phase in EU membership. The simulation is therefore run twice. The first is with nine agents, the initial EU members who implemented the Directives and who represent the pre-expansion phase in EU membership. The second is with fifteen agents, the additional six EU members who joined following the formation and implementation of the Directives and who represent the first post-expansion phase in EU membership.

Each of these agent groups are assigned divergent levels of default commitment \((\text{defaultcomm} (Pc))\) (the reasoning and details were presented in section 6.8.3), and live in a 2D grid-world consisting of 361 (19 x 19) patches (presented in Figure 8.1). Each patch represents an attempt towards attaining a 'common goal' for their principals. The common goal in this case pertains to the harmonisation of EU financial accounting standards. The dimensions of the patch will thus capture the agent group’s deliberating process (D set) in meeting their commitment towards attaining the common goal. Each attempt at attaining the common goal (patch) has a:
1. Probability of being informed by institutional affiliations and interactions \((\text{probinform} \ (\text{Da})), \) ranging from 0 to 1. This is the first dimension.

2. Benefit of informing which heightens their commitment \((\text{benefitinform} \ (\text{Db})), \) ranging from 0.1 to 10 commitment points. This is the second dimension.

3. Cost of informing which reduces their commitment \((\text{costinform} \ (\text{Dc})), \) ranging from -0.1 to -10 commitment points. This is the third dimension.

Patches are coloured in 1 of the 5 shades of yellow which is demonstrated in Figure 8.1. The colour of the patch is determined by the probability of informing \((\text{probinform} \ (\text{Da}))) in increments of 0-20, 20-40, 40-60, 60-80 and 80-100; the shade of yellow darkens as the values of the increments increase. The darker shaded patches represent more difficult relationships, i.e., where the agent's behaviour is highly influenced by factors other than the need to attain the common goal of EU financial accounting harmonisation. This is the influence agents receive from their institutional affiliation and interaction which may or may not be to the betterment of the principal’s interest. Should the agent be on a darker shaded patch the \(\text{probinform} \ (\text{Da}))\) is therefore greater than 60 per cent \((>0.6).\) Alternatively, should the agent be on a lighter shaded patch the \(\text{probinform} \ (\text{Da}))\) is therefore less than 40 per cent \((<0.4).\)

As each agent within the agent groups moves across the 2D grid-world randomly they encounter a change in the dimensions of their collective effort through their move to a different patch (denoted as a time-step). This happens ten times with a single run of the simulation. The values for \(\text{InstnPow} \ (\text{Pa})\) and \(\text{InstnUncern} \ (\text{Pb})\) are fixed during the single run and then the value for \(\text{InstnUncern} \ (\text{Pb})\) is changed for the next 10 single runs to account for the 11 combinations with \(\text{InstnPow} \ (\text{Pa})\) fixed. This represents one combination set and this needs to be undertaken another 10 times whereupon the value of \(\text{InstnPow} \ (\text{Pa})\) changes for each combination set. A full run therefore accounts for 11 single runs applied for 11 combination sets\(^1\).

\(^1\) In a single run \(\text{InstnPow} \ (\text{Da})\) is set at 0 and \(\text{InstnUncern} \ (\text{Db})\) is set at 0 and this is run 10 times, i.e., the agent moves to 10 different patches given the set Institutional variables. In the next single run \(\text{InstnPow} \ (\text{Da})\) is set at 0 and \(\text{InstnUncern} \ (\text{Db})\) is set at 10 and this is run 10 times. This will continue another 9 times until all values of \(\text{InstnUncern} \ (\text{Db})\) are explored given that \(\text{InstnPow} \ (\text{Da})\) is set at 0. This is one combination set. In the next combination set \(\text{InstnPow} \ (\text{Da})\) is set at 10 and \(\text{InstnUncern} \ (\text{Db})\) varied for each single run. This continues another 9 times until \(\text{InstnPow} \ (\text{Da})\) is set at 100 and \(\text{InstnUncern} \ (\text{Db})\) varied.
Each time-step represents a discrete event with differentiated patch dimension values. This movement in patches (i.e., the series of ten time-steps) depicts the workings of a dynamic environment accustomed to change. It is with every time-step that the agents within the agent groups reconsider his or her initial commitment (defaultcomm or Pc) as the dimensions have changed. The effect of the reconsideration is recorded as his or her finalcomm (Ca) at the end of each of the ten time-steps in every single run. The only time the initial commitment (defaultcomm (Pc)) is carried forward is when the probability of institutional influence is less than likely (i.e. when probinform or Da is set <0.50). The agent groups’ final commitment value (finalcomm (Ca)) is the average value of all agents within the group.

Probinform (Da), benefitinform (Db) and costinform (Dc) are dimensions of the patch that agents within agent groups are on at any given time. These dimensions collectively represent the given state, each of which will change with every time step (depicted by a movement of patches). It is the agent’s perception of these dimensions that determines the level of their influence upon his or her behaviour. These are labelled:

1. perceivepb (Df) to represent the agent’s perception of the dimension of probinform (Da), and is the fourth dimension.
2. perceivepo (Dd) to represent the agent’s perception of the dimension of benefitinform (Db), and is the fifth dimension.
3. perceiveve (De) to represent the agent’s perception of the dimension of perceivene (Dc), and is the sixth dimension.

These dimensions collectively represent the informed state which will also change with every time step (also depicted by a movement of patches). This varies across every agent even within agent groups because agents are heterogenous actors with their own perceptions that inform their beliefs, desires and intentions and eventually their behaviour.
There is thus a given state and the informed state for each relationship. Neither of these states will be the same value at any given time step. As, the informed state is dependent upon the perception the agent receives from their institutional influence and hence, is at variance form the uninfluential given state. The given and informed states are both relevant to all agents within the SERA groups whose behaviour is influenced by institutional affiliation and interaction.

The influential level that the informed state has upon the behaviour of the agent groups is determined by the influential power of institutions ($\text{instnpow (Pa)}$ slider as shown in Figure 8.1) and the variations in institutional influence ($\text{instnuncern (Pb)}$ slider as shown in Figure 8.1). The extent of this influence is determined by the weighting assigned to the relative importance of institutional influence ($\text{InstnAsso (Dg)}$), which varies across each of the agent groups ranging from 0.05 to 1.0 (refer to the assigned values of the $\text{InstnAsso (Dg)}$ sliders in Figure 8.1). The values of which can be set by the respective sliders on the interface tab. The influential power ($\text{InstnPow (Pa)}$) of institutions can vary from 0 (no influence) to 100 (substantial influence) denoting the level of involvement of institutions, i.e., the higher the value the greater their involvement and hence, the influential power of institutions. This is set at 90 in Figure 8.1; a very high value. The $\text{instnpow (Pa)}$ slider, therefore, affects the agent's perception of $\text{probind}(i.e., \text{perceivepb} (Df))$, i.e., the greater the influential power the higher the probability that the agent's behaviour will be influenced by institutional affiliation and interaction.

There can also be variations in institutional influence ($\text{InstnUncern (Pb)}$) from 0 (no variation) to 100 (complete variation) denoting the variation from the agent's initial perceptions, i.e., the higher the value the greater the variation of subsequent perceptions in comparison to the agent's original perceptions. This is set at 40 in Figure 8.1; a low value. The $\text{instnuncern}$ slider, therefore, affects the agent's perception of $\text{benefit}(i.e., \text{perceivepbo} (Dd))$ and perception of $\text{cost}(i.e., \text{perceivene} (De))$, i.e., the greater the value the greater the chances that a variation in perceptions could result in an increased commitment or a decreased commitment towards the attainment of the common goal(s)
Both the above moderators (*InstnPow* (Pa) and *InstnUncern* (Pb)) determine the standard deviation used for the normal distribution of which the mean is the true value of *probinform* (Da), *benefitinform* (Db) and *costinform* (Dc) of the patch. A value within the deviation to the mean is the value for the informed dimensions of *perceivePB* (Df), *perceivePO* (Dd) and *perceiveNE* (De). It is a random number because each agent is an individual, interpreting and reacting differently to a given situation (Lamper and Johnson, 2002: 1) and hence, a precise number is inappropriate. The greater the value of these two sliders, the greater the deviation and hence, the influence of institutional affiliation and interaction in informing the agent's behaviour, and subsequently in adjusting their commitment towards attaining the common goal(s). How is each agent presented with these states?

Agents within agent groups in the simulation are depicted as persons. One person for each type of agent within each agent group is present. This is depicted in the interface tab of Figure 8.1 both visually through the monitor and numerically through the setting of agent number sliders. These agents move across patches with every time step, and thus each agent within each agent group is presented with a relationship of different conditions (i.e., a patch with different values for *probinform* (Da), *benefitinform* (Db) and *costinform* (Dc)) with their multiple agents and principals at every time step. At each time step every agent must decide how to react to achieve the common goal, i.e., whether to commit further or not from the default commitment (*defaultcomm* (Pc)) presented. This decision is made according to the agent's process of deliberation or reasoning.

Generally, all agents engage in perceptive and deliberative reasoning derived from being informed by institutional affiliation and interaction. The extent of which is determined by the relative importance of institutional influence (*InstnAsso* (Dg)). An agent, however, only reacts to institutional influence when the probability of informing (*probinform* (Da)) exceeds that of not informing. The final level of commitment (*finalcomm* (Ca)), therefore, is determined by whether the variations in perceptions add or detract from the agents’ default commitment (*defaultcomm* (Pc)). The agents' final commitment (*finalcomm* (Ca)), therefore, may be a positive value which is in accordance with achieving the common goal respectively or a negative value which is not in accordance with achieving the common goal.
How then is this reaction calculated and the commitment level determined? Figure 8.2 depicts the procedures tab which demonstrates a snapshot of the programming language of simulation two. Appendix 4 section A4.4 provides the full details of the programming language of simulation two in English-Like commands. Put in simple terminology, each agent within the agent groups reacts when the agent's perception of the probability of informing \((\text{probinform} \ (\text{Da}))\) is greater than 50 per cent \((0.5)\). When this is the case the value for the final agent's commitment \((\text{finalcomm} \ (\text{Ca}))\) is increased or decreased by the value of the perception, i.e., \(\text{perceivepo} \ (\text{Dd})\) or \(\text{perceivene} \ (\text{De})\) respectively which ever is greater. When the probability of informing \((\text{probinform} \ (\text{Da}))\) is less than 0.5 then the agent does not react and the final commitment remains \((\text{finalcomm} \ (\text{Ca}))\) as the default value \((\text{defaultcomm} \ (\text{Pc}))\). This final commitment \((\text{finalcomm} \ (\text{Ca}))\) value is presented in the interface tab of Figure 8.1 graphically and through the average output. In Figure 8.1 this is a negative final commitment \((\text{finalcomm} \ (\text{Ca}))\) value of -0.506 for the Anglo Saxon agent, a negative final commitment \((\text{finalcomm} \ (\text{Ca}))\) value of -0.727 for the Germanic agent, a positive final commitment \((\text{finalcomm} \ (\text{Ca}))\) value of 0.203 for the Latin agent, and a positive final commitment \((\text{finalcomm} \ (\text{Ca}))\) value of 0.413 for the Nordic agent.

The above sections discussed and demonstrated the process through which the second simulation was designed and performed. The following section will now discuss the results attained from the simulation and their analysis.
Figure 8.2 - A Snap Shot of the Programming for Simulation Two
8.2 Analysis of Results for Simulation Two

A full run of each part of the simulation entails that the program is run 11 times to account for every possible combination of the *instnpow* (Pa) slider (i.e., value ranges from 0 to 100 in 10 value increments) and *instnuncern* (Pb) slider (i.e., value ranges from 0 to 100 in 10 value increments). Recall that a single run lasts 10 time steps. For every time step a final commitment (*finalcomm* (Ca)) value is recorded in the command centre. This implies that there are 1210 (i.e., 11 combination sets x 11 single runs x 10 time steps) measurements of final commitment (*finalcomm* (Ca)) for each agent group, and hence there are a total of 4840 (1210 measurements x 4 agent groups) values to be analysed. A full run of the simulation, therefore, provides a long series of numbers for all four socio-environmental rationalist agent groups (SERA). These numbers represent the final commitment (*finalcomm* (Ca)) values of the SERA groups in varying degrees of institutional influence and can be converted from its raw form to display both visual and numerical results. Analysis of the results produced from the simulation therefore consists of two types. The first is visual and the second is statistical.

The processes to be used to perform this are also identical to that in simulation one and therefore do not need to be reintroduced. The only difference between the analysis of the results from simulation one and two is that with simulation one a comparative analysis of the results from two agent types was performed. With simulation two an analysis of the results from one agent type and the variations of that type will be performed. There are also two parts to the analysis of simulation two. The first part of the simulation is a run with nine agents, denoting the pre-expansion phase in EU membership, and the second part of the simulation is a run with fifteen agents, denoting the first post-expansion phase in EU membership. Numerous analyses will be undertaken for the results from both part one and part two of the simulation. The first to be addressed is the visual analysis.

---

2 This first post-expansion phase in EU membership does not include the recent round of nations accepted into the EU in 2004.
8.2.1 Visual Analysis: The Results

The long series of numbers produced by a full run of the simulation will also be presented in the improved form of a visualisation. A visualisation of the long series of numbers generated by Simulation two will facilitate the reading of data, and a comparison of the commitment values produced by the four SERA groups with the intention of inferring a relationship between institutional influence and agent group behaviour. Maple 9.5 will be used to develop the contour graphs, the medians for visual analysis.

Before these contour graphs are presented for analysis it is necessary to introduce the method through which these graphs will be analysed. Similar to the method used for the analysis of the contours in simulation one the matrix of institutional dimensions (refer to Figure 8.3 below) will be used to analyse the contours developed from the results of simulation two. The only difference with this analysis is that a particular matrix division within the contours for each agent group will be analysed rather than all the divisions of the matrix within the contours. This is because the matrix in Figure 8.3 represents a plane of analysis of responses towards the commitment to harmonise given the different institutional states of the agent groups. Therefore, it is only appropriate to assign an institutional state (i.e., a matrix division) to each agent group given their institutional setting at the pre-expansion and post-expansion phase of EU membership.

The divisions to be selected to analyse each respective contour is dependent upon the agent group. Each one of the four agent groups is positioned within a division of the matrix in their pre-expansion and first post-expansion phase in EU membership. Chapter 4 undertook a comprehensive analysis of the institutional settings of each of the agent groups. From this a positioning with respect to the matrix of institutional dimensions was determined for each agent group in the pre-expansion and first post-expansion phase in EU membership. Figure 8.4 below expounds upon the Figure presented in Chapter 4 to present the matrix of institutional dimensions with each agent groups’ positioning depicted at the pre-expansion phase and the first post-expansion phase of EU membership.
Figure 8.3 - Agent Positioning within the Matrix of Institutional Dimensions

Examining Figure 8.3 the divisions for visual analysis for each agent group is presented. The division of analysis for the Anglo Saxon agent group contour is the region surrounding the coordinates of ‘upheaval in society’. The institutional upheaval created via the two consecutive World Wars and the ongoing political issues with Ireland have assigned its positioning to be within the ‘upheaval in society’ division. Following the first post-expansion in EU membership, the ongoing associations with the EU and further developments created a more stable and controlled institutional environment for the Anglo-Saxon agent group and hence, lead to its assignment within the ‘controlled society’.
The division of analysis for the Germanic agent group contour is the region surrounding the coordinates of a ‘controlled society’. The conservative nature of its institutions and the intensity of its influence have assigned its positioning to be within the ‘controlled society region’ during the pre-expansion phase of EU membership. Following the first post-expansion in EU membership, the entrance of another Germanic nation with less rigidity in its systems and ongoing positive associations with the EU resulted in the need for change and hence, the assignment of the group to the region surrounding the coordinates of the ‘reforming society’.

The division of analysis for the Latin agent group contour is the region surrounding the coordinates of a ‘reforming society’. At the initiation of the EU agreement, the Latin agent groups sought to adjust their settings to a desired uniform approach, to be if not the instigators of the process, and hence it is positioned within the region of the ‘reforming society’ coordinates. Following the first post-expansion in EU membership the Latin agent group having established the approach and with the additional agents having adopted the set approach, its assignment moves towards the ‘atomistic society’ region where the individual plays a greater role in choosing to conform to the institutional settings.

The division of analysis for the Nordic agent group contour is the region surrounding the coordinates of an ‘atomistic society’. This assignment pertains to both the pre-expansion and the post-expansion phases of EU membership. In both instances the Nordic nations presented no significant influences, deterrents or forces in adopting the approved approach and thus, is assigned to the ‘atomistic society’ region where institutional settings play a lessor influential role. Having identified the areas of the contours to be analysed for each agent group it is now necessary to examine the contours themselves.
8.2.2 Visualisation and Analysis of the Anglo-Saxon Agent Group

Analysis of the contours for simulation two will begin with an analysis of the Anglo-Saxon agent group contour graph in Figure 8.4A below and Figure 8.4B which represent the Anglo-Saxon agent group’s final commitment values (finalcomm (Ca)) given the InstnPow (Pa) and InstnUncern (Pb) coordinates. The analysis will compare the visual results with the agent group’s default commitment (defaultcomm (Pc)) to determine the effect of the institutional influence.

The analysis will begin with the examination of the coordinates of the ‘upheaval in society’ and the areas surrounding these coordinates. The peaks protruding from the bottom view of this division are clearly more numerous in number than that of the number protruding from the top view of the division (refer to Figure 8.4A). The overall behaviour of the agent within this division therefore has an inclination towards negative commitment. These results are synonymous with the agent’s stance towards harmonisation upon initiating membership with the EU. While the Anglo-Saxon agent group at the time could see the benefits of harmonisation, they were unable to entrust their system to foreign standards and hence, enforced the introduction of standards suitable to their system. Positive commitment towards the association appears to exist in the immediate areas of the ‘upheaval in society’ coordinates or in the extreme sections of the division. These results are also synonymous with the Anglo-Saxon agent group’s behaviour upon considering association with the EU. In its state of desperation for fear of being isolated in a region of Europeans, it sought to commit to EU membership and harmonisation.

What the above analysis has demonstrated is that in an environment of upheaval with institutions that possess less than moderate levels of power but are relatively influentially important, the agent is encouraged to behave negatively contrary to their default positive commitment. This behaviour in essence resembles the level of commitment presented by the agent group in an extreme event or condition. The question now is: does this behaviour change following expansion in EU membership?
Figure 8. 4A - 3D Contour Graph of the Anglo Saxon Agent Group Commitment Values at its Intersecting InstnPow and InstnUncern Values Part 1

Top View

Bottom View

Note:
- The Anglo-Saxon agent group’s default commitment is simulated as 0.25. It is this that determines whether changes in the variables have a positive effect on final the commitment value (i.e., the positive commitment value is maintained) or a negative effect on the final commitment value (i.e., the positive commitment value converts to a negative value).
- The relative importance of institutional influence for the Anglo Saxon agent group is 0.75. It is this that determines the extent of institutional influence.
The coordinates that require closer examination for the Anglo-Saxon agent group after the first post-expansion phase now differs and relates to the coordinates of a ‘controlled society’ and the areas surrounding these coordinates. The peaks protruding from the top view of the division are clearly more numerous in number than that of the number protruding from the bottom view of the division (refer to Figure 8.4B below). The overall behaviour of the agent within this division therefore has an inclination towards positive commitment, which is the exact opposite of the overall behaviour presented in the pre-expansion phase of EU membership (as demonstrated in Figure 8.4A and discussed above). These results are synonymous with the agent’s current stance towards harmonisation within the EU. The improved strength and stability of the UK and the ongoing success of the EU (demonstrated by the expansion in EU membership) fostered the development of a positive attitude towards harmonisation and hence, the maintenance of a positive level of commitment that is if not higher than their default commitment level.

This is not to say that the Anglo-Saxon agent group is entirely positive in its commitment. As, there are several areas of the division with negative levels of commitment. At times this is actually representative of the harmonisation commitment provided by the agent. For example, in several instances the Anglo-Saxon agent group has sought not to adopt certain aspects of the Directives due to their conservative estimate and presentation of profits. Areas outside financial accounting harmonisation also prove to support this result. For example, the Anglo-Saxon agent group deciding not to commit to the Single Monetary Union (SMU) due to the strong institutional support for the preservation of the English Pound. This can be presented by the negative peak in the bottom view of the contour graph at the coordinates of 50 InstnUncern, 100 InstnPow, a conservative area of examination.
Figure 8.4B - 3D Contour Graph of the Anglo Saxon Agent Group Commitment Values at its Intersecting InstnPow and InstnUncern Values Part 2

Note:
- The Anglo-Saxon agent group’s default commitment is simulated as 0.25. It is this that determines whether changes in the variables have a positive effect on final the commitment value (i.e., the positive commitment value is maintained) or a negative effect on the final commitment value (i.e., the positive commitment value converts to a negative value).
- The relative importance of institutional influence for the Anglo Saxon agent group is 0.75. It is this that determines the extent of institutional influence.
What the above analysis has demonstrated is that an agent group’s commitment levels can be altered by variations in the \textit{InstnPow} and \textit{InstnUncern} variables. In the first post-expansion phase of EU membership the increased stability and strength of institutional settings enable the exhibition of a positive default commitment. The presence of a number of positive and negative peaks, and the variability of the peaks demonstrate that changes and variations in the \textit{InstnPow} and \textit{InstnUncern} variables affect the commitment of the Anglo-Saxon agent group when a high level of importance is attached to institutional influence.

\textbf{8.2.3 Visualisation and Analysis of the Germanic Agent Group}

Analysis of the contours for simulation two will now focus on an analysis of the Germanic agent group contour graph in Figure 8.5A below and Figure 8.5B which represent the Germanic agent group’s final commitment values (\textit{finalcomm} (Ca)) given the \textit{InstnPow} (Pa) and \textit{InstnUncern} (Pb) coordinates. The analysis will compare the visual results with the agent group’s default commitment (\textit{defaultcomm} (Pc)) to determine the effect of the institutional influence.

The analysis will begin with the examination of the ‘controlled society’ and the areas surrounding these coordinates. Upon examining this particular division in Figure 8.5A, the peaks protruding from the bottom view of this division are clearly more numerous in number than that of the number protruding from the top view of the division. There is in fact a negative trend with random positive escapes. The overall behaviour of the agent within this division therefore has an inclination towards negative commitment.
Figure 8.5A - 3D Contour Graph of the Germanic Agent Group Commitment Values at its Intersecting InstnPow and InstnUncern Values Part 1

Top View

Note:
- The Germanic agent group's default commitment is simulated as 0.5. It is this that determines whether changes in the variables have a positive effect on final the commitment value (i.e., the positive commitment value is maintained) or a negative effect on the final commitment value (i.e., the positive commitment value converts to a negative value).
- The relative importance of institutional influence for the Germanic agent group is 1.00. It is this that determines the extent of institutional influence.

Bottom View
These results parallel the agent’s stance towards harmonisation upon initiating membership with the EU. The initial formulation of the Directives was based upon the Germanic and Latin approach, conservative and strict in application, their similarities with the Germanic system lent their full commitment towards its attainment. The stretch of high positive commitment values present within the top right corner of the controlled division in the contour graph in Figure 8.5A portrays this, i.e., a powerful institutional setting that is fully aware of its obligations in a time of change. With the introduction of the Anglo-Saxon agent group and the ensuing reformulation of the Directives, this positive commitment level declined drastically. This effect is demonstrated in the bottom view of the controlled society division in the contour graph in Figure 8.5A. Stretches of negative commitment are visible in areas of lessor institutional power. Institutions in this situation are less powerful, due to their unawareness of its obligations in such a time of change. This behaviour in essence resembles the level of commitment presented by the Germanic agent group in a defensive event or condition.

What the above analysis has demonstrated is that in an environment of control arriving with powerful institutions that are highly influentialy important, the agent is encouraged to behave negatively contrary to their default positive commitment. The question now is: does this behaviour change following expansion in EU membership?

The coordinates that now require closer examination for the Germanic agent group after the first post-expansion phase relate to the coordinates of a ‘reforming society’ and the areas surrounding these coordinates. The peaks protruding from the top view of the division are clearly more numerous in number than that of the number protruding from the bottom view of the division (refer to Figure 8.5B). The overall behaviour of the agent within this division therefore has an inclination towards positive commitment, which is the exact opposite of the overall behaviour presented in the pre-expansion phase of EU membership (as demonstrated in Figure 8.5A and discussed above). This replicates the agent’s current stance towards harmonisation within the EU.
Figure 8.5B - 3D Contour Graph of the Germanic Agent Group Commitment Values at its Intersecting InstnPow and InstnUncern Values Part 2

Note:
- The Germanic agent group's default commitment is simulated as 0.5. It is this that determines whether changes in the variables have a positive effect on final the commitment value (i.e., the positive commitment value is maintained) or a negative effect on the final commitment value (i.e., the positive commitment value converts to a negative value).
- The relative importance of institutional influence for the Germanic agent group is 1.00. It is this that determines the extent of institutional influence.
During the pre-expansion phase the Germanic agent group having realised the costs of its conservatism and isolation is now dedicated to improving its commitment towards harmonisation. For example, with regards to financial accounting and reporting corporations are now being encouraged to prepare accounts and reports in accordance with those of the Union and the larger international community.

The enjoinment of an additional Germanic member already committed to harmonisation provided further impetus for positive commitment and hence, the maintenance of a positive level of commitment that is if not higher than their default level of commitment. This is not to say that the Germanic agent group is entirely positive in its commitment. As, there are several areas of the division with negative levels of commitment. This is synonymous with the aspects of the Germanic system that are unchangeable and this is their concern for uncertainty. When such uncertainty is experienced the Germanic agent group reverts back to their conservative behaviour. This is demonstrated by the incidence of negative commitment within the ‘reforming society’ division typically when institutional uncertainty is high.

What the above analysis has demonstrated is that an agent group’s commitment levels can be altered by variations in the InstnPow and InstnUncern variables, and by the commitment of others who effectively are also institutions of influence. In the post-expansion phase of EU membership the easing of scepticism and conservatism and introduction of the second member into the group increased the ability of institutions to deal with increased uncertainty, which enabled them to maintain a positive default commitment. The presence of a number of positive and negative peaks, and the variability of the peaks have demonstrated that changes and variations in the InstnPow and InstnUncern variables affect the commitment of the Germanic agent group when an extremely high level of importance is attached to institutional influence.
8.2.4 Visualisation and Analysis of the Latin Agent Group

Analysis of the contours for simulation two will now focus on an analysis of the Latin agent group contour graph in Figure 8.6A below and Figure 8.6B which represent the Latin agent group’s final commitment values ($finalcomm (Ca)$) given the $InstnPow (Pa)$ and $InstnUncern (Pb)$ coordinates. The analysis will compare the visual results with the agent group’s default commitment ($defaultcomm (Pc)$) to determine the effect of the institutional influence.

The analysis will begin with the examination of the coordinates of the ‘reforming society’ and the areas surrounding these coordinates. The peaks protruding from the top view of this division are clearly more numerous in number than that of the number protruding from the bottom view of the division (refer to Figure 8.6A). There is in fact a positive trend with limited negative escapes. The overall behaviour of the agent within this division therefore is of positive commitment. This parallels the agent group’s stance towards harmonisation upon initiating membership with the EU. This particular agent group consists of France the initiator of and solicitor for unification across Europe, and Italy who adjusted their financial accounting system to be more reflective of the Anglo-Saxon accounting system. Hence, it is expected that there should be the exposition of a strong positive commitment (large number of peaks in the top view) in the reforming society division of the contour graph in Figure 8.6A.
Figure 8.6A - 3D Contour Graph of the Latin Agent Group Commitment Values at its Intersecting InstnPow and InstnUncern Values Part 1

Note:
- The Latin agent group’s default commitment is simulated as 1.00. It is this that determines whether changes in the variables have a positive effect on final the commitment value (i.e., the positive commitment value is maintained) or a negative effect on the final commitment value (i.e., the positive commitment value converts to a negative value).
- The relative importance of institutional influence for the Latin agent group is 0.50. It is this that determines the extent of institutional influence.
It is also important to note that these are instances of extreme change where negative commitment is witnessed. This is demonstrated by the stretches of negative commitment visible in the upmost top section of the reforming society division of the contour graph in Figure 8.6A. This is further indicative of the agent group behaviour. In times of high uncertainty with regards to the new system, the powerful institutions present enforce behaviour that is familiar but contrary to harmonisation and hence, results in negative commitment. This in practice is evident by their need to maintain a tax-based and uniform accounting system. This behaviour in essence resembles the level of commitment presented by the agent group in a speculative or trial event or condition.

What the above analysis has demonstrated is that in an environment of great institutional uncertainty and power eventuating from the devastation of Europe and the ensuing need to prevent the reoccurrence of similar devastation. This agent group with yet an intermediate level of influential importance behaved positively maintaining their high level of default commitment. The question now is: does this behaviour change following expansion in EU membership?

The coordinates that now require closer examination for the Latin agent group after the first post-expansion phase relate to the coordinates of an ‘atomistic society’ and the areas surrounding these coordinates. The peaks protruding from the top view of the division are clearly more numerous in number than that of the number protruding from the bottom view of the division (refer to Figure 8.6B). The overall behaviour of the agent within this division therefore also has an inclination towards positive commitment, which supports the behaviour presented in the pre-expansion phase of EU membership (as demonstrated in Figure 8.6A and discussed above). This is synonymous with the agent’s ongoing stance towards harmonisation within the EU.
Figure 8.6B - 3D Contour Graph of the Latin Agent Group Commitment Values at its Intersecting InstnPow and InstnUncern Values Part 2

Note:
- The Latin agent group's default commitment is simulated as 1.00. It is this that determines whether changes in the variables have a positive effect on final the commitment value (i.e., the positive commitment value is maintained) or a negative effect on the final commitment value (i.e., the positive commitment value converts to a negative value).
- The relative importance of institutional influence for the Latin agent group is 0.50. It is this that determines the extent of institutional influence.
The end of the reform process complemented by the addition of new members further supported their positive commitment towards harmonisation. This is not to say that the Latin agent group is entirely positive in its commitment. Underlying this positive commitment each agent still exhibits some degree of their traditional approach to accounting (e.g., the uniformity of their accounting system) inherent when no influence exists at all, i.e., where the agent is reduced to his or her fundamentals. This is demonstrated by the negative peaks present towards the ‘atomistic society’ coordinates in the bottom view of the contour graph in 8.6B.

What the above analysis has demonstrated is that an agent group’s commitment levels can be altered by variations in the $\text{InstnPow}$ and $\text{InstnUncern}$ variables, and by the commitment of others who effectively are also institutions of influence. In the post-expansion phase of EU membership the easing of speculation and the introduction of supporting members into the group further supported the positive level of their default commitment. The presence of a number of lesser negative peaks and smoother peaks (on the bottom view) have demonstrated that changes and variations in the $\text{InstnPow}$ and $\text{InstnUncern}$ variables affect the default commitment of the Latin agent group to a lesser extent than that of other agent groups (Anglo Saxon and Germanic agent groups) due to the intermediate level of influential institutional importance. The lesser affect enables the maintenance of their initial positive commitment.

8.2.5 Visualisation and Analysis of the Nordic Agent Group

Analysis of the contours for simulation two will now focus on an analysis of the last agent group contour graph, the Nordic agent group, in Figure 8.7A below and Figure 8.7B which represent the Nordic agent group’s final commitment value ($\text{finalcomm}$ (Ca)) given the $\text{InstnPow}$ (Pa) and $\text{InstnUncern}$ (Pb) coordinates. The analysis will compare the visual results with the agent group’s default commitment ($\text{defaultcomm}$ (Pc)) to determine the affect of the institutional influence.
Figure 8.7 - 3D Contour Graph of the Nordic Agent Group Commitment Values at its Intersecting InstnPow and InstnUncern Values Part 1

**Note:**
- The Nordic agent group’s default commitment is simulated as 0.75. It is this that determines whether changes in the variables have a positive effect on final the commitment value (i.e., the positive commitment value is maintained) or a negative effect on the final commitment value (i.e., the positive commitment value converts to a negative value).
- The relative importance of institutional influence for the Latin agent group is 0.25. It is this that determines the extent of institutional influence.
The analysis will begin with an examination of the coordinates of the ‘atomistic society’ and the areas surrounding these coordinates. The peaks protruding from the bottom view of this division are clearly more numerous in number than that of the number protruding from the top view of the division (refer to Figure 8.7A). There is in fact a negative trend with an isolated incident of positivist commitment. The overall behaviour of the agent within this division therefore has an inclination towards negative commitment. This parallels the agent’s stance towards harmonisation upon initiating membership with the EU. The Nordic agent group exhibits traits that are a hybrid of the Anglo-Saxon agent group and the Germanic agent group. It is therefore to be expected that there is going to be the existence of both positive and negative commitment, at almost similar levels, towards the attainment of the common goal of harmonisation. This is demonstrated in Figure 8.7A below.

Increases in institutional variability brought about by the adoption of new policies favouring the Anglo-Saxon approach lead to the maintenance of a positive commitment value. This is demonstrated in Figure 8.7A by the isolated incident of positive commitment in the region of increasing variability of institutional influence. Increasing levels of institutional power, on the other hand, suggest that the policies of the Germanic approach are retained and hence, being contrary to the requirements of the harmonisation the default commitment becomes negative. This effect is demonstrated in the bottom view of the contour graph in Figure 8.7A by the stretches of negative commitment within the division as institutional power increases. This behaviour in essence resembles the level of commitment presented by the agent group in a hybrid case.

What the above analysis has demonstrated is that in an environment of low institutional power and uncertainty the low influential importance fails to encourage the agent to act on the whole more positively or negatively, which is at times contrary to their default commitment and at other times is not. The question is: does this behaviour change following expansion in EU membership?
The coordinates that require closer examination for the Nordic agent group after the first post-expansion phase are identical to the pre-expansion phase and thus, are the coordinates of a ‘atomistic society’ and the areas surrounding these coordinates. The peaks protruding from the top view of the division are clearly more numerous in number than that of the number protruding from the bottom view of the division (refer to Figure 8.7B). The overall behaviour of the agent within this division therefore has an inclination towards positive commitment, which is the exact opposite of the overall behaviour presented in the pre-expansion phase of EU membership (as demonstrated in Figure 8.7A and discussed above). These results replicated the agent’s current stance towards harmonisation within the EU.

With the challenge of competitors with a more refined and optimistic approach, and the introduction of additional members seeking to adopt this approach, adjustments were necessary to adapt those aspects that are in accordance with the Germanic approach fostering negative commitment. As demonstrated in Figure 8.7B by the presence of a thick strip of positive commitment in the coordinates of increasing institutional uncertainty and low institutional power. There will be aspects of the Germanic approach that are unchangeable. This is presented in the bottom view of the contour graph in Figure 8.7B by the negative commitment as institutional power is increasing denoting the non-compliance with EU mandated policies.

What the above analysis has demonstrated is that an agent group’s commitment levels can be altered by variations in the InstnPow and InstnUncern variables, and by the commitment of others who effectively are also institutions of influence. In the post-expansion phase of EU membership, the addition of new members and increased competition increased the need for the agent group to undertake adaptations to better suit their system resulting in an overall positive commitment towards harmonisation. The presence of a number of negative peaks, and the variability of the peaks, be that positive or negative have demonstrated that changes and variations in the InstnPow and InstnPow variables affect the commitment of the Nordic agent group, but to a lesser extent due to the low level of importance attached to institutional influence.
Figure 8.7B – 3D Contour Graph of the Nordic Agent Group Commitment Values at its Intersecting InstnPow and InstnUncern Values Part 2

Note:
- The Nordic agent group’s default commitment is simulated as 0.75. It is this that determines whether changes in the variables have a positive effect on final the commitment value (i.e., the positive commitment value is maintained) or a negative effect on the final commitment value (i.e., the positive commitment value converts to a negative value).
- The relative importance of institutional influence for the Latin agent group is 0.25. It is this that determines the extent of institutional influence.
8.2.6 Visualisation Summary

An analysis of the contour graphs for the all the SERA groups’ commitment values demonstrate that changes in the institutional settings (i.e., institutional power and variability) affect the default commitment ($\text{defaultcomm (Pc)}$) of agent groups positively and negatively to varying levels depending upon the importance placed on institutional influence. The analysis demonstrates that the recorded commitment levels are relative to the condition of occurrence, i.e., their institutional settings and the importance of their influence. These conditions and the effects of these conditions on commitment values is summarised and listed below:

1. In an environment of upheaval with institutions that possess less than moderate levels of power that are relatively influentially important, the uncertainty they deliver encourages the agent group to behave negatively contrary to their default commitment. A move to an environment of control, however, where institutions possess more than moderate levels of power and are influentially important has consistency which encourages the agent group to exhibit a level of positive commitment.

2. In an environment of control with institutions that posses extreme levels of power that are highly influentially important, the introduction of the smallest levels of change create resistance and hence, encourage the agent to behave negatively contrary to their default commitment. A move to an environment of reform where the institutions continue to posses extreme levels of power that are highly influentially important, enable the introduction of change that fosters redevelopment and hence, encourages the agent to behave positively maintaining their positive default commitment.

3. In an environment of reform with institutions that posses extreme levels of power that are intermediate in influential importance, the introduction of change encourage the agent to accept change and behave positively maintaining their high level of default positive commitment. A move to an environment of freedom with institutions that posses low levels of power but are still intermediate in influential importance, only encourages the agent to accept change further and behave positively maintaining their high level of default commitment. Here the
intermediate level of influential importance was not significant enough to create divergent behaviour, but rather ensure compliance.

4. In an environment of freedom with institutions that possess low levels of power that are also low in influential importance, the introduction of change fails to encourage the agent to act on the whole more positively or negatively, which is at times contrary to their default commitment and at other times is not. It is with the introduction of additional agents in support of change, other vehicles of institutional influence, that a definite distinction is made and positive commitment ensues.

The above demonstrates just how variable the reaction of the SERA group is to changes in institutional settings. Different levels of variability in institutional influence (InstnUncern (Pb)) and influential power (InstnPow (Pa)) and the relative influential importance (InstnAsso (Dg)) of these have varied effects on the commitment levels of the SERA groups. At times this implies that the default commitment (defaultcomm (Pc)) value is maintained and higher commitment values are exhibited as the final commitment (finalcomm (Ca)) value. Alternatively, there are instances where the default commitment value is not maintained, and varied levels of negative commitment are recorded as the final commitment value. Their level of commitment is dependent upon the signals they receive from their environment which directs, controls, constrains and supports their behaviour. This changes with shifts to alternative environmental settings, as discussed in the points above, which demonstrates the conditionality of the agent’s behaviour. This adequately portrays the extended conceptualisation and reformulation of agent behaviour being informed by their environment in seeking to attain the principal’s goal even in a multi-agent community.

This extended conceptualisation and reformulation of agent behaviour even in the multi-agent community provides a more informed and detailed understanding of agent group behaviour. In the context of the EU this implies the reasoning of their reactions to harmonisation. The varied responses are a result of their varied institutional settings, that is, the stages that they were and are at in the matrix of institutional dimensions, and the relative importance their institutional influence plays within their environment. Given that each agent group is positioned in dissimilar dimensions of
the matrix (i.e., in the pre and post expansion phases in EU membership) and are assigned with distinct levels of influential institutional importance, it is not unexpected that disharmony in EU financial accounting eventuated and persists today.

What is interesting though is the changes to this disharmony are possible if change occurs within the group. The introduction of additional members into groups with positive attitudes to change and similar institutional settings can themselves be institutions of influence directing, controlling, constraining and supporting behaviour. This simulation demonstrates that even in multi-agent communities the level of positive commitment exhibited by agent groups is not guaranteed. These are conditional and open to influence. This may be or may not be to the betterment of the principal’s interests, that is, the attainment of the common goal of harmonisation.

Statistical analysis is now necessary to complement the visual analysis performed and to provide the numerical grounding for the visual results achieved.

### 8.3 Statistical Analysis: The Results

The statistical analysis to be conducted also pertains to the determination and examination of relationships between the variables of the simulation. The only difference between the statistical analysis in simulation one and two is that there are two parts to simulation two. The first part of the simulation is a run with nine agents, the pre-expansion phase in EU membership, and the second part of the simulation is a run with fifteen agents, the first post-expansion phase in EU membership. Numerous analyses will therefore be undertaken for the results from part one and part two of the simulation. The initial analysis begins with the descriptives and then the type of agent group and commitment values achieved for both part one and part two.
8.3.1 Descriptives and Variance Analysis

Table 8.1 below provides the frequencies of the 4840 final commitment \( (\text{finalcomm} (\text{Ca})) \) values produced for all SERA groups divided into quarterly increment values starting from negative one through to zero and ending at positive one. Table 8.2 below provides basic descriptives of the measurements produced for parts one and two of simulation two.

<table>
<thead>
<tr>
<th>Levels of Commitment</th>
<th>Frequency Part 1*</th>
<th>Frequency Part 2*</th>
<th>Percent (Part 1)</th>
<th>Percent (Part 2)</th>
<th>Change in Frequencies (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.00 to -0.75</td>
<td>131</td>
<td>50</td>
<td>2.7</td>
<td>1.0</td>
<td>-1.7</td>
</tr>
<tr>
<td>-0.75 to -0.50</td>
<td>565</td>
<td>354</td>
<td>11.7</td>
<td>7.3</td>
<td>-4.4</td>
</tr>
<tr>
<td>-0.50 to -0.25</td>
<td>544</td>
<td>491</td>
<td>11.2</td>
<td>10.1</td>
<td>-1.1</td>
</tr>
<tr>
<td>-0.25 to 0.00</td>
<td>976</td>
<td>1183</td>
<td>20.2</td>
<td>24.4</td>
<td>+4.2</td>
</tr>
<tr>
<td>0.00 to 0.25</td>
<td>901</td>
<td>1477</td>
<td>18.6</td>
<td>30.5</td>
<td>+11.9</td>
</tr>
<tr>
<td>0.25 to 0.50</td>
<td>763</td>
<td>680</td>
<td>15.8</td>
<td>14.0</td>
<td>-1.8</td>
</tr>
<tr>
<td>0.50 to 0.75</td>
<td>628</td>
<td>473</td>
<td>13.0</td>
<td>9.8</td>
<td>-4.2</td>
</tr>
<tr>
<td>0.75 to 1.00</td>
<td>332</td>
<td>132</td>
<td>6.9</td>
<td>2.7</td>
<td>-4.2</td>
</tr>
<tr>
<td>Total</td>
<td>4840</td>
<td>4840</td>
<td>100.0</td>
<td>100.0</td>
<td>0</td>
</tr>
</tbody>
</table>

*Paired Samples Test: \( t = 1.052, \text{df} = 4839, \text{Significance} = 0.293 \)

An examination of the table above reveals a number of interesting outcomes. The first of which pertains to the frequency of commitment levels in part one of the simulation. The most frequent values are concentrated around two quarterly increment values: the low negative commitment value (i.e., -0.25 to 0.00) and the low positive commitment value (i.e., 0.00 to 0.25). This implies that on the whole agent groups (nations) are either minimally committed to achieving the joint goal of harmonisation or are minimally uncommitted to achieving the joint goal of harmonisation. These quarterly increments are more frequent than others because of the nature and number of the nations within the agent groups.

The results portray a portion of the nations that are content with the enacted Directives who are generally willing to accept the commitment towards harmonisation but with minimal commitment. The other portion of nations finds the enacted Directives in opposition to their existing systems and is reluctant to commit positively exhibiting low levels of negative commitment. The values far and in between
represent the diversity of the agent groups, some being more committed or uncommitted than others depending on their institutional circumstance. These results provide an accurate depiction of the current condition of the accounting harmonisation process in the EU, i.e., a level of commitment is present but is minimal resulting in little harmonisation. There is no uniformity in commitment towards harmonisation in the EU and the diversity in the levels of commitment is synonymous with this.

Upon examination of the results for part two (refer to Table 8.1), the most frequent of quarterly increments has changed from the low negative commitment value (in part one of the simulation) to the low positive commitment value (in part two of the simulation). A paired samples t-test finds, however, that this difference between the frequencies for part one and part two of the simulation is not significant (refer to Table 8.1). The addition of new members into multi-agent group, the EU, therefore on the whole does not result in significant changes in the commitment values. Conditionally, however, as was demonstrated in the visual analysis, these minimal changes in frequencies brought about by the expansion in numbers can be encouraging. This parallels the current condition of EU accounting harmonisation, i.e., overtime although the commitment towards harmonisation has improved on the whole, disharmony in EU financial accounting has continued to be prevalent. This is likely to continue to be the case even with the planned and intended further addition of new members into the EU in 2004. The relativity of the nations’ circumstances proves to be driving force not the numbers. Agents even in a multi-agent setting conform to the socio-environmental rationalist agent’s (SERA’s) decision making process even with communal change.

An examination of the overall commitment values for all agent groups revealed divergent results reinforcing the current condition of harmonisation in the EU. Table 8.2 below demonstrates this variability for part one and two of the simulation. The commitment values are widely dispersed around the mean occurring at every 0.204 for part one and 0.130 for part two. This is the overall variance of the simulation for all nations or agent groups.
Table 8.2 - Descriptives of Final Commitment (finalcomm (Ca)) Values from Simulation One and Two

<table>
<thead>
<tr>
<th>Simulation Part and Agent Types</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part One</td>
<td>-.86283</td>
<td>.97267</td>
<td>.06061</td>
<td>.45176</td>
<td>.204</td>
</tr>
<tr>
<td>Part Two</td>
<td>-.86124</td>
<td>.95350</td>
<td>.05182</td>
<td>.36037</td>
<td>.130</td>
</tr>
<tr>
<td>Anglo Saxon Part 1</td>
<td>-.86069</td>
<td>.90969</td>
<td>.02686</td>
<td>.44036</td>
<td>.194</td>
</tr>
<tr>
<td>Anglo Saxon Part 2</td>
<td>-.86824</td>
<td>.90343</td>
<td>.02444</td>
<td>.45197</td>
<td>.130</td>
</tr>
<tr>
<td>Germanic Part 1</td>
<td>-.86283</td>
<td>.95344</td>
<td>.03671</td>
<td>.69557</td>
<td>.372</td>
</tr>
<tr>
<td>Germanic Part 2</td>
<td>-.84046</td>
<td>.95350</td>
<td>.06479</td>
<td>.42408</td>
<td>.130</td>
</tr>
<tr>
<td>Latin Part 1</td>
<td>-.80091</td>
<td>.97267</td>
<td>.10086</td>
<td>.35109</td>
<td>.282</td>
</tr>
<tr>
<td>Latin Part 2</td>
<td>-.65233</td>
<td>.72460</td>
<td>.05977</td>
<td>.24954</td>
<td>.082</td>
</tr>
<tr>
<td>Nordic Part 1</td>
<td>-.75000</td>
<td>.89374</td>
<td>.07802</td>
<td>.35279</td>
<td>.124</td>
</tr>
<tr>
<td>Nordic Part 2</td>
<td>-.75535</td>
<td>.79321</td>
<td>.06027</td>
<td>.26874</td>
<td>.072</td>
</tr>
</tbody>
</table>

Table 8.2 above also provides dispersion details for each nation or agent group. Upon examination one finds that all agent groups have maximum and minimum values on both ends of the spectrum (-1 to 0 to 1) within similar ranges. It is at their means and variances that the agent groups vary significantly. The Anglo Saxon agent group and Germanic group varying significantly in comparison to that of the Latin and Nordic groups (refer to Table 8.2; the variance column). Given that the Anglo Saxon and Germanic agent groups were of those in strong opposition to the method and system to be used in harmonisation, the variability in commitment is expected. The Latin and Nordic groups, on the other hand, being more relaxed sought to achieve commitment with little reluctance and hence, have varied less in their efforts.

A one-way analysis of variance (ANOVA)\(^3\) presented in Table 8.3 below confirms that there is significant difference among the mean final commitment (finalcomm (Ca)) values of the agent groups in part one and part two of the simulation – that is, the final commitment (finalcomm (Ca)) values exhibited is related to agent group types. This analysis has thus proved that each agent group has a varied level of final commitment (finalcomm (Ca)) even with all group agents facing similar circumstances/conditions and with the addition of new members. This is synonymous with the current status of EU attempts towards financial accounting harmonisation.

\(^3\) In performing the Analysis of variance (ANOVA) tests, a p-value less than the 5 per cent level of significance would indicate that the value for the F statistic is significantly large and thus, the null hypothesis would need to be rejected and the alternate hypothesis accepted. The null hypothesis here is that there are no significant differences between the agent group variances in commitment values.
Each nation in the EU has assigned themselves a different level of commitment towards harmonisation through the Directive procedures they have chosen to implement (as demonstrated and discussed in Chapter 4). The frequencies of commitment values for each agent group needs to be examined in order to confirm this.

<table>
<thead>
<tr>
<th>Simulation Parts</th>
<th>Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Part One</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>4.396</td>
<td>3</td>
<td>1.465</td>
<td>7.207</td>
<td>.000</td>
</tr>
<tr>
<td>Within Groups</td>
<td>983.181</td>
<td>4836</td>
<td>.203</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>987.577</td>
<td>4839</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Part Two</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>1.411</td>
<td>3</td>
<td>.470</td>
<td>3.628</td>
<td>.012</td>
</tr>
<tr>
<td>Within Groups</td>
<td>627.002</td>
<td>4836</td>
<td>.130</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>628.413</td>
<td>4839</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 8.4 below tabulates the frequencies of final commitment \( \text{(finalcomm (Ca))} \) values for each agent group in part one of the simulation. Examining the results of part one of the simulation in Table 8.4, the final commitment \( \text{(finalcomm (Ca))} \) values of the agent groups are concentrated around divergent areas. For the Anglo Saxon group a heavier concentration is exhibited around the low positive final commitment \( \text{(finalcomm (Ca))} \) values (i.e., 0.00 to 0.25). On the whole though a greater portion of the values (643 of the 1210 values; 53 per cent) ly in the positive region of the final commitment \( \text{(finalcomm (Ca))} \) levels. For the Germanic group, on the other hand, a heavy concentration is exhibited around the high negative final commitment \( \text{(finalcomm (Ca))} \) values (i.e., -0.75 to -0.50). On the whole a greater portion of the values (615 of the 1210 values, 51 per cent) ly in the negative region of the levels of final commitment \( \text{(finalcomm (Ca))} \). For both the Latin and Nordic agent groups a heavier concentration is exhibited around the low negative final commitment \( \text{(finalcomm (Ca))} \) values (i.e., -0.25 to 0.00). For both however a greater portion of the values (634 of the 1210 values, 52 per cent and 672 of the 1210 values, 56 per cent respectively) ly in the positive region of the levels of final commitment \( \text{(finalcomm (Ca))} \). The final commitment \( \text{(finalcomm (Ca))} \) values presented in part one of the simulation therefore varies with the agent group type. Friedman’s non-parametric chi-square test of independence confirms this conclusion (data presented in
Table 8.4). That is, the commitment values achieved by the agent groups are dependent upon the agent group type. A particular group’s final commitment ($finalcomm \ (Ca)$) preferences are thus significant in divergence from those of the other groups.

<table>
<thead>
<tr>
<th>Agent Group</th>
<th>Level of Commitment</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-1.00 to -0.75</td>
<td></td>
</tr>
<tr>
<td>Anglo-Saxon</td>
<td>28</td>
<td>1210</td>
</tr>
<tr>
<td>Germanic</td>
<td>101</td>
<td>1210</td>
</tr>
<tr>
<td>Latin</td>
<td>2</td>
<td>1210</td>
</tr>
<tr>
<td>Nordic</td>
<td>80</td>
<td>1210</td>
</tr>
<tr>
<td>Total</td>
<td>131</td>
<td>4840</td>
</tr>
</tbody>
</table>

Pearson Chi-Square Test: $\chi^2 = 1119.482$, df = 21, Significance = 0.000

0 cells (.0%) have expected count less than 5. The minimum expected count is 32.75

These results not only have statistical significance but also practical significance. The results tabulated actually are synonymous with the commitment effort of EU agent groups in the early stages (i.e., pre-expansion phase in EU membership) of Directive implementation. The Anglo Saxon group having been successful in reforming the Directives to reflect their existing system was on the whole more content with committing to harmonisation than any of the agent groups and hence, was not fazed terribly by the commitment towards harmonisation. This reformation however being in opposition to the existing Germanic system (the former system upon which the Directives were modelled) instilled a degree of distrust in the Germanic group. The group thence refrained from implementing the totality of all Directive requirements in support of harmonisation. This behaviour was demonstrated in the simulation by the high level of negative commitment towards harmonisation. The Latin and Nordic groups while in support of harmonisation were initially fazed by the differences between the Directive requirements and those of their own system; the Latin group more so. This resulted in the weary effort towards harmonisation, which is demonstrated in the results by the high frequency of low negative final commitment ($finalcomm \ (Ca)$) but on the whole a greater portion of values in the positive final
commitment \((finalcomm \ (Ca))\) region. Is there a change in these frequencies with the expansion of the EU?

Table 8.5 below tabulates the frequencies of the final commitment \((finalcomm \ (Ca))\) values for each agent group in part two of the simulation. Examining Table 8.5 one finds that the final commitment \((finalcomm \ (Ca))\) values of the agent groups are now concentrated around slightly dissimilar areas. This area is the low positive commitment \((finalcomm \ (Ca))\) with the frequency of low negative commitment \((finalcomm \ (Ca))\) being marginally lower. Therefore, for all agent groups the heaviest concentration is exhibited around the low positive final commitment \((finalcomm \ (Ca))\) values (i.e., 0.00 to 0.25). While this is followed closely by a heavy concentration of the low negative final commitment \((finalcomm \ (Ca))\) for all agent groups, there is still subtle difference in the frequencies between agent groups.

<table>
<thead>
<tr>
<th>Agent Group</th>
<th>Level of Commitment</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-1.00 to 0.75</td>
<td></td>
</tr>
<tr>
<td>Anglo-Saxon</td>
<td>35</td>
<td>1210</td>
</tr>
<tr>
<td>Germanic</td>
<td>14</td>
<td>1210</td>
</tr>
<tr>
<td>Latin</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Nordic</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>4840</td>
</tr>
</tbody>
</table>

For the Anglo Saxon group the frequencies are quiet similar with little growth in the positive region, i.e., a greater and similar portion of the values (631 of the 1210 values; 52 per cent) ly in the positive region of the levels of final commitment \((finalcomm \ (Ca))\). This similarity is attributed to nil expansion in the number of agents with the Anglo Saxon group. For the Germanic group while the frequencies are spread across all areas, a greater portion of the values (708 of the 1210 values, 59 per cent) now ly in the positive region of the levels of final commitment \((finalcomm \ (Ca))\). This is attributed to the addition of a new Germanic group member increasing the agent count within this group to two. Lastly, for both the Latin and Nordic group
a greater portion of the values (724 of the 1210 values, 60 per cent and 699 of the 1210 values, 58 per cent respectively) lie in the positive region of the levels of final commitment \((\text{finalcomm (Ca)})\). The increase in frequencies within the positive areas can also attributed to the increase in agent numbers within both groups. The commitment values presented in part two of the simulation therefore has changed to some to extent. This is largely a result of the changes experienced within the Germanic group.

While the results for part two show a greater degree of congruency around final commitment \((\text{finalcomm (Ca)})\) values than in part one, differences in frequencies across the agent groups are still evident (refer to frequencies in recorded in Table 8.5). Friedman’s non-parametric chi-square test of independence confirms this conclusion (refer to Table 8.5). That is, the final commitment \((\text{finalcomm (Ca)})\) value achieved by the agent groups is still dependent upon the agent type. Although a greater degree of positive commitment is now exhibited than in the pre-expansion phase, a particular agent group’s final commitment \((\text{finalcomm (Ca)})\) preferences are still significant in divergence from those of the other groups’ even with the addition of new agents.

The results of part two of the simulation, like those of part one of the simulation, not only have statistical significance but also practical significance. The results tabulated in part two are synonymous with the commitment effort of the agent groups following post-expansion in EU membership. The Germanic group, Latin group and Nordic group in the simulation moved to a heavier concentration around positive final commitment \((\text{finalcomm (Ca)})\) values; the Germanic group in particular making radical change. Why is there more of a positive final commitment \((\text{finalcomm (Ca)})\) towards harmonisation with the widening of the EU? The new EU members are committed to joining the existing arrangements, they have no pre ordained stances about the existing arrangements and seek not to adjust them but simply to adopt them to be a part of the wider community. Their institutions therefore foster an environment embracing EU policies and procedures. This is an entirely different stance to the initial members whose institutions played a primary role in policy formation, enforcing their own principal’s interests. It is these initial nine members who continue to influence policy formation today through their institutional arrangements. There is thus a diversity of responses towards the commitment to
harmonise in practice today, which is demonstrated in the results by not only the high frequency of low final positive commitment \((\text{finalcomm} \text{ (Ca)})\) and low negative final commitment \((\text{finalcomm} \text{ (Ca)})\), but also by the frequency of other quarterly incremental final commitment \((\text{finalcomm} \text{ (Ca)})\) values.

This simulation has thus demonstrated that the commitment levels of agent groups can and do vary through the incorporation of institutional influence upon agent group behaviour. To what extent does this institutional influence have an effect on agent group behaviour? Recall that in simulation two each agent group is assigned a weighting on the relative importance of institutional relevance. This weighting determines the extent to which institutional affiliations and interactions influence agent group behaviour. Does the weighting on the relative importance of institutional relevance have a proportionate association on an agent group’s final commitment \((\text{finalcomm} \text{ (Ca)})\) efforts towards harmonisation?

Table 8.6 below tabulates the frequencies of final commitment \((\text{finalcomm} \text{ (Ca)})\) values for each weighting of institutional relevance. Examining Table 8.10 the final commitment \((\text{finalcomm} \text{ (Ca)})\) values of the weighted groups demonstrate a particular pattern. A low weighting of institutional relevance seems to indicate that a higher portion of final commitment \((\text{finalcomm} \text{ (Ca)})\) values are contained in the positive region (refer to Table 8.6). This pattern appears to change with higher weighted groups, a higher portion of final commitment \((\text{finalcomm} \text{ (Ca)})\) values are contained in the negative region and the occurrences are more widely dispersed across all quarterly increments of final commitment \((\text{finalcomm} \text{ (Ca)})\) values (refer to Table 8.6). This illustrates the power of institutional influence. A low weighting indicates that institutional influence has little effect on the effort of the agent group to the extent that the initial default positive final commitment \((\text{finalcomm} \text{ (Ca)})\) value assigned to the agent group fluctuates slightly. A high weighting indicates that institutional influence has a significant effect on the effort of the agent group to the extent that the initial default positive final commitment \((\text{finalcomm} \text{ (Ca)})\) value assigned to the agent group fluctuates widely and more frequently across diverse areas and both regions. This pattern is maintained even in part two of the simulation, as demonstrated in Table 8.7 below. The weighting of institutional influence therefore
has an effect on the effort towards final commitment \((finalcomm \ (Ca))\) by agent groups.

Table 8.6 – Final Commitment \((finalcomm \ (Ca))\) Values Tabulated by Weighting of Institutional Relevance for Part One

<table>
<thead>
<tr>
<th>Weighting of Institutional Relevance</th>
<th>Level of Commitment</th>
<th>-1.00 to -0.75</th>
<th>-0.75 to -0.50</th>
<th>-0.50 to -0.25</th>
<th>-0.25 to 0.00</th>
<th>0.00 to 0.25</th>
<th>0.25 to 0.50</th>
<th>0.50 to 0.75</th>
<th>0.75 to 1.00</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25</td>
<td>0.25</td>
<td>80</td>
<td>126</td>
<td>332</td>
<td>272</td>
<td>244</td>
<td>129</td>
<td>27</td>
<td>1210</td>
<td></td>
</tr>
<tr>
<td>0.5</td>
<td>0.5</td>
<td>2</td>
<td>55</td>
<td>128</td>
<td>311</td>
<td>289</td>
<td>263</td>
<td>117</td>
<td>45</td>
<td>1210</td>
</tr>
<tr>
<td>0.75</td>
<td>0.75</td>
<td>28</td>
<td>182</td>
<td>103</td>
<td>254</td>
<td>299</td>
<td>106</td>
<td>179</td>
<td>59</td>
<td>1210</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>101</td>
<td>246</td>
<td>187</td>
<td>79</td>
<td>41</td>
<td>150</td>
<td>203</td>
<td>201</td>
<td>1210</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>131</td>
<td>565</td>
<td>544</td>
<td>976</td>
<td>901</td>
<td>763</td>
<td>628</td>
<td>332</td>
<td>4840</td>
</tr>
</tbody>
</table>

**Pearson Chi-Square Test:** \(\chi^2 = 1119.482, \text{ df} = 21, \text{ Significance} = 0.000\)

0 cells (.0%) have expected count less than 5. The minimum expected count is 32.75

Table 8.7 – Final Commitment \((finalcomm \ (Ca))\) Values Tabulated by Weighting of Institutional Relevance for Part Two

<table>
<thead>
<tr>
<th>Weighting of Institutional Relevance</th>
<th>Level of Commitment</th>
<th>-1.00 to -0.75</th>
<th>-0.75 to -0.50</th>
<th>-0.50 to -0.25</th>
<th>-0.25 to 0.00</th>
<th>0.00 to 0.25</th>
<th>0.25 to 0.50</th>
<th>0.50 to 0.75</th>
<th>0.75 to 1.00</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25</td>
<td>0.25</td>
<td>1</td>
<td>17</td>
<td>143</td>
<td>350</td>
<td>408</td>
<td>227</td>
<td>61</td>
<td>3</td>
<td>1210</td>
</tr>
<tr>
<td>0.5</td>
<td>0.5</td>
<td>12</td>
<td>114</td>
<td>360</td>
<td>447</td>
<td>227</td>
<td>61</td>
<td>50</td>
<td>1210</td>
<td></td>
</tr>
<tr>
<td>0.75</td>
<td>0.75</td>
<td>35</td>
<td>173</td>
<td>123</td>
<td>248</td>
<td>276</td>
<td>110</td>
<td>183</td>
<td>62</td>
<td>1210</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>14</td>
<td>152</td>
<td>111</td>
<td>225</td>
<td>346</td>
<td>116</td>
<td>179</td>
<td>67</td>
<td>1210</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>50</td>
<td>354</td>
<td>491</td>
<td>1183</td>
<td>1477</td>
<td>680</td>
<td>473</td>
<td>132</td>
<td>4840</td>
</tr>
</tbody>
</table>

**Pearson Chi-Square Test:** \(\chi^2 = 744.094, \text{ df} = 21, \text{ Significance} = 0.000\)

0 cells (.0%) have expected count less than 5. The minimum expected count is 12.50

Friedman’s non-parametric chi-square test of independence confirms the above conclusion for both part one and two of the simulation (refer to Table 8.6 and 8.7 respectively). That is, the final commitment \((finalcomm \ (Ca))\) value achieved by the agent groups is influenced by the weighting of institutional relevance. A particular group’s commitment preferences are thus significant in divergence from those of other groups’ to the extent of their institutional influence and this is even with the addition of new agents within the agent groups.
The next point of observation therefore pertains to the magnitude of institutional influence, i.e., to what extent does institutional affiliation and interaction affect agent group behaviour. Recall that there are two variables that represent the magnitude of institutional influence within the simulation, these are instnpow and instnuncern. The former relates to the influential power that the institutions possess within the environment and the later relates to the variability in the institutional influence. Each of these variables has a range in value from zero to one hundred in increments of ten. Does a variation in these variables cause a subsequent variation in the final commitment ($finalcomm(Ca)$) levels of the agent groups? A correlation test of the variables with the associated final commitment ($finalcomm(Ca)$) values will determine this.

### 8.3.2 Correlation Analysis

Table 8.8 below presents the results of the correlation tests for parts one and two of the simulation. The results indicate that a correlation between:

1. InstnPow and the final commitment ($finalcomm(Ca)$) values for all agent groups (correlation 1), and
2. InstnUncern and the final commitment ($finalcomm(Ca)$) values for all agent groups (correlation 2),

is not significant for part one and two of the simulation (refer to Table 8.8). This indicates that the two variables in both correlations for both parts of the simulation are uncorrelated. There is no relationship between the variables of InstnPow and final commitment ($finalcomm(Ca)$) and InstnUncern and final commitment ($finalcomm(Ca)$), a variation in one does not cause a subsequent variation in the other even in agent group expansion. This may be because the correlation tests present no differentiation between the final commitment ($finalcomm(Ca)$) values of each agent group. A correlation tests for each agent group finds similar results.
A correlation between:

1. InstnPow and for each respective agents’ group (i.e., Anglo Saxon group, Germanic group, Latin group, and Nordic group) final commitment \( (\text{finalcomm (Ca)}) \) values (correlation 1), and

2. InstnUncern and for each respective agents’ group (i.e., Anglo Saxon group, Germanic group, Latin group, and Nordic group) final commitment \( (\text{finalcomm (Ca)}) \) values (correlation 2)

for parts one and two of the simulation demonstrate no statistical significance (refer to Table 8.8). This indicates that the two variables in both correlations for part 1 and part 2 of the simulation for each respective agent group (i.e., Anglo Saxon group, Germanic group, Latin group, and Nordic group) is uncorrelated.

There is therefore no relationship between the variables of InstnPow and final commitment \( (\text{finalcomm (Ca)}) \) for all SERA groups, and InstnUncern and final commitment \( (\text{finalcomm (Ca)}) \) for all SERA groups, a variation in one does not cause a subsequent variation in the other. This at first appears to be quite a contradiction of the formalised SERA behaviour, which describes the agent as being directly influenced by institutional affiliation and interaction. On closer examination, however, a correlation between the two is not necessary. Recall that each SERA group is a heterogenous actor. While the set of states (i.e., the principal-multi-agent
relationships) and the available actions (i.e., committing to the common goal(s)) are
components common to all discrete events (i.e., time step), the degree to which they
are instanced varies in each of the ten time steps. For example, the dimensions of the
relationship (e.g., probinform, benefitinform, costinform) that an agent faces in one
discrete event will not be replicated in another, nor will the agent take the same action
in every state instanced (i.e., defaultcomm will vary) or have similar perceptions (e.g.,
percievepb, perceivepo, perceivene). For this reason it is difficult for there to be any
correlation in the dimensions of states if the given and informed states and actions
vary for each agent within agent groups at every instance (i.e., at each time step).

More importantly with this simulation the given states and actions vary even within
agent groups. This demonstrates the heterogeneity of the agents even within the agent
groups. For example, each of these agent groups consists of a number of diverse EU
member states, each of which while being within the same group is not necessarily
identical in behaviour or in the systems within which they operate. They have
similarities in their core structure such as their institutional arrangements but are
differentiated by their influences from these and their responses to them. This is
synonymous of the status of EU financial accounting harmonisation. No two EU
member nations have an identical accounting system despite the existence of a core
structure such as their economic institutions and the enforced Directives (Temel
2000). Their responses and reactions to the enacted Directives enforce a
differentiated behaviour towards the commitment to harmonise. For this reason it is
difficult for there to be any correlation in commitment efforts even within the agent
groups especially when the states vary for each agent within the agent group.

While the results do not demonstrate a correlation, the results do demonstrate that
heterogeneity is evident even within agent groups of similar description. This
variability in multi-agent community behaviour can not be described by the existing
theory which is the homogenous description of self-interested rationalism. The
variability in multi-agent community behaviour is portrayed adequately by the
contextual nature of the socio-environmental rationalism. This accommodates for
agent individuality, differences in behaviour, and environmental dynamism. The
extended conceptualisation and reformulation of agent behaviour proves to be more
representative of the EU harmonisation effort.
8.4 Summary of Findings in Relation to the Research Objectives and Questions

The analysis of the results obtained from simulation two above, in short, also reinforces the predictions of the extended conceptualisation and reformulation of agent behaviour in a multi-agent setting, i.e., the SERC. What does this imply for the research objectives and questions presented in Chapter 7? The objective and questions to be addressed were as follows:

1. **To Evaluate Existing Agency Theory.**
   RQ1. What aspects of the existing theory of Agency require a reassessment?

2. **To Redevelop and Model Concepts of Agency.**
   RQ2. How can Agency be conceived and modelled more adequately, particularly after examination of SIR behaviour?

3. **To Discern the Influential Factors.**
   RQ3. What factors play a role in affecting the behaviour of individuals in agency?

4. **To Review Concepts and Formulation.**
   RQ4. How effective and influential is the extended conceptualisation and reformulation of agent behaviour in various contexts?

5. **To build an Operationalisation.**
   RQ5. How can an extended conceptualisation of agent behaviour be modelled using object-oriented methods so as to provide more informative understanding of the notion of agency?

6. **To Evaluate Practical Applicability.**
   RQ6. How applicable are the concepts, developments and modelling to various situations?
Research questions 1, 2, 3 and 5 have been addressed in Chapter 7 through the results obtained in simulation one. These findings are reinforced through the results obtained in simulation two but in the context of a multi-agent community. This also utilised an object-oriented method of model simulation, almost identical to that used in simulation one. It is research question number 4 and 6 that will be addressed here from the results obtained in simulation 2.

Chapter 4 introduced a context for examination. This context relates to the EU financial accounting harmonisation process. The institutional analysis presented an explicit description of the influence of national institutions upon national accounting systems and hence, their adoption of the EU Financial Accounting Directives. An analysis of the attributes of the institutional arrangements within each member nation and their consequent effects on the selection of accounting policies demonstrated the plausibility of the supposition that societal institutions have influenced the adoption of particular styles of financial accounting from the EU Directives. These are diverse and are rarely in accordance with the principles of harmonisation. This diversity and variability is demonstrated and presented in the simulation across all agent groups. It is this degree of diversity in EU financial accounting that does not reinforce or support the notion that member nations are acting in accordance with the assumptions of self-interested rationalism. Diversity is not in the best interests of member nations (the agents) or the EU citizens (the principals). Hence, this demonstrated that SIR behaviour does not necessarily inform member nation behaviour in policy selection but rather their institutional settings. Institutions were thus the instruments through which member nations’ (agent) behaviour was driven.

Affiliations and interactions with institutions were instrumental in supporting, assisting, directing and constraining member nations’ (agent) behaviour towards the EU citizens’ goal of harmonisation. The harmonisation of financial accounting in the European Union (EU) represents just one of the many contexts for application. This particular principal-multi-agent relationship represented one of multiple agents and dual parties, presenting a comprehensive case for analysis. The analysis and simulation of which have demonstrated that the extended conceptualisation and reformulation of agent behaviour (SERA) is effective in providing a more informed understanding of agent behaviour even in alternate contexts.
The malleable variables within the simulation allowed its use in the various and diverse contexts of the EU financial accounting harmonisation process. Similar results were obtained as to that of the results in the simulation of the individual agent. Each agent group presented varied results depending on the context within which they were placed and the importance placed upon institutional influence. This simulation of agent behaviour presented results that were synonymous with the behaviour of each agent group that existed at the time of the pre-expansion phase in EU membership and that which existed at the first post-expansion phase of EU membership. The case of EU financial accounting harmonisation represents just one example of a multi-agent community to which the simulation was adequately applied. The flexibility and adaptability of the model to suit the context to which it is applied implies that different contexts and agent examples are not a barrier to its application but its strength.

The discussion presented above demonstrates how the method adopted and the results obtained therein address the research questions 4 and 6 established at the beginning of the dissertation.
8.5 Conclusion

This Chapter has discussed and presented the method through which the formalised conceptualisations of the SERC were undertaken. This involved the use of NetLogo, a computer simulation tool. The results obtained from the simulation were analysed visually and statistically, each providing both informative and supportive information of the need to consider the context in which even the agent group operates. This further supporting the extended conceptualisation and reformulation of agent behaviour, i.e., SERA.

The simulation demonstrated that commitments towards the principal’s goal even in the collective context can be both positive and negative depending upon influence the agent receives from his or her institutional affiliations and interactions. The extent of this is dependent upon the institutionally specific variables of institutional power and institutional variability. Both these variables present varied effects upon agent group behaviour which is even in variance to that presented for the individual SERA because of the agent specific variable of influential institutional importance. The discussion undertaken in analysing these results and the processes utilised to attain them address research question 4 and research question 6 established at the onset of the Dissertation. Discussions will now proceed with an examination of the implications of the findings obtained in Chapters 7 and 8.
9. Conclusions

A comprehensive examination of the theory of Agency, particularly that developed by Jensen and Meckling (1976), and the context within which the agent behaves is presented in this dissertation. It is an examination that has sought to enhance understanding at a conceptual level through the contextualisation of the theory. This has resulted in an extended conceptualisation and reformulation of agent behaviour (SERA), shedding light on the limited success of the existing research within Agency theory. The comprehensive explanation and analysis undertaken has generated a deeper understanding of agent behaviour in both the individual and multi-agent setting. Significant implications exist for not only Agency theory, but also the business community and society in general. A review of the research will now follow proceeded by a discussion of the implications of the research.

9.1 The Study in Review

The theory of Agency is just one of a number of theories that examines and recognises the conflicts of interests within the contracting process. These conflicts typically emerge as problems associated with risk aversion, adverse selection and asymmetric information. Coupled with the fundamental assumption that all agents are self-interested rationalists (SIRs), the theory predicts that without contractual restraints and incentives the agent will use the resources available to them to maximise their own utility. The limited success of these predications has rarely been adequately addressed despite its significance and extensive use.

This limited success of the existing Agency research rests upon the simplistic assumption of self-interested rationalism. It is this assumption that is assumed to underlie the reasoning of the agent in virtually every condition encountered. Therefore, this study sought to develop an extended conceptualisation and reformulation that provided a deeper understanding of the agent behaviour generating the conflicts of interests within the contracting process. A relaxation of the self-interested rationalist (SIR) assumption expanded the narrow focus of this utility based
assumption to include the role of an influential environmental context. Focusing in particular on the institutional affiliations and interactions the agent encounters during the contracting process gave rise to the conceptualisation of the socio-environmental rationalist agent (SERA). This conceptualisation is not to the exclusion of risk aversion, adverse selection and information asymmetry within the contracting process. Their existence within the contracting process remains but their role in generating and encouraging agent behaviour becomes secondary.

A reformulation of agent behaviour demonstrates that it is the influence the agent receives from their institutional affiliation and interaction that supports, assists, constrains, or directs their behaviour. This study therefore examined the simple links between institutional influence, and individual and multi-agent behaviour towards attaining the principal’s goal. The links were identified in an examination of the literature and through critical analysis.

The Object Orientated (OO) Approach, the design methodology of the study, facilitated the development of the extended conceptualisation and reformulation of agent behaviour (SERA). An OO model of the extended conceptualisation and reformulation of agent behaviour supported the design of two simulation models. Simulations of each provided quantitative outcomes for visual and statistical analysis. These results visually and statistically demonstrate an individual agent’s and multi-agents’ commitment levels towards achieving the principal’s goal.

The analysis confirmed that agent behaviour, specifically agent commitment towards the relationship with their principal, is conditional. The levels of institutional power and variability in institutional influence have varied and diverse effects upon agent behaviour. These varied and diverse effects are contrary to the relatively static behaviour of the SIR agent. A simulation of the EU financial accounting harmonisation process as a multi-agent socio-environmental rationalist multi-agent community (SERC) demonstrated that a more informed and deeper understanding of multi-agent behaviour is possible. Institutional influence, here also, influences the commitment of agents towards their relationship with their principal (i.e., EU citizens and EU Commission).
The implications these findings exhibit are numerous and will be examined in the following sections. Table 9.1 below summaries the research achievements of each chapter, and this is in respect of their research domains and specific research questions. It is the final section of this table, the last column representing implications, and the implications pertaining to each of the respective sections within this table that will be examined next.

Table 9.1 - Summary of Research Outcomes and Domains in Relevant Chapters

<table>
<thead>
<tr>
<th>Orientation Focus</th>
<th>Exploratory of Ideas</th>
<th>Testing Out Ideas as Formed and Linked</th>
<th>Problem solving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pure Research</td>
<td>General conceptualisation</td>
<td>General formulation</td>
<td>Simulations of general and specific form</td>
</tr>
<tr>
<td>(more abstract and conceptual)</td>
<td>Chapter 2 &amp; 3 RQ1 &amp; 2</td>
<td>Chapter 6 RQ3</td>
<td>Chapter 7 RQ4</td>
</tr>
<tr>
<td>Conceptualising SERA</td>
<td>Formulating SERA</td>
<td>SERA and SIR Simulated</td>
<td></td>
</tr>
<tr>
<td>Implications 1a</td>
<td>Implications 1b</td>
<td>Implications 1c</td>
<td></td>
</tr>
</tbody>
</table>

Object-Oriented (OO) Approach

Chapter 5 RQ 5

Developing and detailing the OO Model

Applied Research

(more particular and as constructed)

<table>
<thead>
<tr>
<th></th>
<th>Application of SERA and SIR to EU</th>
<th>Frame EU in SERA</th>
<th>Four EU cases simulated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Articulations of SIR and SERA</td>
<td>Chapter 4 RQ4</td>
<td>Chapter 6 RQ5</td>
<td>Chapter 8 RQ6</td>
</tr>
<tr>
<td>Specifications of SERA</td>
<td>Applying SERA to a case situation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Table 5.2
9.2 Research Implications

The theory of Agency has been the subject of extensive research and is one of the first theories to address the behavioural implications of the economic actors in a firm setting, an area often overlooked by neoclassical theory. The theory of agency, however, has had limited success. Notably, even in the simplest of instances it has incorrectly predicted phenomenon. The ineffectiveness of the existing approach may have a detrimental effect on its usefulness as a tool to explain behaviour in contracting relationships. While the initiators of the theory envisaged wider development its theoretical development and application in ongoing research has been reserved. The excessive focus on the assumption of self-interested rationalism through contractual incentives may, at worst, even misguide research and may or may not be necessary or even a part of the problem or answer.

Therefore, by adopting an extended general conceptualisation and reformulation of agent behaviour, an alternative understanding of the agency relationship can be obtained which may improve predictability. The use of this approach will demonstrate that with more adequate framing and a deeper understanding of agent behaviour, a broader and deeper explanation of agent behaviour in agency relationships can be attained. Understanding why, when and how parties behave in the manner they do and the risks of contracts may even improve outcomes and prevent non-functional behaviour. In doing so, a more informed understanding of the firm, the region and world at large may be obtained.

The implications of this research therefore have profound effects upon three areas. Each of these areas is presented within Table 9.1. These areas are:

1. Research in Agency theory (top half of Table 9.1),
2. Harmonisation in EU financial accounting, a multi-agent community perspective (bottom half of Table 9.1), and
3. For the wider business community and society (last column of Table 9.1).

The following sub-sections will examine these three sets of implications in turn.
9.2.1 Implications for Agency Theory

An implementation of an extended conceptualisation and reformulation of agent behaviour can provide a more informed understanding of Agency theory and of the behaviour of the agent in a principal-agent relationship in particular. Implications exist for the conceptualisation, formulation and simulation of agency (and of principal-agent situations more generally).

Implications 1a: of Concept

The first of the implications to be examined pertains to the conceptualisation of the agent in theory (‘implications 1a’ in Table 9.1). The agent within the existing theory is conceptualised as a homogenous actor, acting in accordance with SIR behaviour unless constrained by incentives and contractual restrictions. In this sense the agent is always assumed to be in conflict with the principal’s interests (which are themselves acting in a predetermined self-interested way). The extended conceptualisation and reformulation of agent behaviour removes this predicability in agent behaviour. The agent is a heterogenous actor, a construct in an environment that acts in accordance with the influences therein. The agent’s behaviour is, therefore, anything but predictable. In fact it is highly variable responding to changes within the influential environment and varying from agent to agent.

There appear to be no quick fixes to the alignment of interest issues in the principal-agent relationship. The use of contractual constraints and incentives, the sole focus of the existing research in aligning agent behaviour with those of the principal, is not necessarily useful if self-interested behaviour is not the driving influence of agent behaviour. Existing research within agency has demonstrated the limited usefulness of such solutions, but no direct explanation has demonstrated why. It is contended in this work that notions beyond those of self-interested rationalism can assist explanation.
Chapter 9: Conclusions

The variability in agent behaviour creates a degree of information asymmetry. This not only in the sense of that portrayed in the existing research where there is an assumed asymmetry due to the separation of control from the ownership of resources. Information asymmetry also exists in the sense of the inability to predict the information transmitted to the agent via institutional affiliation and interaction. The extended conceptualisation recognises information asymmetry as a result of the separation of ownership and control and that generated through institutional affiliation and interaction. It seeks to alleviate existing shortcomings through the inclusion of the context.

The extension has demonstrated that the existing research presents a one dimensional view (from an internal perspective imposed by the agent) of the presence of information asymmetry within the agency association. The extension clearly highlights and supports the need to redirect efforts towards examining the role that information transmission via institutional affiliation and interaction exhibits on agent behaviour. The agency relationship is no longer a mutually dependent asymmetric form. But rather a mutually dependent instrumental form. The agent is instrumental in performing the principal’s goals, and it is the information transmitted via institutional affiliation and interaction that is instrumental in influencing agent behaviour. Thus institutional affiliations and interactions can support, direct, assist and constrain behaviour.

The move from the sole examination of the internal environment (SIR behaviour) to the inclusion of the external environment, make the examination and understanding of agency behaviour more complex. This is demonstrated through Figure 9.1 below, which presents the institutional matrix of dimensions for types of individual agent behaviour.
This matrix can be applied to assess the feasible behaviour of for example a CEO operating in varying environments. The CEO can be cast as an agent of various types:

- As ‘agent 1’ in the matrix the CEO is operating in an environment of minimal institutional influence. Behaviour on the part of the CEO is set to remain static with minimal change if any resulting in favourable behaviour. If ‘agent’ 1 moves to the corner ‘A’ institutional considerations collapse leaving a SIR formulation.
- At ‘agent 2’ in the matrix the CEO is operating in an environment of significant influential power with minimal change. Behaviour on the part of the CEO is set to be in strict accordance with established procedures and contracts and hence, highly predictable with minimal variation in behaviour.
- At ‘agent 3’ in the matrix the CEO is operating in an environment of significant influential variation with little imposition. Behaviour on the part of the CEO is set to be inconsistent with established procedures, as such procedures have little enforcement power and hence, behaviour will be questionable.
- At ‘agent 4’ in the matrix the CEO is operating in an environment with significant influential power and variation in influence. Behaviour on the part of the CEO is set to be adaptive with constant change and hence, is encouraging that an appropriate outcome will be attained given appropriate institutional forces.
Such usages effectively demonstrate the increased dimensionality and complexity of socio-environmental rationalist agent behaviour in comparison to the static behaviour of the SIR. The SERA is a richer and more general representation than SIR.

**Implications 1b: of Formulation**

The second of the implications (‘implications 1b’ in Table 9.1) to be examined pertains to the reformulation and particularly treatment of the process through which affiliations and interactions influence agent behaviour. Research will thus need to consider what and which institutions should be examined, and how these are perceived. Their relativity to the context of examination will require that this be undertaken with each and every investigation of a principal-agent relationship. That is a more complete initial specification needs to be carefully and sensitively developed.

The key issue is how institutional influences are to be rendered as part of agent perception. There are three different approaches through which this could be undertaken. These are as follows:

1. Render the influence of all institutions uniform and equivalent to one another, and leave the perceptions open to influence with varying types of institutions for each investigation,

2. Render the perceptions received from institutional affiliation and interaction equivalent and vary and leave the influences to be relative to the situation with varying types of institutions for each investigation, or

3. Render the influence and perceptions received to be variable with set types of institutions for each investigation.

The first approach represents an impossible or an extreme task and is unrepresentative of institutions within society. The role that institutions play in society varies significantly, and the power of their influence varies widely across circumstances and institutions. If the first approach were used, it would represent a simplified and unrealistic examination of institutional influence within agency. The second
approach represents another simplified and extreme approach, which is also unrepresentative of agents affiliating and interacting with institutions. An agent is a heterogeneous actor and to render that all perceptions be received equally is unrepresentative of such an actor. It more appropriately represents a method through which behaviour can be prescribed and fixed but not understood. The last approach through its flexibility can facilitate an understanding of the role of institutions and their effects. The institutional specificity for each circumstance enables a comprehensive examination of responses through its variability in both influences and perceptions.

Varying both the influences and perceptions for each investigation rather than one (as is in the first two approaches) with varying institutional types therefore represents a more appropriate method for analysis given the dynamics of institutional affiliation and interaction within agency. Understanding just how and what influences the agent with certain institutions can highlight the areas for concern that lend to inconsistent behaviour with the principal goal(s). Efforts can thus be directed towards countering the inconsistent behaviour. For example, the ability to automatically recover the intentions involved in the negotiation process by the agent might help understand and enforce dubious contracts.

**Implications 1c: of Simulation**

Implications follow from the simulations of the extended conceptualisation and reformulation of agent behaviour (‘implications 1c’ in Table 9.1). The results presented from the first simulation demonstrate that an agent can act in accordance with the principal’s interests while no longer solely a SIR. There is therefore no longer a principal-agent problem but a principal-agent association. The agent’s behaviour is not necessarily in misalignment with the principal’s interests but dependent upon the association in which it is contracted. While the agent is instrumental to attaining the principal’s goal, the institutional influence the agent receives is instrumental in assisting, directing, supporting and constraining his or her behaviour.
Through understanding the influences of institutional affiliation and interaction the researcher is able to understand the reasoning of the agent. Where there are any behaviours deviating from the interests’ of the principal, efforts can be directed towards alleviating the inconsistency in interests through perhaps building an understanding of the agent’s belief structure. Therefore the relationship is of a principal-agent association of possible conflicts instrumental to achieving a predetermined outcome. Through this better informed formulation the researcher would be able to more efficiently determine appropriate solutions to resolve conflicts rather than to misdirect resources towards excessively examined problems, as is done in the existing theory of agency.

9.2.2 Implications for Harmonisation in EU Financial Accounting

The application of the extended conceptualisation and reformulation of agent behaviour to an instance of agency, the EU case, sought to provide a more informed understanding of agency theory in the context of a multi-agent community. A number of implications follow for each of the research outcomes and domains (as depicted in the bottom half of Table 9.1).

Implications 2a: of Articulation

The first of the implications to be examined pertains to the articulation of the EU case using the extended conceptualisation of agent behaviour (‘implications 2a’ in Table 9.1). The articulation has demonstrated that the institutions within EU member states have been effective in influencing the direction of European integration. These developments have serious implications for the future of the EU and for European integration in general. This is especially the case with the ongoing widening and deepening of the EU. Unless efforts are directed towards appreciating the varying differences in institutional influence efforts towards harmonisation within the EU will be in constant disarray.
This may even be more apparent with the deepening of the EU. The increased complexity of harmonisation is set to challenge well established and entrenched rules, standards and norms. Without fully understanding the underlying reasons for existing disharmony in the EU (and the failure to attain the goals established by the nominated principal, the EU citizens), existing conceptualisations will not only misguide research but also misinform researchers about the appropriate means through which to approach and alleviate the problems.

**Implications 2b: of Specification**

The case specification to the reformulated agent behaviour demonstrates the added complexity of multi-agent communities. Multiple agents possess similar abilities and capabilities in terms of their rationality processes but simultaneously exhibit just as diverse behaviour as do individual agents. They also experience an added complexity in their reasoning process because of the differences exacted in affiliation and interaction. This is the exact difficulty experienced in transnational activity. States have at times been in conformance and in others their influence has sought to extend beyond their borders (Huntington 1973; Tarrow, 2001: 3). In the case of the SERC institutional influences determine the extent of commitment towards achieving the common goal. Variations in domestic structure (specifically institutional influence) affect the impact of transnational actors and their efforts towards attaining harmonisation. In essence institutional influence predicts why some transnational actors (i.e., certain EU members) succeed while others fail in the similar context of EU financial accounting harmonisation.

There are several associated and usually unasked questions about the influential nature of EU member institutions. When will member institutions stimulate transnational activity in their principals’ interests and on what basis will such formulations be ascertained? For example, will national institutions reach a convergence in their influence for the collective good? The specification of the harmonisation process using the reformulated agent behaviour indicates that this is likely to happen when all institutions instigate similar levels of influence assisting, directing and supporting behaviour that fosters harmonisation but constraining those that deter harmonisation. With the ongoing widening of the EU this appears to be
Chapter 9: Conclusions

quite difficult. This is demonstrated by the respective positions of member states in the matrix of institutional dimensions in Figure 9.2 below. Additional members to the EU are likely to be positioned within the top half of the matrix. These newer members are less developed nations and/or ex-communist nations. The fall in communism within these newer members initiated a period of intense social, political and economic change (Newman, 2000: 602). Their positioning conveys a situation of instability and change in comparison to the stability of existing members who are familiar with the policies and procedures (as demonstrated by their positioning in the lower portion of the matrix). The initial placements indicate that divergence may well continue and that there will be no majority sentiment given the widening of the EU. Convergence, however, could occur when EU member states provide models for transnational activity isomorphic with their own way of conceiving the world. Since such projection appears to be far removed from their actual behaviour, disharmony can be expected. It is the durable national differences in EU member states that are causes of the contrasting outcomes present in EU harmonisation.

Figure 9.2 – Matrix of Institutional Dimensions Examining EU Member State Positions

![Matrix Diagram]

314
Implications 2c: of Simulation

The last of the implications to be examined pertains to the results obtained from the simulation of a SERC (‘implications 2c’ in Table 9.1). In the second simulation it was seen that each agent within the multi-agent community can exhibit divergent behaviour, which may or may not be in accordance with the interests of the principal. This is due to the institutional dimension within which they operate, each conditioning the agent to act either positively or negatively towards the commitment to harmonise. Such results are important as they indicate serious implications for the future of EU harmonisation.

Following the recognition of problematic harmonisation the European Commission welcomed the European Parliament's vote to approve the proposal for a Directive amending the EU's Accounting Directives. The amendments will bring existing EU rules into line with current best practice and complement the International Accounting Standards (IAS) Regulation, adopted in June 2002. The amendments require all EU companies listed on a regulated market to use IAS from 2005 onwards with the authority to extend this requirement to all companies left to member states (Gulin et al, 2002). Where endorsed IAS are not applied (i.e., for companies not listed on the regulated market), the detailed provisions of the 4th and 7th Accounting Directives, which this proposal would amend, will continue to act as the basis of EU accounting requirements (ibid). These earlier Directives may therefore continue to be applicable to up to 5 million companies in Europe in comparison to the 5000 or so companies listed on the European stock exchanges to which the amendments apply (ibid: 3). The proposed amendments bring EU accounting requirements into line with modern accounting theory and practice, and perhaps enhance the comparability of corporate financial statements for the benefit of companies and investors. However, a two-tier accounting system has now been established. The impacts and implications of this remain unclear.
Chapter 9: Conclusions

The EU Parliament’s support for this proposal gives a strong political signal not only that the EU is serious about achieving an integrated capital market by 2005, but also that it is committed to improvements in financial reporting and auditing for all affected EU companies. There are, however, currently many different financial reporting rules and differing interpretations based on distinct traditions within the EU (Temel 2000). These traditions and their differences are delivered and initiated through institutional settings and their influences. With the added amendments the inconsistencies and difficulties have only increased and may well continue to do so. European financial reporting will remain fragmented, thereby hampering the development of a deep liquid single EU capital market. With the accelerating pace of business, the need for a more dynamic and responsive legislative framework for financial reporting is ever increasing.

The EU’s lengthy legislative processes needs close examination to ensure it meets the varied environments of the EU, which can not be attained through amending the Directives to standards that are even more removed from their existing environment. As the simulation has demonstrated application of uniform standards within a multi-agent community can produce varied results. Ways to move from the rigid, and sometimes overly-prescriptive nature of EU directives to a more efficient and responsive system for financial reporting best suited to the needs of securities markets deserve consideration.

It is important, particularly for reasons of ongoing performance and cohesion, that each Member State move towards harmonisation at a pace appropriate to that individual country. Change through the implication of uniform standards can not be enforced but rather facilitated through understanding the influential factors responsible for instigating and responding to change. This will allow gradual alignment of each member nations’ approach as has been shown in the multi-agent simulation by the difference in commitment levels pre and first post expansion in EU membership (refer to Chapter 8 section 8.2 and 8.3 for the simulation results). An agent within a multi-agent community is also deeply influenced by their institutional associations and these vary across the group. An approach to attaining a goal that considers the differences and allows for experimentation could be an effective means through which a joint goal can be ascertained in a varying environment.
9.2.3 Implications, for the Wider Business Community and Society

The extended conceptualisation and reformulation of agent behaviour presented challenges existing agency research and the wider implications drawn from it. Existing agency theory through its homogenous conceptualisation has facilitated its diverse application, but it is this generality that has limited its success in reinforcing the predictions established. In fact its broad applicability (i.e., the ease with which agents are assumed to be self-interested rationalists (SIRs)) has left it open to application without appropriate examination and analysis. What does the extended conceptualisation and reformulation entail for the wider business community and society in general?

Implications 3, for the Business Community

From a theoretical perspective the research findings have interesting implications for the theories examining the firm, in particular Transaction Costs Theory (TCT). The shift in focus away from utilising contractual incentives and engaging in monitoring and bonding costs and towards institutional analysis in the extended conceptualisation and reformulation of agent behaviour implies a reduction in agency costs. This effectively also reduces the transaction costs in establishing a firm. The formulations of SERA can be considered in its effects upon transaction costs. For example, through incorporating institutional analysis in TCT can there be effects upon transaction costs. Will transaction costs in establishing a firm vary in different societal dimensions (e.g. those in a controlled society versus those in a reforming society)? Thus, in considering the costs of establishing a firm the costs of inputs, outputs and negotiating need not be the only costs to consider. It may be useful to also consider the type of institutional environment within which the firm may operate. For example, it may be appropriate to leave production to firms or the market depending on whether the institutional environment creates impediments to firm establishment that increase costs or is conducive to firm establishment that decrease costs. The SERA formulation thus can be complementary to TCT in determining the suitability of establishing a firm as opposed availing one’s self to the workings of the market. SIR has limited application to TCT, being solely represented as an addition to the transacting costs of establishing a firm.
Excessive focus on the simplistic notions of self-interested rationalism need no longer be the sole descriptive focus of conceptualisation. Research efforts within the wider business community will need to shift efforts from focusing on contractual incentives and constraints to the institutional environment within which business operates. For example, an investigation of CEO behaviour could properly consider the influence that the labour market, legislative standards, religious institutions, financial markets, and educational institutions play. Each is related to the development of the corporate form. The CEO within the firm is subjected to their influence and hence, their behaviour may vary accordingly. Understanding the shape and the manner of their influence and their manifestation anticipates the agent’s potential behaviour to which appropriate procedures can be enacted to pre-empt behaviour that may not be in the interests of the principal(s). This is unlike the existing theory of agency which repeatedly applies contractual incentives and constraints in anticipation of any (expected) negative behaviour regardless of its appropriateness to the situation. The extended conceptualisation and reformulation of agent behaviour, on the other hand, applies to all contexts of business and other fields of investigation. Its heterogenous conceptualisation allows wide application without compromising on depth and detail of the investigation. The diversity enabled with its application also produces variable results expanding the potential for research within agency even further.

A unique contribution of this institutional influence upon agency theory and in particular agent behaviour is the emphasis on how institutions shape the ways individuals and organisational agent(s) act and evolve in varied contexts. People find, ally with, invest in, and oppose organisational activities based largely on their beliefs about what is possible and appropriate, including as affected by their institutional affiliations and interactions. This is irrespective of the contractual incentives and constraints that are provided and imposed upon them. Through institutional affiliation and interaction much behaviour is influenced, accepted and legitimised without conscious awareness. The extended conceptualisation and reformulation of agent behaviour can thus be used to understand behaviour through which appropriate action can be undertaken to resolve any conflict or to further promote favourable behaviour. Attempts made to predict agent behaviour or even to second guess possible agent behaviour taken based upon simplistic assumptions will on the whole result in limited success, and this is the case in the existing theory of
agency. The behaviour of an agent will vary from situation to situation depending on the societal institutions to which an agent affiliates and interacts with and their extent or level of affiliation and interaction. What this implies for the study of agency overall is that various applications can be made to diverse cases generating an understanding of behaviour through which practical resolve can be established.

A case example relates to the settings facing a subsidiary of a Multi National Corporation (MNC). The matrix of institutional dimensions can be applied to the settings of a MNC to assess the behaviour of subsidiaries towards establishing and attaining parent company goals. A representation is presented in Figure 9.3. Subsidiaries can be placed within each of the quadrants of the matrix with a view to determining possible behaviour given their institutional settings. For example, a MNC may seek to implement changes to the working conditions of its employees’ enterprise wide with a view to reforming its image as an employer which may or may not be contrary to those within the host countries. What does this imply for its subsidiaries presented in Figure 9.3?

Figure 9.3 - Matrix of Institutional Dimensions for Subsidiaries Operating in Diverse Environments
A subsidiary operating within a:

1. Atomistic society may respond favourably to the new employment conventions, given there are no or little institutional influences to the contrary and the introduction of change can proceed with little discomfort. An example is a subsidiary in Vietnam where regulation regarding employment is not heavily enforced.

2. Controlled society may respond unfavourably to the changes given the tight controls exiting within the host country. The inability to implement the new employment conventions detracts from the company’s image. Alternative methods such as, negotiating with government officials, may need to be arranged to attain the corporate goal. An example is a subsidiary in North Korea where the government heavily controls the employment practices and legislation of corporations.

3. Society of upheaval may respond with great inconsistency. The lack of stability and institutional support therein may require that efforts are undertaken at the subsidiary level to ensure that the conventions are implemented. For example, penalties may be enforced if the conventions are not adhered to. An example would be a subsidiary in post-war Iraq where great uncertainty persists with stated institutions possessing little power.

4. Lastly, reforming society may also respond favourably to the changes but with delays in implementing the practices. This is to ensure that the changes are in accordance with those that are being reformed or to adapt existing legislation to reinforce the changes. An example is a subsidiary in Post-Communist Russia where the free market principles are being instilled.

The considerations in choosing the multinational entry mode constitutes one of the most important strategic decisions in the internationalisation process of the firm (Palenzuela and Bobillo (1999)). Through the application of the SERA principle of institutional influence to the context of MNC and subsidiary operation a more informed understanding of CEO subsidiary management (agent) behaviour can be obtained. Also management (by the agent) that is contrary to the principles of the corporation can be circumvented and alleviated in advance of their occurrence. The
flexibility and adaptations this constitutes is an important factor in the evolution of foreign based operations.

**Implication 3, for Society**

Another case to which the extended conceptualisation and reformulation of agent behaviour in agency can be applied is the United Nations (UN). The UN has been intended at its inception to be the instrument of the permanent members of the Security Council for maintaining the status quo that was established at the end of World War II (Jacobson, 2000: 150). Member states also used the UN sometimes for cooperative purposes and sometimes for contestation. The individual states represent each of the individual agents within the multi-agent community who collectively aim to maintain peace for the benefit of their citizens, the principals of the association. This is achieved through the adoption of numerous treaties and international agreements.

While each agent aims to adopt all treaties and international agreements this does not necessarily always occur. National preferences still play a role, which are conveyed via their institutional influences. State identity fundamentally shapes state preferences and their actions. Knowing about a state's perception of its identity (both type and role) could facilitate the understanding of state behaviour and responses. Such a process may be used to determine the ultimate reasons for the varied responses of states, for example towards the contribution of resources for the 1990-2003 Iraqi wars. Few theories exist which successfully identify this link of domestic actors to transnational actors and to states and international institutions (Tarrow, 2001: 2). The extended conceptualisation and reformulation of agent behaviour provides a method through which this might be attained.

An individual in the true sense can not embody the preferences of another. In the collective sense systems cannot simply be imported or imposed on other agents. Corporations, associations and international organisations can, however, "teach" agents and/or states new norms of behaviour (Finnemore and Sikkink, 2001: 401), but resolution may well involve state institutions. The strength and continuity of new ideas often depends on the degree to which they become embodied in institutions.
The ideas that are successfully implemented and consolidated are those that have been instilled within an institutional stance, where a team of like-minded people transform their like individual ideas into an institutional purpose. Differences in how new ideas fit existing institutions can even help explain divergent policy responses. Finally, in order to be internalised, new ideas need not only to be institutionalised, but also to fit or be congruent with historically formed ideologies. In an increasingly globalised world this demonstrates the importance of relativity and individuality through institutional association and interaction.

9.2.4 Summary

An agent within the existing agency theory is little more than a calculating machine attempting to maximise its utility through SIR behaviour. The practical and conceptual implications of this were to determine appropriate methods to alleviate such SIR agent behaviour. The extended conceptualisation and reformulation of agency theory removes the constraints imposed by such reasoning. The heterogenic conceptualisation widens both the scope of examination and the potential implications resulting from such a conceptualisation. The results and implications are varied and dependent upon the influence received from institutional affiliations and interactions.

9.3 Areas of Advancement and Research Questions

From a comprehensive examination of agency theory and a number of associated areas undertaken in the Dissertation five key sets of conclusions are reached. These advance understanding of agent behaviour both theoretically and practically at a fundamental and conceptual level. Each of the six research questions presented is addressed in terms of the five areas of advancement (research questions (RQ) 2 and 3 being addressed as a single area).
9.3.1 Agency Theory, its Limitations and Research Question 1

Agency problems are taken to exist in all organisations and in all cooperative efforts such as management in firms, in universities, in mutual companies, financial markets etc. Consequently, substantial attention has been devoted to developing the theory of agency. The existing theory of agency with its focus on the problems of divergence between ownership and control within an organisation has drawn significant attention to the importance of aligning the assumed self-interested nature of the agent with the interests’ of the principal. In doing so a substantial portion of the research has been devoted to examining the methods through which this will be achieved, which largely are concentrated around contractual incentives.

So concentrated is the examination of contractual incentives with respect to this alignment issue that examination of the principal and agent relationship is confined to solely this and to the exclusion of all other factors. This includes those factors influencing the creation, distortion or management of the conflict of interest between the parties. This preoccupation with compensation and incentive schemes may have thus obscured the need to examine other important aspects and hence, fostered the limited application of the agency model. This is irrespective of the area of research. Having examined the theory of agency (a requirement of research question one\(^1\)) aspects of the existing theory that require reassessment need to be determined.

Agents do not operate within a vacuum and contracts are not prepared in such a vacuum to necessitate the lack of interest in the context of agency. This continuing ignorance in examining the context of agency has substantially limited growth within the theory of agency. This is to the point that extensions or even applications of the agency model are based upon the assumptions and framework of the original model, a model that is rarely ever questioned or criticised, and focuses almost exclusively upon compensation packages and incentives within the contract. Although other studies have examined additional issues the context within which the contract is established is not examined or even contemplated to be of importance.

\(^1\) Research Question One: What aspects of the existing theory of Agency require a reassessment?
The hypothesis of SIR behaviour while extremely useful in some contexts is misleading in the theory of agency. The need to satisfy one’s own self-interest is just one aspect of human behaviour not its entirety. SIR behaviour represents an unnecessary oversimplification of economic man, and is not descriptive of human behaviour. Thus, this narrow definition of SIR behaviour assumes both too much and too little about human nature. Conclusions reached in agency research are therefore biased towards the negative or alternatively do not even reinforce its initial predictions. The existing research on the theory of Agency is thus based on an oversimplified model of human behaviour. It is this oversimplified model that requires reassessment.

9.3.2 Agent Behaviour, its Context and Research Questions 2 and 3

The limited success of the reinforcement of the theory’s initial predictions (i.e., their assumed SIR behaviour) rests with the over simplification of human behaviour and over emphasis on incentive schemes. Simply because the agent is unable to embody the preferences of the principal does not necessarily mean that they will act with self-interested rationalism, and require the imposition of rewards and constraints to align interests or preferences. Behaviour is influenced by more than self-interest. This is not to say that there is no place for economic incentives but that they are less likely to be paramount in influencing behaviour. The behaviour of individuals is ultimately shaped by their upbringing, that is, the institutions to which they affiliate and interact with. This initially identified the model concepts to be redeveloped (a requirement of research question two). The context of agent behaviour deemed to be the prime importance in conceptualisation.

Institutions are formed within society to ensure that certain norms and values are supported and adhered to. An affiliation and interaction with such institutions aligns an individual’s beliefs in accordance with such values and norms, and consequently constrains their behaviour within these ideals. Each individual is, thus, shaped and

---

2 Research Question Two: How can Agency be conceived and modelled more adequately, particularly after examination of SIR behaviour?
moulded differentially in accordance with their socio-environment. This extent or level of influence can be assessed on the basis of the power the institutions possess and the variability in their influence. Individuals may then use rational calculations in selecting what aspect will influence their identities. Rationality can, thus, also be informed by the socio-environment and not just by self-interest. An individual can be rational and yet justify and/or undertake actions with other motivations, impulses, interests or needs in mind, which is denoted the BDI (beliefs-desires-intentions) theory of human rational action. This thus discussed the influential factors of the redeveloped model of agent behaviour (a requirement of research question three).  

Through incorporating the contextual nature of agent behaviour, e.g., societal affiliations and interactions the agent is no longer a homogenous actor but a heterogeneous one. Whose behaviour depends on their beliefs, desires and intentions (BDI) generated and fostered through their dynamic societal institutional affiliations and interactions. Consideration of the environment within which the contractual relationship is incepted, and the associated behavioural influence upon agent behaviour, presents an extended conceptualisation of the traditional agent behaviour (i.e., a SIR) in existing agency literature. This extended conceptualisation is termed the SERA, and in accordance with this conceptualisation a general reformulation of the agent’s transacting/reasoning process is also necessary. The agency relationship is no longer a formulation of asymmetric mutual dependence informed by self-interested rationalism, but one of instrumental mutual dependence informed by institutional affiliations and interactions that assist, direct, support and constrains agent behaviour.

### 9.3.3 Agency Theory, its Application and Research Question 4

The harmonisation of financial accounting in the European Union (EU) represented one context for agency theory application. The simplicity of the existing conceptualisation and the applicability of the extended conceptualisation were demonstrated through examining the financial accounting harmonisation process in

---

3 *Research Question Three:* What factors play a role in affecting the behaviour of individuals in agency?
the European Union (EU) (a requirement of research question four\(^4\)). The EU case is a case of multiple agents and dual parties. Through the application of the existing predictions of agency theory member states (agents) were expected to adopt and adhere to the financial accounting policies within the Directives that maximise their own utility and to reject those that do not. This, however, was not the case. The EU case framed in the context of socio-environmental rationalism demonstrates that the behaviour of respective member nations (the agents) reflect their institutional settings.

An analysis of the attributes of the institutional arrangements within each member nation and their consequent effects on the selection of accounting policies demonstrated that societal institutions can influence the style of financial accounting adopted. Hence, this demonstrated that self-interested rationalism does not necessarily inform member nation behaviour in policy selection but rather their institutional settings. Institutions are thus the instruments through which member nations’ (agent) behaviour are driven. Affiliations and interactions with institutions can be instrumental in supporting, assisting, directing and constraining member nations’ (agent) behaviour towards the EU citizens’ goal of harmonisation. The notions of socio-environmental rationalism can provide a more informed understanding of agent behaviour in the EU context, the effectiveness of which is replicable in other contexts involving a principal-agent relationship (addresses research question four).

### 9.3.4 Alternative Methods of Agency Research and Research Question 5

The principal agent problem has been extensively developed in a particular paradigm, one influenced by positivism. The positive-agency literature has generally been empirically orientated, focusing essentially on predictability. This approach has dominated research in the theory of Agency. This research adopted an Object Orientated (OO) methodology, which focuses on examining the object and its context (i.e., the agent and its environment), and not just on the defined predictive capability

\(^4\) Research Question Four: How effective and influential is the extended conceptualisation and reformulation of agent behaviour in various contexts?
of the object’s (agent’s) behaviour. The use of this method demonstrated that through seeking some more adequate framing and a deeper understanding of the agent behaviour (the foundations of the theory), a broader and deeper explanation of the agency relationship can be attained, providing greater insights and practical implications.

While there are various methods that utilise the OO methodology, simulation via the use of artificial intelligence (i.e., computer software) was the chosen method through which the extended conceptualisation and reformulation of agent behaviour is modelled. This addressed the requirement of research question five.

Simulation via the use of artificial intelligence demonstrates an innovative approach in the analysis of agent behaviour. It allows experimentation with models of agent behaviour in a rapid and flexible way which would be difficult to perform in a real world situation or in a laboratory. This is particularly the case with attempting to experiment with institutional affiliation and interaction and the associated agent behaviour. The sheer difficulty in performing this task is heightened once applied to the EU case. This case is simply too complex and large to be realistically examined and modelled with experimentation. This simulation procedure provided the ideal environment in examining and testing the behaviour of the individual SERA and the SERC.

**9.3.5 Implications of Applying the Socio-Environmental Rationalist Agent (SERA) and Research Question 6**

Analyses of the results obtained from the simulations exhibited that the agent behaviour is relative to the condition of occurrence, i.e., the institutional settings. The results demonstrated the diversity in the reaction of the SERA to changes in the institutional settings. Different levels of variability in institutional influence and influential power have varied effects on the commitment levels of the SERA, which are positive and negative nature. Their level of commitment towards attaining the

---

5 *Research Question Five*: How can an extended conceptualisation of agent behaviour be modelled using object-oriented methods so as to provide more informative understanding of the notion of agency?
principal’s goal is determined by the signals received from their environment. These results were demonstrated to be entirely different to that of the SIR agent whose own utility maximisation is the driving force of their behaviour. Such was the unwavering approach of the SIR agent that was highlighted by its stativity in comparison with the variability presented by the SERA.

In assessing the practical applicability (a requirement of research question six) the results demonstrated that a homogenous description can not be assigned to agents. With a homogenous description only a limited view of agent behaviour is ever exhibited and nothing more. Consequently, this does not accommodate for agent individuality and varied instances that naturally deliver varied behaviour. This was emulated with the conceptualisation and formulation of the SERA. By considering the full spectrum of agent behaviour (i.e., both positive and negative) and the extent of analysis (i.e., inclusive of institutional influence) a more informed understanding of agent behaviour towards attaining the principal’s goal can be attained.

This extended conceptualisation and reformulation of agent behaviour also assisted the understanding of agent behaviour in a multi-agent community. In the context of the EU this implied the reasoning of their reactions to harmonisation. The varied responses of member nations (agents) are a result of their varied institutional settings. These varied institutional settings are positioned in the matrix of institutional dimensions, and the relative importance that institutional influence plays within the environment. With each agent group positioned in dissimilar dimensions assigned with distinct levels of influential institutional importance, disharmony in EU financial accounting eventuated and is synonymous with the condition of harmonisation to date.

What is interesting though is changes to this disharmony are possible if change occurs within the group. This simulation demonstrated that even in multi-agent communities the level of commitment exhibited by agent groups is not guaranteed. These are conditional and open to influence. This may be or may not be to the betterment of the principal’s interests. This is contrary to the predictions of the existing research which

---

6 Research Question Six: How applicable are the concepts, developments and modelling to various situations?
assigns agent behaviour as being solely detrimental to the principal’s interests. This variability in multi-agent community behaviour is portrayed adequately by the contextual nature of the extended conceptualisation and reformulation (a requirement of research question six). The extended conceptualisation and reformulation is significantly applicable. It accommodates for agent individuality and differences in behaviour. Even in the multi-agent community it is demonstrated to be representative and the results synonymous with the EU harmonisation effort, which is a practical example of multi-agent community behaviour.

9.4 Limitations

This Dissertation has presented a comprehensive investigation of the theory of Agency, and from this five sets of conclusions have been drawn each addressing the research questions established. However, like most research into a new area, the work remains somewhat exploratory. While an extended conceptualisation and reformulation of agent behaviour has been developed with statistical and visual significance a number of limitations are present within the research.

A limitation of this study rests with the particular methodology adopted and the method of analysis used. The study is an exploratory one, a new problem is being ‘tackled’ about which little is known. Consequently, it can not be all encompassing and empirical at the same time. The use of an OO methodology has meant that no empirical data will be collected and hence, no empirical data will be analysed. Instead the data to be analysed will be based on a simulation, modelled and conceptualised by the researcher, which may introduce bias. The simulation undertaken will be based on the researcher’s understanding of the theory, their process of conceptualisation, and their choice of objects for analysis. In other words, the data to be simulated will be compiled by the researcher and not from some external source. This may affect the validity and reliability of the study and any results obtained. Undertaking a comprehensive literature review where all resources are exhausted in their entirety and the advice of other researchers and experts were sought to ensure that these affects are kept to a bare minimum.
Criticism may also arise as to the use of non-empirical data, the principal-agent problem is being reconceptualised and modelled without the use of externally sourced data. How well will this reflect reality? The simulation of a real case scenario (the EU) to which the extended conceptualisation and reformulation will be applied provides some grounding for the research and incorporates some form of external data.

Lastly, while computer models provide many advantages over traditional experimental methods, they also have several problems. In particular, the actual process of writing software is a complicated technical task with much room for error. This is even the case for artificial intelligence software. Ultimately, the use of artificial intelligence requires the researcher to have some understanding of computer programming. Even if this is achieved, custom-built computer models tend to be very specific, a dense tangle of code that is understandable only to those who wrote it (Minar et al, 1996: 2). Simulation software contains a large number of implicit assumptions, accidents in the way a particular code is written (researcher error) which has nothing to do with the actual model could substantially affect the results of the study (ibid: 3). The use of a standardised technique, description of the process in detail, and the repeat of all simulations performed will ensure that researcher error is kept to a minimum.

Having examined the limitations of the research it is now necessary to discuss the contributions of the research to theory and to practice.

9.5 Contributions of the Research

This exploratory study has made a substantial contribution to both theory and to practice. Unlike the existing research in Agency theory, this study has progressed beyond the traditional approach to agency research, which solely describes the agent as being a SIR and applies the theory to every instance as such. This study extends the conceptualisation of the existing agent behaviour and reformulates this traditional agent behaviour to examine the context within which the principal-agent relationship occurs. This has sought to explore the influence of institutional affiliation and
interaction upon agent behaviour through their belief structure and is labelled as a SERA. The extension in conceptualisation is demonstrated in Figure 9.4 which presents the positioning of the SIR agent in terms of the SERA institutional dimensions. The simple assumptions and stativity of the SIR conceptualisation is best demonstrated by the circular arc in the far left of the quadrant ‘atomistic society’ where institutional influence is minimal. Any movement to the right of the circular arc (beyond the shaded arc) represents the conceptualisation of the SERA a far expansive approach with significant institutional influence.

Figure 9.4 - Matrix of Institutional Dimensions Demonstrating the significance of SIR Agent Conceptualisations to the SERA Conceptualisation

The extended conceptualisation and reformulation of agent behaviour is differentiated from the existing research which assumes agent behaviour to be contrary to the principal’s interests. Existing research has thus attempted to discover methods that would motivate the agent to act within the principal’s interests. Such existing research, however, has proven to be limited in reinforcing its predictions. This research has illustrated that agents are not necessarily self-interested in their performance. Agents can also act either positively or negatively towards fulfilling the principal’s interests depending upon the assistance, support, direction and constraint they receive from their institutional affiliation and interaction.
Chapter 9: Conclusions

Through the use of the OO approach a simulation applying SERA and SIR to individual agent and multi-agent behaviour was performed. The results obtained were statistically and visually significant in supporting the need for contextual analysis in examining agent behaviour. This particular aspect of the study differentiates it from the existing research, which traditionally focuses on reinforcing the predictability of the research. Examples of such research include examining the increases and decreases in CEO income with that of the variability in corporate earnings, and examining the assignment of capital investments to agents and their corresponding performance etc.

The significance of this study, however, is not confined to the traditional formulations within agency theory (i.e., CEO and Shareholder association) or to the EU case an example of a multi-agent community. The EU harmonisation program represents a comprehensive example of one case of SERC behaviour. This method can be used in any individual and multi-agent circumstance where there is the alienability of decision rights and the need for delegated activities.

Research on how to improve business outcomes is extensive. Studies by Sebenius (2002) and Goold and Campbell (2002) in the *Harvard Business Review* are two relevant examples. Both articles provide substantial detail, describing the common mistakes in business and the tools that should be adopted to achieve success in business, which is much like the existing research within agency. Their focus is on the outcomes of the interaction and how to better these outcomes, but not on the foundational perspectives, as is the case with the theory of agency.

If research involves examination of the foundational perspective and examines the situational reasoning underlying the behaviour of actors, greater insights and sounder practical implications can be expected. This may, in fact, provide a better explanation of behaviour and outcomes that would contribute to the limited theoretical insight in agency theory and to the knowledge in attaining business success and avoiding failure. It is through understanding the reasoning of actors that outcomes can be determined. In the case of EU financial accounting harmonisation through an improved understanding and consideration of institutional differences within member nations, a substantial contribution towards the redevelopment and reimplementation
of accounting system could be made. Application may be feasible to alternative fields of harmonisation within the EU or internationally.

9.6 Future Research Possibilities

Areas for future research which arise from this study rest primarily upon providing further supporting evidence of the extended conceptualisation and reformulation of agent behaviour. Alternative avenues of research will therefore be explored as a part of future research, such as subjecting the extended conceptualisation and reformulation of agent behaviour to empirical investigation.

9.6.1 Research in Relation to the Theory of Agency

Research re-examining the theory of Agency is still in an early stage of development. Thus numerous opportunities exist for future research. The research undertaken in this exploratory study presented just one method of re-examination, extending the conceptualisation of agent behaviour with an appropriate reformulation. The examination provided some tentative answers to the research questions posed.

There is evidence to suggest that the behaviour of an agent is not solely based upon self-interested rationalism and can result in positive efforts towards the relationship with the principal. The research has identified that the extended conceptualisation and reformulation of agent behaviour (SERA) provides a more informed and detailed understanding of an agent’s reasoning and response in a principal-agent relationship. This is with regards to the direction of their commitment, which may be positive or negative given the influence from their institutional environment. The quantitative (e.g., reported profits) or qualitative effects (e.g., customer satisfaction) the influence may have on the goal set by the principal is yet to be investigated and proves to be an interesting area for future examination. For example, empirical data documenting the quality of a firm’s products could be collected over a period of institutional change to measure the extent of institutional influence upon the established goal of improving product quality. This may find that in times where liability for faulty products is
lenient, the CEO may be less interested in improving product quality and hence, product quality may decline or even be substandard.

In the context of EU financial accounting, the change in investor attitudes towards a member nation’s investment potential given the changes in accounting imposed by institutional influence may also prove to be useful and interesting. It may also prove useful to re-examine the state of EU financial accounting harmonisation with the now 25\(^7\) EU member nations in the context of a SERC. Practices of companies from recent entrants into the EU in 2004, such as Poland, Hungry, Czech-Republic, Slovenia, Estonia, Romania and so on, could be examined and compared to the practices of companies in long-standing EU member states. This would be highly relevant as these countries are former centrally planned economies (CPEs) and hence do not have a comprehensive accounting system nor well established institutional settings. Will these nations adopt those practices in accordance with their institutional setting or those stipulated by the Directives? Or will there be an incidence of institutional convergence and hence behaviour associated with the establishment of closer associations with EU members?

These questions remain to be addressed and answered and prove to be of interesting significance for future research.

**9.6.2 Research in Relation to the Implications of the Extended Conceptualisation and Reformulation of Agent Behaviour**

This study has introduced and discussed the context of the principal-agent relationship and the influences this context permeates through to agent behaviour. Many questions remain with respect to the implications this extended conceptualisation and reformulation present for the principal-agent relationship. For example, having determined that institutional affiliations and interactions influence agent behaviour can institutions be designed to develop the perfect agent? What is the perfect agent? Is it one that embodies the preferences of the principal while staying true to its

\(^7\) The recent entrants into the EU in addition to the long-standing 15 member nations are: Cyprus, Czech-Republic, Estonia, Hungry, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia.
institutional associations? After careful description of what in fact a ‘perfect agent’ is, future research may also be able to simulate this exact question and generate answers to attain the desirable principal-agent relationship.

Unanswered questions also relate to the impact of the extended conceptualisation and reformulation of agent behaviour upon existing research within agency, which has been unable to reinforce the predictions of the traditional approach to agency. Could these studies be re-examined with contextual analysis of agent behaviour? A comparative analysis of the results may determine whether in fact a more reflective and informed outcome and understanding of agent behaviour has been obtained, further supporting the results and conclusions attained in this dissertation.

This study chose to apply the extended conceptualised and reformulation of agent behaviour to one case example, and this was to the financial accounting harmonisation process in the EU. This was just one example of a multi-agent community seeking to obtain a common goal. With respect to the EU, there is an extensive area for application. For example, the development of the single monetary union (SMU) represents an interesting case, or even the implementation of food standards across the EU, and allocation of community aid both represent troubling areas across the EU that could benefit from the application of the extended conceptualisation and reformulation of agent behaviour.

Multi-agent communities outside the EU, e.g., the implementation of UN conventions, represent great potential for future research. Understanding the influential importance that the context of an individual’s or groups’ environment plays with regards to their behaviour offers the potential to better understand the agency relationship. This may assist in obtaining the intended or desired outcome/s. A board range of empirical studies applying the extended conceptualisation and reformulation of agent behaviour will help achieve this.
9.7 Conclusion

Through a review of the literature, institutional analysis, simulation, and the use of statistical and visual analyses five sets of conclusions were drawn and six research questions were addressed. The main conclusions were that agents can be socio-environmental rationalist actors behaving according to the influences received from their institutional affiliations and interactions. This is an extended form of constructivism, the extension being that of an institutional analysis. Through the use of an institutional framework (an instrument of agency) contextual analysis is incorporated into the theory of agency. The contextual analysis in agency is an analysis of the internal and external environment of agency. This extended conceptualisation and reformulation of agent behaviour (SERA) differs greatly from the conceptualised agent behaviour (SIR) in the existing research. As the existing research is divorced of context and agents are assumed to be self-interested rationalists (SIRs). This study has provided a fundamental understanding and an important insight into the limited understanding of the principal-agent relationship within the existing research.

This study utilises the OO research methodology to simulate the extended conceptualisation and reformulation of agent behaviour (SERA). The results obtained from the simulations are statistically and visually significant. They thus support the need to incorporate the contextual analysis of agent behaviour into agency theory. Important implications have been drawn for agency theory, EU harmonisation, and business and society in general. The analysis and framework developed in this dissertation also presents further opportunities for future research.
APPENDIX 1
A1. Appendix 1: Agency Theory

Appendix 1 contains additional information pertaining to the characteristics of the agency specification: the reward structure, information transmission and agency costs incurred in the agency relationship.

A1.1 Reward Structure

The agent’s reward is determined by the sharing rule in the distribution of the outcome of the process, typically a share of the profit earned. The agent’s reward must be attractive enough to offer the agent an ‘acceptable’ level of expected utility (e.g. expected utility of the agent in his/her next best employment opportunity) in order to sustain an ongoing exchange between the parties. The application of the sharing rule in the determination of the agent’s reward is based upon the principal’s perception of the agent’s success. This perception depends on the information received by the principal about the agent’s efforts and actions. The reward structure must therefore have two components:

1. *Rational preference alignment*, which, like the traditional economic theory of agency, is concerned with the assignment of payoffs across observable states to make the agent's long-term, reflective choices consistent with the principal's goals.
2. *Impulse control*, which requires positioning the payments in time and context to maximize their behaviour modifying effects (Bernnan, 1994: 33).

Constructing a reward structure using these basic components ensures an attractive reward is provided.
A1.2 Information Transmission

Researchers have assumed that the agent is the party who obtains private information and controls its transmittal to the principal. For example, according to Lambert (2001) agents acquire information in two instances:

1. Prior to entering the agency relationship, for example, information about his/her skill, expertise, degree of risk aversion, or minimal acceptable level of utility, and
2. Once the agent begins work, that is, the agent would become better informed about the operational aspects of the firm.

It is therefore generally the case that the agent has superior information about the expected profitability or the timing of the payoffs than does the principal (Lambert, 2001: 69). Note that, as a strategy, a ‘solid’ agent not only intermediates but ‘blocks the view of the principal’. Any assumption of perfect information renders the agent transparent and begs the question of why the agent would be needed at all.

The principal suffers a welfare loss due to the information rent possessed by the agent, which cannot simply be eliminated by ‘selling the firm’ to the agent because the agent is assumed to have superior information about what the firm is ‘worth’. A second type of communication restriction is that the agent cannot fully communicate the full dimensionality of his/her information (Lambert, 2001: 109). Information possessed by the agent can be extremely rich and thus, difficult and costly to communicate. The principal may not have superior information to that of the agent nor the technical expertise to fully comprehend the agent’s information set.
A1.3 Agency Costs

There are several methods of control used to overcome the agency problem and the problems of information asymmetry and conflicting interests. These include: internal monitoring by management levels, external monitoring by the management employment market; threatened takeovers; ex-ante and ex-post settling up via the wage review process (Butterworth, 1987: 193, Barnea, Haugen and Senbet, 1981). These methods of control are deemed to represent costs of establishing and maintaining the agency relationship and hence, are termed collectively as agency costs (as depicted in Figure 2.7 above).

The principal’s problem, however, is to design a contract to make the agent’s overall performance measure as congruent as possible to the firm’s outcome (Deegan, 2000: 204). In other words, the principal resorts to contractual mechanisms that align the agents’ interests with his or her interest. The principal could establish appropriate incentives for the agent (e.g. a compensation scheme) and incur costs of monitoring to limit the aberrant activities of the agent (Jensen and Meckling, 1976: 308; Ekanayake, 2002: 87). In doing so, agency costs are incurred. Agency costs are the out-of-pocket costs of establishing, structuring, administering and enforcing contracts (both formal and informal) (Drew and Stanford, 2003: 2). These agency costs are depicted in Figure 2.7, and are defined by Jensen and Meckling (1976) as:

1. Monitoring expenditures by the principal to monitor agent behaviour,
2. Bonding expenditures by the agent to assure the principal that the agent will behave in the interests’ of the principal, and
3. Residual losses borne by the principal.
There are at least two agency relationships which cause principals to bear agency costs. The first is the relationship between shareholders (the principals) and the manager (the agent) and the second is the relationship between the bondholders (the principals) and the manager (the agent) (Watts and Zimmerman, 1979: 276). They arise because the manager’s interests do not necessarily coincide with the interests of shareholders or bondholders (ibid). For example, the manager (if he or she owns shares) has incentives to convert assets of the corporation into dividends, thus leaving the bondholders with the ‘shell’ of the corporation (ibid). Alternatively, the manager (if he or she does not own shares) has incentives to transfer wealth to himself at the expense of both shareholders and bondholders (e.g., via perquisites) (ibid). The principal therefore needs to undertake monitoring expenditure, and expend effort on ensuring that bonding expenditure is undertaken by the agent so as to minimise the non-compliance aforementioned. This will be profitable for the principal to the extent that the reduction in the loss from non-compliance is equal to the incremental costs of enforcement (Drew and Stanford, 2003: 3).

Incentives, therefore, exist to write contracts that provide monitoring and bonding activities and bonus provisions of compensation plans to reduce the associated agency problems and to align the interests of agents with those of the principal (Jensen and Meckling 1976; Drew and Stanford, 2003: 3). In most agency relationships, however, there will be costs that cannot be contracted away and these are termed as the residual losses of agency (Jensen and Meckling 1976). The residual loss is the value of losses incurred by the principal from decisions made by the agent which produce results which deviate from those resulting from a decision of the principal with the same information and talent as the agent (Drew and Stanford, 2003: 2). It is generally optimal to allow for some residual loss in agency, as it is too expensive and cumbersome to contract for every instance in which the interests of the agent are likely to diverge from those of the principal. Essentially, it is the opportunity cost of incompletely enforced contracts (Drew and Stanford, 2003: 3; Jensen and Meckling 1994: 13).
Appendix 1

The magnitude of the agency costs will vary from firm to firm (e.g., because of the physical size, dispersion, and complexity of the firm) and with the situation. Jensen and Meckling (1976: 34) state that this will depend on the:

- Preferences of the managers,
- Ease with which managers can exercise their own preferences as opposed to value maximisation in decision-making,
- Costs of monitoring and bonding activities,
- Costs of measuring and evaluating the manager’s (agent’s) performance,
- Costs of devising and applying index for compensation, and
- Cost of devising and enforcing specific behavioural rules or policies.

An equilibrium occurs when the net costs of an agency relationship, i.e., the monitoring and bonding expenditures and the reduced utility associated with the residual loss, are minimised (Watts and Zimmerman, 1979: 276). Agency costs are real factor costs that affect production decisions (Barnea, Haugen and Senbet, 1981: 19). Ultimately, a firm that minimises its agency costs (i.e. the cost of controlling its agency problems) effectively maximises its chances of survival, as it is able to organise and produce products and/or services at a lower cost (Jensen, 1983: 22, Deegan, 2000: 211).

Appendix 2 contains additional information pertaining to the research method used and this is object orientated (OO) approach. Specifically, further information pertaining to the development of the object model is discussed here (section A2.1). Additional information is also provided detailing the median for the analysis of simulation results, and this is visualisation (examined in section A2.2)

A2.1 Constructing an Object Model

Recall that models are abstract representations of reality usually designed for some practical purpose such as examining possible future states of the world, the all encompassing bigger picture (Bodily (1985), Neelamkavil (1987)). The object-model is also a means of expressing these models of reality but with a set of concepts about an object in the real world (Edwards, 1992: 42; Coad and Yourdon, 1991: 5). Alternatively put an object-model is a meta-model which has objects and classes as the central concepts (Edwards, 1992: 42; Coad and Yourdon, 1991: 1).

In the technical tradition an ‘object’ is a symbol which represents one or more occurrences of a real-world ‘entity’ (Coad and Yourdon, 1991: 27). In essence, it is then an abstraction of the real world, reflecting certain capabilities and attributes of that ‘world’. An object has state, behaviour, and identity, the structure and behaviour of similar objects as defined in their common class (Booch, 1991: 77). The concepts of a class and object are tightly interwoven, one can not be mentioned without brief mention of the other. There are differences between the two terms. An object is a concrete entity that exists in time and space, a class represents only an abstraction, the ‘essence’ of an object (Booch, 1991: 93). A class is, therefore, a collection of one or more objects with a uniform set of attributes and capabilities (Coad and Yourdon, 1991: 53). A class represent a collection of objects sharing the same template (Pastor et al, 1998: 185).

\[1\] A meta-model is an integrated collection of broad concepts from which models can be built (Kent, 1978: 93). For example, a meta-model of this research would consist of a collection of behavioural influences from which a model of agent behaviour can be built.
The initial step in creating an object model is to find objects in the real world, and describe them with attributes and to group them within classes (Coad and Yourdon, 1991: 27). In applied research the primary motivation for identifying classes-&-objects is to match the technical representation of a system more closely to the conceptual view of the real world (Coad and Yourdon, 1991: 53). For example, a person is an object and grouping them into an ethnic origin is one way to view society. Additionally, by emphasising a class and object a stable framework for analysis and specification is created in which the objects behaviour can be thoroughly examined (Coad and Yourdon, 1991: 53).

### A2.1.1 Selecting Class-&-Objects

The strategy of selecting an object consists of notation, followed by where to look, what to look for, and what to consider and challenge\(^2\) (Coad and Yourdon, 1991: 56).

Notation of an object in an OO method consists of constructing a ‘Class-&-Object’ symbol. A Class-&-Object symbol represents a Class and its Objects, as shown in Figure A2.1 below.

**Figure A2.1 – The Class-&-Object**

Source: Coad and Yourdon, 1991: 53

\(^2\) The ‘where to look, what to look for, and what to consider and challenge’ aspect of the strategy relates to the problem domain, which in this case was highlighted through a review of the literature.
Appendix 2

The symbol represents both a class (represented by the bold rectangle, divided into three horizontal sections) and its object(s) (represented by the light rectangle). The class surrounded by two light rectangles indicates that there are two objects within that class. The object therefore encapsulates an instance of class, which provides depth and insight into the objects. Alternatively, objects can be segmented instances of classes. The symbol is labelled with its Class name, Attribute(s) (applicable to each Object in the Class), and Service(s) (applicable to each Object in the Class) (Coad and Yourdon, 1991: 57).

In the light of this research the agent is an object, an abstraction from the real world of one of the actors (the other being the principal) in a relationship of mutual dependence. An agent being one such object has its own class and also its own set of attributes and capabilities. An agent in this research is classed by its rationalism. The existing research classes an agent as a self-interested rationalist (SIR) and this research classes an agent as a socio-environmental rationalist (SERA). There are therefore two agent objects within the class of rationalism. The notation of this in a Class-&-Object symbol is presented in Figure A2.2 below.

Figure A2.2 – The Class-&-Object as Defined in Agency Research
A2.1.2 Attributes of Objects

The Class-&-Object symbol reflects Objects which the system keeps information about, interacts with, or both (Coad and Yourdon, 1991: 62). The information kept within this template relates to the attributes of the object (Pastor et al, 1998: 186). Thus, once the candidate Class-&-Object is identified its attributes need to be considered.

In OO analysis, the term ‘Attribute’ is some data (state of information) for which each Object in a Class has its own value (Coad and Yourdon, 1991: 119). Attributes add detail to the Class-&-Object and structure abstractions (ibid). Attributes describe values (or a state) kept within an Object to be exclusively manipulated by the Services of that Object (ibid). That is, attributes are localised values within the objects but are a function of the class. Attributes are placed in the centre section of the Class-&-Object and Class symbols (Refer to Figure A2.3).

Figure A2.3 – The Class-&-Object and Attributes

This figure is not available online. Please consult the hardcopy thesis available from the QUT Library

Source: Coad and Yourdon, 1991: 121

Recall that the agency relationship is a contract in which one or more persons (the principal(s)) engage another person (the agent) to take actions on behalf of the principal(s) which involves the delegation of some decision-making authority to the agent (Jensen and Meckling (1976)). From the above description it is evident that the agent, the object, is capable of independent, autonomous action on behalf of the principal. The attributes of independence and autonomy are uniform attributes that all
rational agents will exhibit (Wooldridge (2000)), as demonstrated in Figure A2.4 below.

Figure A2.4 – The Class-&-Object and Attributes in Agency Research

A2.1.3 Generalised and Specialised Structure

A Class contains uniform attributes that are applicable to all objects within that class. There are instances, however, where the objects within the class have distinctive attributes. Should this be the case, it is necessary to identify a uniform set of attributes that apply to each object in that class and those that apply to each individual object. In doing so a Generalised-specialised Structure is constructed.

For classes within a Generalised-Specialised Structure, an Attribute that is uniform to all objects is placed at the uppermost point in the Structure (Coad and Yourdon, 1991: 125). This ensures that it remains applicable to each of the specialised objects. In other words, if an Attribute applies across an entire level of specialisations, then it is uniform and is moved up to the corresponding generalisation instead, that is the uppermost point in the structure (ibid).

The Generalised-Specialised Structure notion is shown with a Generalisation Class at the top and Specialisation Classes below, with lines drawn between them in Figure A2.5 below (Coad and Yourdon, 1991: 81). A semi-circle marking distinguishes Classes as forming a Generalised-Specialised Structure. Each specialisation is named in such a way that it can stand on its own.
Figure A2.5 – Generalised-Specialised Structure Notation

Each Generalised-Specialised Structure forms either a hierarchy or a lattice. In practice, the most common form of Generalised-Specialised Structure is a hierarchy which is depicted by Figure A2.5 above (ibid: 87). What this indicates is that an object can exist which inherits a combination of Attributes from its ancestors and also have its own Attributes (ibid, 1991: 87). This is known as inheritance.

The original formulation of an agent in the existing agency theory is one of asymmetric mutual dependence where the agent is conceptualised as a self-interested rational decision maker subsisting in a vacuum (Wooldridge (2000)). The actions of such self-interested rationalist (SIR) agents are informed by the need to maximise their utility. A review of the literature reveals that there is in fact an alternative course of conceptualisation and formulation (i.e., an extended conceptualisation and reformulation of agent behaviour). Agents are now assumed to act in accordance with their institutional affiliations and interactions and are denoted the socio-environmental rationalist agent (SERA). Socio-environmental rationalist agents (SERA) are able to perceive their environment and respond to it accordingly, and are capable of social interaction in order to satisfy their objectives. They are in essence intelligent, reactive and sociable beings.

Therefore, upon application to the research, there is in fact a generalised class (i.e., the generic agent) that specifies the common/uniform attributes of agent, and two specialised classes (i.e., the self-interested rationalist (SIR) agent and the socio-environmental rationalist agent (SERA)) that specifies the individual attributes of
each of the respective agents. That is, an agent in a principal-agent relationship will always exhibit the attributes of the generalised structure and at the same time either exhibits the attributes of the first specialisation structure (i.e., the self-interested rationalist (SIR) agent) or the second specialisation structure (i.e., the socio-environmental rationalist agent (SERA)). The attributes of both sub-classes are detailed in Figure A2.6 below. It is the second specialisation structure, the socio-environmental rationalist agent (SERA), which forms the focus of this research. As, it is the first specialisation, the self-interested rationalist (SIR) agent, that has been extensively applied in the existing research.

Figure A2.6 – Generalised-Specialised Structure Notation in the Existing and Reconceptualised Agency

A2.1.4 Whole-Part Structure

Once the Class-&-Object and its attributes have been defined it’s necessary to consider the existence of any further relationship. Objects grouped in some fashion form part of a whole. Recall an object is an abstraction from the world. Whole-part is one of the basic methods that pervade all human thinking (Coad and Yourdon, 1991: 87) and enabling such a visualisation of the objects facilitates a comprehensive examination of the object and its role.
Appendix 2

The notation for a whole-part structure is shown with a whole Object (of a Class-&-Object symbol) at the top, and then a part Object (of a Class-&-Object symbol) below (Figure A2.7), with a line drawn between them (Coad and Yourdon, 1991: 87). A triangle marking distinguishes Objects as forming a Whole-Part Structure. In Figure A2.7 below, a whole is an assembly of either one Part 1 or many Part 1s; and Part 1 is part of at most one whole.

Figure A2.7 – Whole-Part Structure Notation

This figure is not available online.
Please consult the hardcopy thesis available from the QUT Library

Source: Coad and Yourdon, 1991: 91

Existing research within the principal-agent problem has conceptualised the agent as though existing in a vacuum where he/she does not consider any external influences on behaviour besides those contracted for in the principal-agent relationship. The self-interested rationalist (SIR) agent is, thus, only existing within and a part of the principal-agent relationship. In Figure A2.8 below, the principal-agent relationship can be an assembly of either one self-interested rationalist (SIR) agent or many, and a self-interested rationalist (SIR) agent can be a part of one principal-agent relationship or many.

A socio-environmental rationalist agent (SERA), on the other hand, interacts and reacts with their environment, i.e., their behaviour is informed by their societal institutional affiliations and interactions. A socio-environmental rationalist agent (SERA) is a social being capable of interaction with their environment and also other agents in that environment (Wooldridge, 2002: 23). Socio-environmental rationalist
agents (SERAs) are, thus, a part of society in which their principal-agent relationship is transacted. The socio-environmental rationalist agent (SERA) is then part of a wider principal-agent relationship which is denoted here as being society. In Figure A2.8 below, society can be an assembly of either one socio-environmental rationalist agent (SERA) or many; and a socio-environmental rationalist agent (SERA) can be a part of one society or many.

### Figure A2.8 – Whole-Part Structure Notation in the existing and Reconceptualised Agency

![Diagram]

#### A2.1.5 Summary

The above sections have demonstrated how an object models is constructed and how the notations are used to describe them. This demonstrates the focus of the OO methodology, which is to develop and formulate an understanding of the objects of the study. Chapter 6 provides a more detailed and complex development of the object model of the socio-environmental rationalist agent (SERA) (i.e., the socio-environmental rationalist agent (SERA) framework), formulating its entire behavioural/transacting process in the principal-agent relationship. A basic example of this process (i.e., object model construction and notation development) was demonstrated in this appendix.
A2.2 Visualisation: Process, Benefits and Limitations

In general, visualisations are used for one or more of the following purposes:

1. To read one precise value (table look up),
2. To compare two or more values, and
3. To infer a more complex relationship (perceive patterns).

A visualisation of the long series of numbers generated by simulation one and two will thus facilitate the reading of data, and a comparison of the commitment values produced by the socio-environmental rationalist agent (SERA) with those of the self-interested rationalist (SIR) agent, with the intention of suggesting a relationship between institutional influence and agent behaviour.

There are several advantages to visualising data, and these can all be obtained through visualising the data generated by simulation one and two. The advantages are the following:

1. The user can absorb large sets of data, so data can be easily accessed and patterns perceived. This is especially important given that the simulation produces large quantities of data, which is hard to interpret.
2. Visual pattern perception is a ‘natural’ function of the human brain, and therefore an appropriate tool for analysis.
3. Navigation through complex and disparate sets of data is easier. This will be particularly useful given the disparate nature of the data for the two types of agents.
4. Communication is made more straightforward, which is essential given the complex nature of the data produced by the simulation.
There are, however, several disadvantages to visualising data, and these are:

1. Visualisations need to be put into context, to compliment rather than replace numeric values and textual meaning.
2. Visualisation is a translation of values, so there is the possibility of error due to the design of the graph.
3. Visualisation is resource hungry. It needs large amounts of processing power and memory space
4. Visualisations can be over-elaborate and lose their point

The method of visualisation to be used in this analysis will ensure that these disadvantages are kept to the bare minimum. This will be possible because this visual analysis will compliment the statistical analysis to follow, sophisticated mathematical software will be used to perform the task to minimise errors, and 3D contour graphs will be used as the visualisation to portray the results without being over-elaborate.

A 3D contour graph is generated by associating a dependent variable value with each point on a grid with constant spacing in each independent variable value direction. In preparing a 3D contour graph for the simulation the dependent variable is the commitment value produced by a full-run of the simulation for the socio-environmental rationalist agent (SERA) and the self-interested rationalist (SIR) agent and the independent variables are the values for instnpow and instnuncern. The grid is cartesian, although there are other types available, such as polar, cylindrical, or defined by implicit function coordinates (u, v). The curve is defined analytically, based on imported tabular data read in from a file. Differentiated colours will be used for the surface colour of each contour graph; one contour graph is assigned to each agent type in colours used in the simulation. A contour display will also be used for each contour graph to accentuate the fluctuations within the contour graphs. The use of 3-D design also has several advantages, and these are:
1. Highly complex data relationships can be generated by using depth perception at relatively little cost and effort.
2. More information can be put into the same space.
3. Pattern perception is more immediate. For example a 3-D contour map of a mountain range is easier to perceive that 2-D contour lines
4. Data clusters can be analysed from different angles (in conjunction with animation techniques).
5. Visualisations can be simplified. For example fewer colours can be used, and contour lines can be removed, as appropriate.

With the multiple data set produced by simulation one (i.e., data for the socio-environmental rationalist agent (SERA) and data for the self-interested rationalist (SIR) agent), and simulation two (i.e., the data for the four agent groups) a 3D surface graph can therefore assist in the simultaneous analysis and comparison through the sequencing of images. There are, however, costs in terms of program complexity and processing power. Through the use of Maple 9.5, a mathematical software tool, this problem is alleviated and contour graphs are used as the prime median for visual analysis.
APPENDIX 3
Appendix 3: The BDI Model

Appendix 3 contains additional information pertaining to the BDI form of rational action. In particular BDI components and framework (section A3.1), its grounding (section A3.2) and model application (section A3.3) are examined. The later sections examine the logic entailed in expressing BDI, i.e., LORA, to individual agents (section A3.4) and the logic entailed in expressing multi-agent behaviour (section A3.5).

A3.1 BDI Components and the BDI Framework

There are many possible mental states that can be chosen to characterise an agent: beliefs, goals, desires, intentions, commitments, fears, hopes, and obligations are just a few (Van der Hoek and Wooldridge, 2003: 135). The components of the BDI model, however, consist of beliefs, desires and intentions. Woolridge and Jennings (1995) note that beliefs are informational attitudes, and desires and intentions are pro-attitudes. A brief account of their meanings, relativity and importance is presented below.

Beliefs. An agent’s beliefs correspond to information the agent has about the world (Wooldridge, 2000: 7; Wooldridge and Parsons, 1999: 3; Wooldridge, 1996: 1). Beliefs thus represent knowledge of the world (Georgeff et al, 1998: 3). An agent’s knowledge base thus assumes a vital role in defining their beliefs. How is this knowledge obtained? This research assumes that this knowledge base is attained from an agent’s institutional affiliations and interactions, i.e., through social association (as discussed in Chapter 3). Each agent’s beliefs will, therefore, vary depending on such affiliations and interactions. For example, beliefs that an agent holds may be incorrect, asymmetric or even incomplete depending on the institutional source from which it was obtained.

Desires. An agent’s desires represent the state of affairs that the agent would, in an ideal world, wish to be brought about (Wooldridge, 2000: 7). In other words, desires represent an end state or loosely put a goal (Georgeff et al, 1998: 4). These desires
may well in fact be informed by the agent’s beliefs, e.g., his or her belief that a certain state of affairs is attainable could well in fact command a desire for it. In other words, an agent’s desires are a subset of its belief relation, implying that an agent will not have a goal of something it believes will not happen (Wooldridge, 2002: 284; Van der Hoek and Wooldridge, 2003: 138).

Intentions. An agent may have an infinite number of desires. In general, however, an agent will not be able to achieve all these desires. He or she will have to deliberate about which desire(s) to choose. The chosen desire(s) to which an agent has a commitment to achieving are the agent’s intentions (Wooldridge, 2000: 7; Van der Hoek and Wooldridge, 2003: 140). Desires, are thus used by an agent during the process of intention formation (Wooldridge and Parsons, 1999: 3). Intentions are proactive, that is they generally tend to lead to action and persist overtime (Wooldridge, 2002: 67). As time passes, an intention about the future becomes an intention about the present, and then it plays a direct role in the production of an action (Wooldridge, 2000: 23).

In other words, intentions drive means-end reasoning, if an agent has an intention he or she will attempt to achieve it (after all it is the end of the deliberation process). Intentions are the beginnings of a plan towards achieving desires, which were originally informed by beliefs (Georgeff et al 1998: 4). They are the plan steps that the agent has committed to but not yet acted on, and are stored in an agenda (Freedman, 2000: 2). Cases do exist were an intention does not necessarily always lead to action. This is usually the case when the intention fails to persist due to some prevailing condition, e.g., the desire no-longer persists due to some belief about the future. Intentions therefore are indirectly related to beliefs about the future, i.e., a negative belief regarding the intention may deem it undesirable and hence, unachievable.
Figure 6.5 below depicts the interaction process of the BDI components, as simplified from Bratman *et al.*, 1988\(^1\). It is a general framework that attempts to illustrate how the BDI components can be used collectively to characterize the behaviour of an agent. The beliefs of the agent are influenced by the world – their perceptions – including both the current state, and how things have been in the past and what they are likely to be like in the future, given the performance of particular actions (Traum, 1997: 2). By reasoning about its beliefs, the agent can derive new beliefs (refer to Figure 6.5). These beliefs inform deliberation, as demonstrated by the directional flow of arrows in Figure 6.5. Desires and intentions simultaneously inform the deliberation process. The deliberation process will consider the beliefs about the world, beliefs about what kinds of actions are possible and what effects they achieve (i.e. how they effect desires and intentions), as well as reasoning about the effects of the totality of actions under consideration. The outcome of this deliberation process will be structured plans that the agent has decided to perform. These are the *intentions* of the agent, which focuses their practical reasoning and are crucial to the agent actually performing the action (Bratman (1987)). As, the agent bypasses full consideration of options that conflict with those intentions (Georgeff *et al*, 1998: 1; Van der Hoek and Wooldridge, 2003: 138). Some intentions may require further planning and redeliberation before they are undertaken to be achieved. This is demonstrated by the two directional arrows between the intention and deliberation boxes in Figure A3.1.

\(^1\) The original figure included separate boxes for *means-ends reasoning* (i.e., planning), and a plan library as a part of the more general beliefs and reasoning. Also, Bratman, Pollack, and Israel (1988) included separate boxes for an opportunity analyzer and a filtering process, which here are included as part of the deliberation (Traum, 1997: 2).
Appendix 3

Figure A3.1 - BDI Agent Architecture

Source: Traum, 1997: 2

The above Figure A3.1 is quite similar to Figure 6.3 in many respects, but is also quite different in some respects. For example, several of the necessary aspects of the operators in Figure 6.3 are present (i.e., perception, deliberation, and intention), and some are excluded (e.g., reconsideration and communication). This is because in earlier and later studies Bratman focuses on the role of resource bounds on various aspects of the deliberation process and on the role of intentions in informing practical reasoning to the detriment of other aspects. These processes once undertaken and adopted are the complete focus of the agent’s attention with no chance for recourse or reconsideration.

One other difference with Figure A3.1 and Figure 6.3 is the indirect influence of perceptions upon desires and intentions. More generally, perceptions can affect desires and other attitudes such as intentions as well as beliefs directly, as demonstrated in Figure 6.3 and stated by Traum (1997). One can reject Bratman’s (1987) original claim, but still subscribe to the view that BDI models are useful; the converse, of course, is not true (Georgeff et al, 1998: 1). Bratman’s approach has been elaborated in a computer science context by subsequent researchers in multiple fields (Bratman, Israel and Pollack 1988, Pollack 1992, Georgeff et al. 1998) each with different perspectives. This research will also adopt a different perspective or angle of focus, as is discussed in section 6.2.5.
A3.2 BDI Grounding

It is difficult to give a complete account of the relationships that exist between an agent’s mental states and behaviour. Explaining how an agent’s mental state leads it to select and perform rational actions (i.e., a process of mapping perception to action) is a complex process. This is because the attitudes of the agent – beliefs, desires and intentions – are difficult phenomena to observe in the physical world (Wooldridge, 2000: 9). Theories examining such phenomena are hard to validate as they rely on intuition. So, how effective is the BDI model in overcoming this limitation?

Within the Agent Theories, Architectures, and Languages (ATAL) Community, the belief-desire-intention (BDI) model is possibly the best known and best studied model of practical reasoning agents (Georgeff et al, 1998: 1). The BDI model combines three important elements, which are the elements for its success. These are:

1. A Philosophical Foundation – It is founded upon a well-known and highly respected theory of rational action in humans (or philosophical model of human practical reasoning) originally developed by philosopher Bratman (1987).

2. A Software Architecture – The BDI model of agency does not prescribe a specific implementation (Van der Hoek and Wooldridge, 2003: 140). The model may be realised in many different ways, and indeed a number of different implementations of it have been successfully developed (Van der Hoek and Wooldridge, 2003: 138). It has been implemented in the Intelligent Resource-bounded Machine Architecture (IRMA)\(^2\) (Bratman, Israel and Pollack 1988) and in various Procedural Reasoning Systems (PRS)\(^3\) (Georgeff

---

\(^2\) IRMA was intended as a more or less direct realisation of Bratman’s theory of practical reasoning (Van der Hoek and Wooldridge, 2003: 140).

\(^3\) PRS was originally developed at Stanford Research Institute by Michael Gerogeff and Amy Lansky, and was perhaps the first agent architecture to explicitly embody the belief-desire-intention (BDI) paradigm, and proved to be the most durable agent architecture developed to date (Wooldridge, 2002: 82). In essence, the PRS is a programming environment for developing complex applications that execute in dynamic environments and can best be specified using BDI concepts (Gerogeff and Lansky 1987; Georgeff and Ingrand 1989). All other software frameworks descend in some way from the Procedural Reasoning System PRS (Ingrand, Georgeff & Rao, 1992; Van Eck and Wieringa, 2001: 10). The following is a short description of a number of these systems:
and Lansky 1987), and successfully used in a number of complex fielded applications (including the fault diagnosis system for the space shuttle, as well as factory process control systems and business process management (Georgeff and Rao 1996)).

3. A Logical Formalisation – The theory has been rigorously formalized in a family of BDI logics (Wooldridge, 2000: 7), which have been taken up and elaborated upon widely within the agent research community (Rao and Georgeff 1998; Schild 1999). These logics capture the key aspects of the BDI model as a set of logical axioms (Van der Hoek and Wooldridge, 2003: 140).

These three elements provide the necessary support in applying the BDI model in examining the mental states of actors (agents). The question is, how can the BDI model be presented?

A3.3 Presenting the BDI Model

It is through the use of mathematical logic that the BDI model is presented. Wooldridge (2000: 12-13) states that it is through using fixed structures, well-defined artificial language that the ambiguity (of the object of study) can be removed and properties, interrelationships, and inferences can be examined. The use of BDI components in this research will also render its applicability. Several other models of

1. dMARS. The designers of the PRS system extended the original PRS system with facilities for multi-agent systems, e.g. a communication infrastructure. The new system, dMARS, was developed at the now defunct Australian Artificial Intelligence Institute (AAII). The system was mainly commercial and is no longer available (Van Eck and Wieringa, 2001: 10).
2. UMPRS and JAM. A group at the University of Michigan developed an implementation in C++ of the PRS architecture called UMPRS. A small company called Intelligent Reasoning Systems (IRS) took over the maintenance of UMPRS, markets it as a commercial product, and created an extended version in Java called JAM. JAM is available free for non-commercial use and is primarily active in the consulting business (Van Eck and Wieringa, 2001: 10).
3. Jack. Jack is at the same time an extension to the Java programming language and a component framework for constructing agents with a BDI architecture in Java. Jack is the major product of Agent Oriented Software (AOS), an Australian company that seems to have its roots in the Australian Artificial Intelligence Institute (AAII, the creator of dMARS) (Van Eck and Wieringa, 2001: 10). Currently, Jack is the newest and most advantaged framework available.

The primary focus of Rao and Gerogeff’s (1998) was to explore the possible inter-relationships between beliefs, desires and intentions from the perspective of semantics characterisation (Van der Hoek and Wooldridge, 2003: 142).
practical reasoning such as, decision theory and game theory have been developed incorporating alternative mathematical processes. Why else is logic the more suitable or applicable tool for formulating the socio-environmental rationalist agent (SERA) and describing the framework?

Decision theory defines rational agents as utility maximisers and hence, establishes a framework considering only those decisions that maximise agent utility (Wooldridge, 2000: 10). Decision theory is appropriate in describing the existing principal-agent literature, which assumes self-interested rationalist (SIR) (i.e., utility maximisation) as a justification and precondition for agent behaviour. The want to satisfy one's own utility is perceived to be the motivating force of agent behaviour. A socio-environmental rationalist agent (SERA), however, moves beyond this simplified notion of agency and provides an alternative formulation, i.e., the use of institutional affiliations and interactions.

There are an infinite number of variables that influence or motivate human societies and it is notoriously hard to precisely model the behaviour of human societies. But what makes individuals unique is their social ability, i.e., their ability to learn, communicate, cooperate, coordinate and negotiate with one another in a particular setting. An agent is also a social being or party not solely a self-interested rationalist (SIR). Decision theory provides no such mechanism for this social ability.

Game theory examines the strategic interactions among self-interested agents (Wooldridge, 2002: 10; Mashaw, 1997: 101). It focuses on optimal decision making when all decision agents are presumed to be rational, with each attempting to anticipate the likely actions and reactions of its rivals (Brickley, Smith and Zimmerman, 2001: 213; Mashaw, 1997: 167). A normal game, therefore, consists of three elements: players, strategies, and utility functions (Kline, 2000: 382). When applying game theory it is important to tease out who are the relevant players, what are their relevant strategies, and what influences their payoffs (ibid). Game theory shares with decision theory many concepts, in particular the concept that a rational agent aims to maximise expected utility. Game theory like decision theory is thus not suitable in examining the socio-environmental rationalist agent (SERA). In particular, debate has arisen with respect to whether or not the notion of a rational agent, as
modelled in game theory and decision theory, is valid in examining human behaviour (Wooldridge, 2002: 11). Human preferences and behaviour can not be characterised by a simple ordering over outcomes, let alone by numeric utilities (ibid: 159).

Logical theories of rational agency, on the other hand, view agents as practical reasoning systems, deciding moment by moment which action to perform next, given their beliefs about the world (Van Der Hoek and Wooldridge, 2003: 133, Cohen and Levesque 1990). Logical theories thus represent an ideal approach to formulating the socio-environmental rationalist agent (SERA), whose behaviour is influenced by their beliefs that are informed by their institutional affiliations and interactions. Its ability to render away the ambiguity and flexibility of formulations further facilitates this ability.

### A3.4 Logic of Rational Agents (LORA)

The suitability of logic in examining the BDI model was further facilitated through the development of the ‘Logic of Rational Agents’ (LORA)\(^5\). Logic capable of expressing the dynamic aspects of agency must be able to define how the attributes and properties of agency are related. BDI logic such as LORA allows the representation of an agent’s mental states (i.e., their beliefs, desires and intentions) and their properties in a dynamic environment, and allows an agent’s reasoning to be presented in an unambiguous well-defined way. The LORA language is thus a construct of the conceptualisation of BDI reasoning which will be used to form specific formulations through its logic.

\(^5\) Classical logics were not suitable in their standard form for reasoning about intentional notions and consequently, alternative formalisms were required (Wooldridge, 2002: 269). Vast activity sprung up to support the development of such formalisms. LORA was one of these formalisms and LORA was originally developed by Anand Rao and Michael Georgeff (Wooldridge, 2000: 9). Cohen and Levesque (1990) also developed a formalism of which the emphasis was on developing a theory of intention (Wooldridge, 2002: 283), which has proved to be useful for specifying and reasoning about the properties of agents to the extent that it has been used in the analysis of conflict resolution and cooperation problem solving (Van der Hoek and Wooldridge, 2003: 137).
A3.4.1 LORA Components

LORA is a logical framework, which consists of:

- Syntax – which defines a set of acceptable constructions known as well formed formulae,
- Semantics – which assigns a precise meaning to every formula of LORA.
- Proof theory – which states the basic properties of the logic, and how these properties can be established (Wooldridge, 2000: 48).

These properties function within the LORA logical framework through the LORA language. The language of LORA combines four distinct components, these are:

1. A first-order component, which basically is the classical first-order logic. This component allows the representation of agent properties and their association with other agents. It contains the usual connectives of first-order logic as tabulated in Table A3.1.

2. A belief-desire-intention component, which allows the expression of beliefs, desires and intentions of agents within a system. This is achieved through extending the application of first-order logic. In doing so, LORA incorporates a whole class of extra connectives, know as modal connectives or modalities as tabulated in Table A3.2. It is these modalities that allow the representation and expression of the beliefs, desires, and intentions of agents.
Table A3.2– Belief, Desire, and Intention Modalities

<table>
<thead>
<tr>
<th>Formula</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Bel (i \varphi))</td>
<td>agent (i) believes (\varphi)</td>
</tr>
<tr>
<td>(Des (i \varphi))</td>
<td>agent (i) desires (\varphi)</td>
</tr>
<tr>
<td>(Int (i \varphi))</td>
<td>agent (i) intends (\varphi)</td>
</tr>
</tbody>
</table>

Source: (Wooldridge, 2000: 49; Van der Hoek and Wooldridge, 2003: 138)

These modalities can be combined to have ternary (i.e., three-way) relationships between the modalities. These are presented in Table A3.3 below. The column in Table A3.3 titled ‘name’ lists 3 sets of BDI: a BDI-S set, a BDI-R set, and a BDI-W set. These sets relate to the strength of the realism of the ternary relationship. The BDI-S set represents a strong realism, the BDI-R set represents a reasonable realism, and the BDI-W represents a weak realism. Most strong and weak types of realism are not acceptable properties of rational agents (Wooldridge, 2000: 100-101). An example of the BDI-S1 relationship is: if an agent were to intend to be rich, he or she then desires to be rich, should he or she then believe that he or she is rich. Clearly this strong type of realism is not an acceptable property of a rational agent. Such reasoning is too strong to be realistic. An example of the BDI-W1 relationship is: if an agent believes that he or she can become rich, he or she does not immediately adopt it as an intention. If the agent were to do this, this would imply that the agent chooses to commit to everything he or she believes is true. This demonstrates the weak relationship between the two. This is the reasonable realism set of the ternary relationship. Here the beliefs’ of an agent successively influence their desires and then their intentions.
3. A *temporal component*, which allows the representation of the dynamics of agents and their environments, i.e., how they change over time. The underlying assumption is that the environment may be in any of a set of possible states. One of these states represents ‘now’. The past, as viewed from ‘now’, is a linear discrete sequence of states. There is only one past. The course of future events, however, is yet to be determined. At any given point in time, there will be a number of possible sequences of time points that represent possible futures. Time thus branches into the future. Figure A3.2 depicts a model of a branching temporal structure. In conjunction with the branching structure modal connectives and path quantifiers are used to describe the dynamics of the branching structure, which are tabulated in Table A3.4 and A3.5 below.
Figure A3.2 – An Example of a Branching Temporal Structure

This figure is not available online. Please consult the hardcopy thesis available from the QUT Library.

### Table A3.4 – Modal/Path Connectives

<table>
<thead>
<tr>
<th>Formula</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Omega \phi$</td>
<td>$\phi$ is true next</td>
</tr>
<tr>
<td>$\Diamond \phi$</td>
<td>$\phi$ is eventually true</td>
</tr>
<tr>
<td>$\square \phi$</td>
<td>$\phi$ is always true</td>
</tr>
<tr>
<td>$\phi \mathcal{U} \psi$</td>
<td>$\phi$ is true until $\psi$ is true</td>
</tr>
<tr>
<td>$\phi \mathcal{W} \psi$</td>
<td>$\phi$ is true unless $\psi$ is true</td>
</tr>
</tbody>
</table>


### Table A3.5 – Path Quantifiers

**This table is not available online. Please consult the hardcopy thesis available from the QUT Library**

Source: (Wooldridge, 2000: 58)

4. An *action* component, which allows the representation of actions that agents perform, and the effects that these actions have. The basic idea is that transitions between states are labelled with actions (refer to Figure A3.2). It is the performance of an action by an agent that causes the agent to progress from one state to another. Figure A3.2 depicts this process. LORA provides a number of operatives that express the actions of agents (tabulated in Table A3.6 below). Constructors are also used to describe the action progression along a path (tabulated in Table A3.7 below).

### Table A3.6 – Operators for Representing Actions ($\alpha$)

<table>
<thead>
<tr>
<th>Expression</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$(\text{Happens } \alpha)$</td>
<td>Action expression $\alpha$ happens next</td>
</tr>
<tr>
<td>$(\text{Achvs } \alpha \ \phi)$</td>
<td>Action $\alpha$ occurs, and achieves $\phi$</td>
</tr>
<tr>
<td>$(\text{Agts } \alpha \ g)$</td>
<td>Group $g$ is required to do action $\alpha$</td>
</tr>
</tbody>
</table>

Source: (Wooldridge, 2000: 62; Van der Hoek and Wooldridge, 2003: 138)

### Table A3.7 – Constructors for Action ($\alpha$) Expressions

<table>
<thead>
<tr>
<th>Expression</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha;\alpha'$</td>
<td>$\alpha$ followed by $\alpha'$</td>
</tr>
<tr>
<td>$\alpha</td>
<td>\alpha'$</td>
</tr>
<tr>
<td>$\alpha^*$</td>
<td>$\alpha$ repeated more than once</td>
</tr>
<tr>
<td>$\phi ?$</td>
<td>$\phi$ is satisfied</td>
</tr>
</tbody>
</table>

Source: (Wooldridge, 2000: 63; Van der Hoek and Wooldridge, 2003: 138)

The above components represent the totality of the BDI Logic applicable to the reasoning of agents.
A3.5 Development of Mutual Interests or States

Agents in multi-agent systems are individuals each with their own goals, which may not be common. Their institutional affiliations and interactions may differ at any time. Agents may also have inconsistencies with respect to their beliefs, desires and intentions. Mutual mental states, therefore, play a vital role in group activity and association with society. Each of these mutual states can be presented in LORA through mutual modalities as tabulated in Table A3.8 below.

Table A3.8 - Mutual Belief, Desire, and Intention Modalities

This table is not available online. Please consult the hardcopy thesis available from the QUT Library

Source: Wooldridge, 2000: 118

Through initiating some element of commonalty (i.e., mutual interests), agents prevent the occurrence of coordination problems, which is essential for any element of cooperation to occur and hence, for the achievement of the collective goal or effort. Cooperation is therefore essential as few group activities can be achieved without cooperation. This is because cooperation schedules the necessary expertise and resources to undertake complex tasks that can not be achieved alone (Wooldridge, 2002: 24).

However, agents do not necessarily exhibit such commonality or mutual interests or states and persevere with them. For example, there are two agents $i$ and $j$, of whom $j$ has the capability to perform action $\alpha$. It can not be taken for granted that agent $j$ will execute action $\alpha$ just because another agent $i$ wants it to. This is because $j$ is autonomous: it has control over both its state and its behaviour. Individual agents can not force other agents to perform actions. So how do mutual interests or states develop to foster collective deliberation, reaction and communication?
A3.5.1 Development of Collective Deliberation, Reaction and Communication

An individual agent needs to begin with performing particular actions – communicative or speech actions\(^6\) – in an attempt to influence other agents appropriately (Austin 1962; Alonso, 2002: 26). The purpose being to align the individual beliefs’ (and hence desires and intentions) of an agent towards a mutual or shared internal state, so that the request for collective effort will proceed. Galliers (1991) notes that changes in an agent’s state caused by a communicative act is analogous to an agent revising its beliefs in the presence of new information. This new information is the request of the initiating agent, a perceptive force. In doing so, an agent \(j\) now comes to believe that it wants to do something believing that agent \(i\) believes it wants it to do it. Thus, when agents communicate with one another, it is their attempt to bring about some state of affairs (i.e., mutual interests or states) that will initiate the collective effort (Wooldridge, 2000: 134). The logic for this process is tabulated in Table A3.9 below. An attempt to initiate collective effort, therefore, relies heavily upon communicative actions. Examples of actual communicative actions are request and inform (refer to Table A3.9) (Wooldridge, 2002: 165; Wooldridge, 2000: 127; Traum, 1997: 4).

Table A3.9 – Attempt Actions

This table is not available online. Please consult the hardcopy thesis available from the QUT Library

Source: (Wooldridge, 2000: 135-137)

---

\(^6\) Communicative or Speech acts are those communications modelled as actions that alter the mental state of communication participants (i.e., agents) (Alonso, 2002: 26; Wooldridge, 2002: 164). In doing so, they possess the characteristics of actions to the extent that they can change the state of the world in a way analogous to physical actions.
The inform process involves the exchange of information between agents (i.e., the initiating agent and a group of agents), attempting to bring about some intended state of affairs (Wooldridge, 2000: 137). Through informing the initiating agent adds to the knowledge of another and in doing so facilitates the attempt to bring about a mutual belief for the desire of a certain action. For example, agent $i$ may make a factual statement to $j$ in order to enhance $j$’s knowledge of $i$’s beliefs, desires and intentions. Agent $i$ may believe the stock market is going to crash and desires $j$ to know this and intends for $j$ to know it, as knowing it will lead to some mutually beneficial outcome (e.g., a request for an action). Agent $i$ may do this by informing $j$ of the finance report and of any changes in the index values. For this informing to be successful a number of conditions need to be present: agent $i$ must believe the statement; agent $j$ must also believe the statement; and agent $j$ must believe that $i$ believes the statement to be true (Wooldridge, 2000: 138). The logic to inform is defined in Table A3.9 above and the preconditions for inform are presented in formula A3.1 below.

**Formula A3.1: Preconditions for Inform**

<table>
<thead>
<tr>
<th>This table is not available online. Please consult the hardcopy thesis available from the QUT Library</th>
</tr>
</thead>
</table>


The agent having informed the other of their beliefs and having developed a mutual belief may now request that a certain action be performed. Requests are an attempt by an initiating agent to align the intentions of a group of agents with his or her intentions (Wooldridge, 2000: 139). Requests, therefore, pertain to bringing about a mutual state of affairs (i.e., mutual intention) to perform a collective effort or goal (Wooldridge, 2000: 139). For example, agent $i$ may request agent $j$ to perform an activity in order to develop a mutual state of affairs (i.e., mutual intention) to perform a collective effort or goal. Agent $i$ may believe that the losses from the stock market can be minimised and desires something to be done and intends for this to happen. Agent $i$ may do this by requesting agent $j$ to reinvest their shares elsewhere. For this request to be successful, however, a number of conditions need to be present: agent $i$
must believe that agent \( j \) is capable of performing the action; agent \( j \) must also believe that he or she is able to perform the action; agent \( i \) must want the request to be performed; and agent \( j \) must also want to perform the request believing agent \( i \) wants it to do it (Wooldridge, 2002: 167). Ultimately, there must be a mutual intention to perform the requested action. The logic for request is defined in Table A3.9 and the preconditions for request are presented in formula A3.2 below.

**Formula A3.2: Preconditions for Request**

This table is not available online. Please consult the hardcopy thesis available from the QUT Library

Source: Wooldridge, 2000: 140

Inform and request acts are basic processes through which agents can communicate with one another and hence, align one another’s beliefs (and hence desires and intentions), their key mental states, developing mutual interests\(^7\). Agent \( j \) no longer resists performing the action \( \alpha \) that agent \( i \) requests, as agent \( j \) is of the belief that agent \( i \) wants him or her to perform the action and hence, desires and intends to perform the action \( \alpha \). Agent \( j \) deliberates to perform this request relying on \( i \)'s rational processes of perception and deliberation to intend and perform the action. Both \( i \) and \( j \) have developed mutual interests/states and have collectively deliberated. The first steps towards cooperation and hence, attaining the collective goal has been achieved.

\(^7\) Communicative actions of inform and request can at times fail to achieve the designed outcome. There is no guarantee an outcome will be achieved, and therefore this may require that the joint action be disregarded or further negotiation to proceed until an agreement is reached. The former and latter examples in section A3.5.1 represented a one-to-one negotiation (one agent \( i \) negotiates with one other agent \( j \) through a informing and requesting communicative action (Luck, 2002: 5). Otherwise known as a inform-based negotiation and a request-based negotiation. Other examples may present a many-to-one negotiation where many agents negotiate with other agents simultaneously through perhaps the process of informing (Luck, 2002: 5). Auctions are one example of many-to-one inform-based negotiations (Wooldridge, 2002: 139).
A3.5.2 Post Collective Deliberation and Communication

Once mutual interests or states are developed in multi-agent communities agents have collectively deliberated to achieve a task, cooperation towards achieving the collective goal or effort can now begin. It is now necessary to determine how the process will be executed. That is, how will the agents collectively react to collective deliberation and achieve the desired and intended collective goal? This is through the process of cooperative problem solving. While the desired goal may be evident (i.e., collective deliberation has occurred about what to achieve), the process through which to achieve it may not be apparent and hence, the notion of cooperative problem solving.

A3.5.2.1 Cooperative Problem Solving

Cooperative problem solving can be analysed and achieved through four stages; each of these stages is iterative (Wooldridge, 2000: 148; Wooldridge, 2002: 209; Wooldridge and Jennings 1994, 1999) and can be used not only to describe and formulate the post collective deliberation through to collective communication process of the multi-agent socio-environmental rationalist agent (SERA) framework, but also the initial perceptive stage of the initiating agent. According to Wooldridge (2000; 2002) the stages are:

1. **Recognition** – an agent within a multi-agent community recognises the potential for cooperative action. Thus, the agent has already deliberated about what to achieve and has existing beliefs, desires and intentions, which he or she attained through their institutional affiliations and interactions (their perception process). The agent, however, is unable to achieve the goal in isolation\(^8\), but believes that through developing mutual interests or states cooperative action can be attained.

---

\(^8\) The agent may not have the necessary resources, information or expertise required to achieve the desired goal, but these may be accessible to another agent. (Shoham and Tennenholtz, 1995: 597). Without mutual interests or states and hence, cooperation from the other agent, the desired goal can not be achieved. This demonstrates a case where there is potential to achieve a goal but it can only be achieved through collective effort/action.
and is aware of exactly which action will achieve it. This potential for cooperation (PfC) can be defined as:

$$(\text{PfC}_i \varphi) \Rightarrow (\text{Bel}_i (\text{PfC}_i \varphi))$$

Here the potential for corporation is defined by a belief on the part of the agent ($i$) that there is potential for the goal ($\varphi$) to be achieved. It is now up to the agent to initiate this potential.

2. **Team Formation** – the agent that recognised the potential for action solicits the assistance through communicative acts (e.g., inform and request). Communicative actions are the main tools through which mutual interests or states are assembled (as discussed in section A3.5.1) and through which collective deliberation on whether to undertake the task is facilitated. The formula below demonstrates this team formation process (FormTeam), which involves the agent ($i$) informing the group ($g$) they are able to achieve the goal ($\varphi$) jointly (J-Can), and then requesting $g$ to achieve $\varphi$ through an action ($\alpha$).

$$\{\text{FormTeam} \; i \; g \; \alpha \varphi\} = \{\text{Inform} \; i \; g \; \alpha \; (\text{J-Can} \; g \varphi)\}; \{\text{Request} \; i \; g \; \alpha \varphi\}$$

If successful, this will end with some degree of nominal commitment and joint responsibility to achieve the collective effort or goal (Wooldridge, 2002: 205). This will represent the initial social commitment: a commitment by a group of agents on behalf of another agent to achieve a collective effort or goal. The following is a definition that captures the commitment that agents have to achieving the collective goal if team formation is successful, and is denoted the PreTeam.

$$(\text{PreTeam} \; g \; \varphi) \Rightarrow (\text{M-Bel} \; g \; E^\square \varphi)$$

This formula implies that an initial team of agents (PreTeam) has been formed to achieve a goal ($\varphi$), all of whom ($g$) mutually believe that they ($g$) can eventually jointly achieve the goal ($\varphi$).
3. **Plan Formation** – all agents attempt to negotiate a joint plan that will achieve the desired goal. Negotiation has been long recognised as a process of importance in multi-agent systems and represents the means through which multi-agents can specify their reaction. Negotiation usually involves agents making reasoned arguments for and against courses of action; making proposals and counter proposals; suggesting modifications or amendments to plans; and continuing in this way until all the participants (agents) have agreed on a final result. This plan \( \pi \) can be expressed to have a pre-condition \( \phi \) (when the plan will be executed), a post-condition \( \psi \) (what the execution will achieve), and a body \( \beta \) (aspects of the plan) (Wooldridge, 1996: 13). The possession (Has) of this plan (\( \pi \)) by the team (\( g \)) is presented in the formula below.

\[
\text{(Has } g \pi \text{)} \Rightarrow \text{(Plan } \pi \phi \psi \beta \text{)} = (\text{Pre } \pi \phi) \land (\text{Post } \pi \psi) \land (\text{Body } \pi \beta)
\]

where:

\[
\text{(Pre } \pi \phi) = A \square ((\text{Pre } \pi) \Leftrightarrow \phi)
\]

\[
\text{(Post } \pi \psi) = A \square ((\text{Post } \pi) \Leftrightarrow \psi)
\]

\[
\text{(Body } \pi \beta) = A \square ((\text{Body } \pi) \Leftrightarrow \beta).
\]

In other words it’s a joint attempt by the initial team to achieve the desired goal through a proposed plan. The formula below defines this.

\[
(\text{PreTeam } g \phi) \Rightarrow A \Box \exists \alpha. (\text{Happens } \{ \text{J-Attempt } g \alpha \phi \psi \}) \Rightarrow (\text{Has } g \pi)
\]

If the plan formation phase is successful, the initial team possesses a plan (i.e., (Has \( g \pi \))) and has full joint commitment to achieving the collective goal or effort, and all have agreed on the means to do so. Agents may, however, attempt to bring about some of their own preferences in negotiations and the plan. The plan is in itself a communication tool through which efforts towards achieving the collective goal or effort are specified. Thus, an attempt by an agent(s) to deviate from the original plans
is not impossible or unlikely. This is fostered through an agent re-seeking perception from their own institutional affiliations and interactions which can reinforce their behaviour. This could explain the lack of complete fruition of some collective efforts.

4. **Team Action** – the agreed plan of joint action is executed by the agents and is the means by which multi-agents communicate their efforts towards achieving the collective goal or effort. Each agent thus has what is known as a responsibility to the team, i.e., the agents adopt the responsibility to follow through and achieve the goal ($\phi$). Responsibility in the context of teamwork is compromised of two parts (Wooldridge, 2000: 120), these are:

a. Commitment – a pledge or a promise that an agent makes to a group in which it is working. This is a joint commitment to the overall goal, as well as their individual commitments to the specific tasks that they have been assigned (Wooldridge, 2002: 205). It must by definition persist over time. An agent will maintain a commitment to an intention until (i) it believes the intention has succeeded, (ii) it believes the intention is impossible, or (iii) there is nothing left to execute in the plan (Wooldridge, 2002: 78). In essence, each agent ($i$) will intend to keep the mutual belief in the goal ($\phi$) until this mutual belief persists (Wooldridge, 2002: 123), which is defined by the following formula:

$$A \left( (\text{Int} \ i \ (\text{M-Bel g } \phi)) \ \not\preceq \ (\text{M-Bel g } \phi) \right)$$

b. Convention – a means of monitoring the commitment. It specifies the circumstances under which the commitment can be abandoned and how an agent should behave both locally and towards others when one of these conditions arises. A convention also represents the communication process through which the goal and the circumstances to ensure its achievement are communicated. By adopting a particular convention, team behaviour becomes more consistent and predictable.
A convention, therefore, is a set of rules, where each rule \( r \) is a pair consisting of a re-evaluation condition \( \rho \) and an associated goal \( \gamma \), which is demonstrated in the formula below (Wooldridge, 2000: 121).

\[
r = \langle \rho, \gamma \rangle
\]

A convention will be adopted by a group of agents \( g \) when working towards some goal \( \varphi \). If an agent \( i \) is apart of a group \( g \) (\( i \in g \)) believes \( \rho \) to be true, then it must adopt \( \gamma \) as an intention, and keep this intention until the commitment becomes redundant, i.e., either the goal \( \varphi \) is satisfied or the goal \( \varphi \) is impossible to achieve (Wooldridge, 2000: 124-125). The formula below demonstrates this process of team action in attaining the collective goal or effort:

\[
\forall i \cdot (i \in g) \Rightarrow \\
\neg(Bel\ i\ \varphi) \land (Bel\ i\ E\varphi) \land \\
A[( (Int\ i\ \varphi) \land \\
((Bel\ i\ \Box\neg\varphi) \Rightarrow A(Int\ i\ (M-Bel\ g\ \varphi) \Box\chi_i) ) \land \\
((Bel\ i\ A\Box\neg\varphi) \Rightarrow A(Int\ i\ (M-Bel\ g\ A\Box\neg\varphi)) \Box\chi_i )) ) \Box\chi_i]
\]

where
\[
\chi_i = ^\land [ (M-Bel\ g\ \varphi) \lor (M-Bel\ g\ A\Box\neg\varphi)].
\]

As cooperative problem solving progresses, the group of participating agents build up increasingly greater commitment to the process (Wooldridge, 2000: 148). This commitment continues until the process is completed unless proven otherwise by the convention. Should the process be completed the multi-agent community has successfully jointly achieved the set collective goal, and the initiating agent’s efforts were successful in developing mutual states conducive to achieving the collective goal.

The development of mutual interests or states is an essential element in achieving cooperative or collective effort in multi-agent communities. Cooperative problem solving is the process through which this is achieved and described above.
APPENDIX 4
A4. Appendix 4: The Simulation Tool, NetLogo

Appendix 4 contains additional information pertaining to the simulation tool, NetLogo. Additional information is presented with regards to the NetLogo protocols (section A4.1), existing simulations in agent behaviour (section A3.2), the programming for simulation one (section A4.3), and the programming for simulation two (section A4.4).

A4.1 NetLogo Protocols

Simulations use English-like commands, the behaviour of which is displayed in vivid, real-time animations. An example of these English-like commands is presented in Figure A4.1 below. There is a large collection of these pre-written simulations (much like that in Figure A4.1), both participatory and traditional, available in NetLogo’s Models Library. These pre-written simulations can be used and modified to suit individual circumstances. They address many content areas in the natural and social sciences, including biology and medicine, physics and chemistry, mathematics and computer science, and economics, financial markets and social psychology (Wilensky, 1999: 1; Path, (2001)).
NetLogo is written in Java and thus, can run on any type of operating system, this includes: Mac, Windows, Linux, etc. It is simple enough that with basic programming knowledge of Java model simulations can easily be run or even built on their own. It is also advanced enough to serve as a powerful tool for researchers in many fields as previously mentioned in Chapter 7 section 7.1.1. The researcher has the choice of viewing simulation models found in the model library, adding to existing simulation models, or creating their own simulation models (Wilensky, 1999: 48; Cobcroft, Thapa and El-Afifi, 1999: 32).
A4.2 Existing Simulations in Agency

NetLogo has been used extensively in wide and varied fields of research. To date, however, it is only recently that the rational behaviour of agents (under uncertainty) has been simulated using NetLogo. This project was inspired by the phenomenon of 'motivational bias'. It shows how the principle of seeking maximum expected utility (MEU) can in certain types of environments be outperformed by 'biased' decision rules (Evans, Heuvelink and Nettle (2003)). While their simulation demonstrates this, their decision rules (the defining behaviour of their agents) rests solely upon the traditional notions of self interested rationalism, i.e., the need to maximise ones expected utility. The following discussion will demonstrate the continued unvarying application of agency theory even within simulation.

Evans, Heuvelink and Nettle’s (2003) simulation examines the motivational biases of agents in performing judgements. In the model, a variety of agents (rational, optimistic and emotional agents) with different decision rules are allowed to compete in different environments to determine their level of performance. Rational agents were found to do better than other agents under most conditions, but there were conditions (e.g., an error in the agent’s knowledge of the probability of success) under which the rational agent was outperformed (Evans, Heuvelink and Nettle (2003)). While this was by the biased agents (emotional and optimistic agents) who behaved in ways similar to those observed in humans (i.e., they consider the benefits and costs of an opportunity), the decision rules used as a basis for their motivation concentrated on the positive and negative returns of judgements. Therefore, all agents had only one goal and that was to maximise their utility function or their returns (Evans, Heuvelink and Nettle (2003)). Optimistic and emotional agents were thus modelled and simulated on the exact premises of normative rational agents. In fact, they better represent the traits of the normative rational agent acting in a varied environment with personality traits.
An agent within Evans, Heuvelink and Nettle’s (2003) study may be optimistic towards an event or even slightly the bit emotional nonetheless he/she still seeks to evaluate his or her gains in terms of his or her return no more different than what a rational agent does. Is it, therefore, not more appropriate for this study to conclude that a rational agent with certain traits is better suited in uncertain environments than the normative rational agent? Not that the simulation finds that the principle of maximum expected utility (MEU), in certain types of environment, can be outperformed by 'biased' decision rules, given that all decision rules are based on maximising returns. The properties of this model and simulation bare a strong resemblance to those of the agent behaviour in existing agency research, which assumes that the motivating force for agent behaviour to be one of utility maximisation, otherwise known as self-interested rationalism.

While agents and/or humans may evaluate the costs and the benefits of a particular action and perform only those in their favour, this does not necessarily imply that all decisions and actions are based on such motivations. This would represent a misguided simulation of agent and/or human behaviour. Maximising expected utility is by no means the sole motivating force for agent and/or human judgement or behaviour nor the initiating force for actions. This has been clearly demonstrated by the extensive research in the field of agency (as demonstrated in Table 2.2) and by discussions in Chapter 2 and 3. Evans, Heuvelink and Nettle (2003) conclude their study with the question can a decision rule be found that does better than the rational agent’s principle of maximum expected utility? Simulating the behaviour of a socio-environmental rationalist agent (SERA) may provide further support for its formulated behaviour.
A4.3 Programming for Simulation One

breeds [  
  sociorational  
  selfinterest  
]

patches-own [  
  probinform  
  benefitinform  
  costinform  
]

turtles-own [  
  defaultcomm(sociorational)  
  defaultcomm(selfinterest)  
  commitment  
  perceivepb  
  perceivypo  
  perceivene  
  reaction  
]

globals [  
  clicks  
  average-commitment(sociorational)  
  average-commitment(selfinterest)  
  average-probinform(sociorational)  
  average-benefitinform(sociorational)  
  average-costinform(sociorational)  
  average-perceivepb(sociorational)  
  average-perceivypo(sociorational)  
  average-perceivene(sociorational)  
]

to setup  
  clear-all-plots  
  clear-graphics  
  setup-persons  
  setup-globals  
  setup-patches  
  set clicks 1
end
to setup-globals
  ifelse (display? = true)
    [display]
    [no-display]
  set average-commitmentsociorational ((sum values-from (sociorational) [commitment]) / (count sociorational))
  set average-commitmentselfinterest ((sum values-from (selfinterest) [commitment]) / (count selfinterest))
  set average-probinfo rmsociorational ((sum values-from (sociorational) [probinfo]) / (count sociorational))
  set average-benefitinfo rmsociorational ((sum values-from (sociorational) [benefitinfo]) / (count sociorational) / 10)
  set average-costinfo rm sociorational ((sum values-from (sociorational) [costinfo]) / (count sociorational) / 10)
  set average-perceivepb sociorational ((sum values-from (sociorational) [perceivepb]) / (count sociorational))
  set average-perceiveposociorational ((sum values-from (sociorational) [perceivepo]) / (count sociorational) / 10)
  set average-perceivene sociorational ((sum values-from (sociorational) [perceivene]) / (count sociorational) / 10)
end

to setup-persons
  set-default-shape turtles "person" ;; applies to both breeds
  create-sociorational (sociorationalNo)
  create-selfinterest (selfinterestNo)
  ask turtles [
    if (breed = selfinterest) [set defaultcommselfinterest random-int-or-float -1.0]
    if (breed = sociorational) [set defaultcommsociorational random-int-or-float 1.0]
    set perceivepb 0
    set perceivepo 0
    set perceivene 0
    set reaction 0
    if (breed = sociorational) [set color blue]
    if (breed = selfinterest) [set color red]
    set heading random-int-or-float 360
    jump random-int-or-float 50
  ]
end

to setup-patches
  ask patches [
    set probinfo rm random-int-or-float 1.0
    if probinfo <= 0 [set probinfo 0]
    set pcolor (probinfo * 5) + 43
    set benefitinfo rm random-int-or-float 10
    if benefitinfo <= 0 [set benefitinfo 0.1]
    set costinfo rm random-int-or-float 10
    if costinfo <= 0 [set costinfo 0.1]
  ]
end
to execute
    locals [counter]
    set counter 0
    print ""
    print "InstnPow, InstnUncern, Sociorational, Selfinterest, 10 times,"
    repeat 11 [
        set instnpow counter
        executeinstnuncern
        set counter counter + 10
    ]
end

to executeinstnuncern
    locals [counter]
    set counter 0
    print ""
    repeat 11 [
        set instnuncern counter
        type instnpow
        type ","
        type instnuncern
        type ","
        repeat 10 [
            setup
            repeat 10 [go]
            type average-commitmentsociorational / clicks
            type ",",
            type average-commitmentselfinterest / clicks
            type ",",
            print ""
            set counter counter + 10
        ]
    ]
end

to go
    setup-patches
    setup-globals
    perceive
    deliberate
    react
    do-plot
    set clicks clicks + 1
    if (clicks > 10) [stop]
end

to perceive
    ask turtles [
        perceiveofpo
        perceiveofne
        perceiveofpb
    ]
end
to perceiveofpo
  if (breed = sociorational) [
    set perceivepo random-normal (value-from (patch-here) [benefitinform]) (instnuncern / 10)
    if perceivepo <= 0 [perceiveofpo]
    if perceivepo > 10 [perceiveofpo]
  ]

  if (breed = selfinterest) [
    set perceivepo 0
  ]
end

to perceiveofne
  if (breed = sociorational) [
    set perceivene random-normal (value-from (patch-here) [costinform]) (instnuncern / 10)
    if perceivene <= 0 [perceiveofne]
    if perceivene > 10 [perceiveofne]
  ]

  if (breed = selfinterest) [
    set perceivene 0
  ]
end

to perceiveofpb
  if (breed = sociorational) [
    set perceivepb random-normal (value-from (patch-here) [probinform]) (instnpow / 100)
    if perceivepb >= 1 [perceiveofpb]
    if perceivepb <= 0 [perceiveofpb]
  ]

  if (breed = selfinterest) [
    set perceivepb 0
  ]
end

to deliberate
  ask turtles [
    if (breed = sociorational) [
      ifelse (perceivene > perceivepo) [set reaction -1]
        [ifelse (perceivene < perceivepo) [set reaction 1]
          [if (perceivepb < 0.5) [set reaction 0]
            ]
          ]
    ]
  ]

  if (breed = selfinterest) [set reaction 3]
end
to react
    ask turtles [ sociorational ]
    if (breed = sociorational) [
        if reaction = -1 [set commitment defaultcommsociorational - (perceivene)]
        if reaction = 0 [set commitment defaultcommsociorational]
        if reaction = 1 [set commitment defaultcommsociorational + (perceivepo)]
    ]
    if (breed = selfinterest) [
        if reaction = 3 [set commitment defaultcommselfinterest - (value-from (patch-here) [costinform])]]
    ]
end
to do-plot
    set-current-plot "Average Commitment"
    set-current-plot-pen "sociorational"
    plot average-commitment-sociorational / clicks
    set-current-plot-pen "selfinterest"
    plot average-commitment-selfinterest / clicks
    set-current-plot-pen "zero"
    plot 0
end
A4.4 Programming for Simulation Two

breeds [  
  AngloSaxon  
  Germanic  
  Latin  
  Nordic  
  LaterGermanic  
  LaterLatin  
  LaterNordic  
]  

patches-own [  
  probunify  
  benefitunify  
  costunify  
]  

turtles-own [  
  commitment  
  defaultcommLaterGermanic  
  defaultcommLaterLatin  
  defaultcommLaterNordic  
  perceivepb  
  perceivepo  
  perceivene  
  reaction  
]  

globals [  
  clicks  
  average-commitmentAngloSaxon  
  average-commitmentGermanic  
  average-commitmentLatin  
  average-commitmentNordic  
]  

to setup  
  clear-all-plots  
  clear-graphics  
  setup-persons  
  setup-globals  
  setup-patches  
  set clicks 1  
end  
to setup-globals  
  ifelse (display? = true)  
    [display]  
    [no-display]  
    set average-commitmentAngloSaxon (((sum values-from (AngloSaxon) [commitment]) / (count AngloSaxon))  
    set average-commitmentGermanic (((sum values-from (Germanic)[commitment]) + (sum values-from (LaterGermanic)[commitment])) / ((count Germanic) + (count LaterGermanic)))  
    set average-commitmentLatin (((sum values-from (Latin)[commitment]) + (sum values-from (LaterLatin)[commitment])) / ((count Latin) + (count LaterLatin)))  
    set average-commitmentNordic (((sum values-from (Nordic)[commitment]) + (sum values-from (LaterNordic)[commitment])) / ((count Nordic) + (count LaterNordic)))  
end
to setup-persons
    set-default-shape turtles "person" ;; applies to all breeds
    create-AngloSaxon (AngloSaxonNo)
    create-Germanic (GermanicNo)
    create-Latin (LatinNo)
    create-Nordic (NordicNo)
    create-LaterGermanic (LaterGermanicNo)
    create-LaterLatin (LaterLatinNo)
    create-LaterNordic (LaterNordicNo)

    ask turtles [  
        if (breed = LaterGermanic) [set defaultcommLaterGermanic random-int-or-float 1.0]  
        if (breed = LaterLatin) [set defaultcommLaterLatin random-int-or-float 1.0]  
        if (breed = LaterNordic) [set defaultcommLaterNordic random-int-or-float 1.0]  
        set perceivepb 0  
        set perceivepo 0  
        set perceivene 0  
        set reaction 0  
        if (breed = AngloSaxon) [set color magenta]  
        if (breed = Germanic) [set color cyan]  
        if (breed = Latin) [set color red]  
        if (breed = Nordic) [set color blue]  
        if (breed = LaterGermanic) [set color cyan]  
        if (breed = LaterLatin) [set color red]  
        if (breed = LaterNordic) [set color blue]  
        set heading random-int-or-float 360  
        jump random-int-or-float 50  
    ]
end

to setup-patches
    ask patches [  
        set probunify random-int-or-float 1.0  
        if probunify <= 0 [set probunify 0]  
        set pcolor (probunify * 5) + 43  
        set benefitunify random-int-or-float 10  
        if benefitunify <= 0 [set benefitunify 0.1]  
        set costunify random-int-or-float 10  
        if costunify <= 0 [set costunify 0.1]  
    ]
end

to execute
    locals [counter]
    set counter 0
    print ""  
    print "InstnPow, InstnUncern, AngloSaxon, Germanic, Latin, Nordic, 10 times,"
    repeat 11 [  
        set instnpow counter  
        executeinstructn  
        set counter counter + 10  
    ]
end
to execute\text{instnuncern}
locals [counter]
  set counter 0
  print " "
repeat 11 [ 
  set \text{instnuncern} counter
  type \text{instnpow}
  type ",",
  type \text{instnuncern}
  type ",",
repeat 10 [ 
  setup
  repeat 10 [go]
  type average-commitment\text{AngloSaxon} / clicks
  type ",",
  type average-commitment\text{Germanic} / clicks
  type ",",
  type average-commitment\text{Latin} / clicks
  type ",",
  type average-commitment\text{Nordic} / clicks
  type ",",
  print ""
  set counter counter + 10
]
end

to go
  setup-patches
  setup-globals
  consider\text{request}
  plan
  react
  do-plot
  set clicks clicks + 1
  if (clicks > 10) [stop]
end

to consider\text{request}
  ask turtles [ 
    perceive\text{ofpo}
    perceive\text{ofne}
    perceive\text{ofpb}
  ]
end

to perceive\text{ofpo}
  if (breed = \text{AngloSaxon}) [ 
    set perceive\text{po} random-normal (value-from (patch-here) [benefitunify]) ((\text{instnuncern} / 10) * InstrnAsso\text{Anglo})
    if perceive\text{po} <= 0 [perceive\text{ofpo}]
    if perceive\text{po} > 10 [perceive\text{ofpo}]
  ]

  if (breed = \text{Germanic}) [ 
    set perceive\text{po} random-normal (value-from (patch-here) [benefitunify]) ((\text{instnuncern} / 10) * InstrnAsso\text{Germanic})
    if perceive\text{po} <= 0 [perceive\text{ofpo}]
    if perceive\text{po} > 10 [perceive\text{ofpo}]
  ]
if (breed = Latin) [ 
  set perceivepo random-normal (value-from (patch-here) [benefitunify]) ((instnuncern / 10) * InstnAssoLatin) 
  if perceivepo <= 0 [perceiveofpo] 
  if perceivepo > 10 [perceiveofpo] 
  ] 

if (breed = Nordic) [ 
  set perceivepo random-normal (value-from (patch-here) [benefitunify]) ((instnuncern / 10) * InstnAssoNordic) 
  if perceivepo <= 0 [perceiveofpo] 
  if perceivepo > 10 [perceiveofpo] 
  ] 

if (breed = LaterGermanic) [ 
  set perceivepo random-normal (value-from (patch-here) [benefitunify]) ((instnuncern / 10) * InstnAssoGermanic) 
  if perceivepo <= 0 [perceiveofpo] 
  if perceivepo > 10 [perceiveofpo] 
  ] 

if (breed = LaterLatin) [ 
  set perceivepo random-normal (value-from (patch-here) [benefitunify]) ((instnuncern / 10) * InstnAssoLatin) 
  if perceivepo <= 0 [perceiveofpo] 
  if perceivepo > 10 [perceiveofpo] 
  ] 

end 
to perceiveofne 
  if (breed = AngloSaxon) [ 
    set perceivene random-normal (value-from (patch-here) [costunify]) ((instnuncern / 10) * InstnAssoAnglo) 
    if perceivene <= 0 [perceiveofne] 
    if perceivene > 10 [perceiveofne] 
    ] 

  if (breed = Germanic) [ 
    set perceivene random-normal (value-from (patch-here) [costunify]) ((instnuncern / 10) * InstnAssoGermanic) 
    if perceivene <= 0 [perceiveofne] 
    if perceivene > 10 [perceiveofne] 
    ] 

  if (breed = Latin) [ 
    set perceivene random-normal (value-from (patch-here) [costunify]) ((instnuncern / 10) * InstnAssoLatin) 
    if perceivene <= 0 [perceiveofne] 
    if perceivene > 10 [perceiveofne] 
    ]
if (breed = Nordic) [  
    set perceivene random-normal (value-from (patch-here) [costunify]) ((instnuncern / 10) * InstnAssoNordic)  
    if perceivene <= 0 [perceiveofne]  
    if perceivene > 10 [perceiveofne]  
]  

if (breed = LaterGermanic) [  
    set perceivene random-normal (value-from (patch-here) [costunify]) ((instnuncern / 10) * InstnAssoGermanic)  
    if perceivene <= 0 [perceiveofne]  
    if perceivene > 10 [perceiveofne]  
]  

if (breed = LaterLatin) [  
    set perceivene random-normal (value-from (patch-here) [costunify]) ((instnuncern / 10) * InstnAssoLatin)  
    if perceivene <= 0 [perceiveofne]  
    if perceivene > 10 [perceiveofne]  
]  

if (breed = LaterNordic) [  
    set perceivene random-normal (value-from (patch-here) [costunify]) ((instnuncern / 10) * InstnAssoNordic)  
    if perceivene <= 0 [perceiveofne]  
    if perceivene > 10 [perceiveofne]  
]  

end  

to perceiveofpb  
  if (breed = AngloSaxon) [  
    set perceivepb random-normal (value-from (patch-here) [probunify]) ((instnpow / 100) * InstnAssoAnglo)  
    if perceivepb >= 1 [perceiveofpb]  
    if perceivepb <= 0 [perceiveofpb]  
  ]  

  if (breed = Germanic) [  
    set perceivepb random-normal (value-from (patch-here) [probunify]) ((instnpow / 100) * InstnAssoGermanic)  
    if perceivepb >= 1 [perceiveofpb]  
    if perceivepb <= 0 [perceiveofpb]  
  ]  

  if (breed = Latin) [  
    set perceivepb random-normal (value-from (patch-here) [probunify]) ((instnpow / 100) * InstnAssoLatin)  
    if perceivepb >= 1 [perceiveofpb]  
    if perceivepb <= 0 [perceiveofpb]  
  ]  

  if (breed = Nordic) [  
    set perceivepb random-normal (value-from (patch-here) [probunify]) ((instnpow / 100) * InstnAssoNordic)  
    if perceivepb >= 1 [perceiveofpb]  
    if perceivepb <= 0 [perceiveofpb]  
  ]  
}
if (breed = LaterGermanic) [  
  set perceivepb random-normal (value-from (patch-here) [probunify]) ((instnpow / 100) * InstnAssoGermanic)  
  if perceivepb >= 1 [perceiveofpb]  
  if perceivepb <= 0 [perceiveofpb]  
]  

if (breed = LaterLatin) [  
  set perceivepb random-normal (value-from (patch-here) [probunify]) ((instnpow / 100) * InstnAssoLatin)  
  if perceivepb >= 1 [perceiveofpb]  
  if perceivepb <= 0 [perceiveofpb]  
]  

if (breed = LaterNordic) [  
  set perceivepb random-normal (value-from (patch-here) [probunify]) ((instnpow / 100) * InstnAssoNordic)  
  if perceivepb >= 1 [perceiveofpb]  
  if perceivepb <= 0 [perceiveofpb]  
]  

end  

to plan  
ask turtles [  
  if (breed = AngloSaxon) [  
    ifelse (perceivene > perceivepo) [set reaction -1]  
    [ifelse (perceivene < perceivepo) [set reaction 1]  
      [if (perceivepb < 0.5) [set reaction 0]]  
    ]  
  ]  
  if (breed = Germanic) [  
    ifelse (perceivene > perceivepo) [set reaction -1]  
    [ifelse (perceivene < perceivepo) [set reaction 1]  
      [if (perceivepb < 0.5) [set reaction 0]]  
    ]  
  ]  
  if (breed = Latin) [  
    ifelse (perceivene > perceivepo) [set reaction -1]  
    [ifelse (perceivene < perceivepo) [set reaction 1]  
      [if (perceivepb < 0.5) [set reaction 0]]  
    ]  
  ]  
  if (breed = Nordic) [  
    ifelse (perceivene > perceivepo) [set reaction -1]  
    [ifelse (perceivene < perceivepo) [set reaction 1]  
      [if (perceivepb < 0.5) [set reaction 0]]  
    ]  
  ]
if (breed = LaterGermanic) [
    ifelse (perceivene > perceivepo) [set reaction -1]
    [ifelse (perceivene < perceivepo) [set reaction 1]
        [if (perceivepb < 0.5) [set reaction 0]
        ]
    ]
]

if (breed = LaterLatin) [
    ifelse (perceivene > perceivepo) [set reaction -1]
    [ifelse (perceivene < perceivepo) [set reaction 1]
        [if (perceivepb < 0.5) [set reaction 0]
        ]
    ]
]

if (breed = LaterNordic) [
    ifelse (perceivene > perceivepo) [set reaction -1]
    [ifelse (perceivene < perceivepo) [set reaction 1]
        [if (perceivepb < 0.5) [set reaction 0]
        ]
    ]
]
]
]

to react
ask turtles [
    if (breed = AngloSaxon) [
        if reaction = -1 [set commitment defaultcommAngloSaxon - (perceivene)]
        if reaction = 0 [set commitment defaultcommAngloSaxon]
        if reaction = 1 [set commitment defaultcommAngloSaxon + (perceivepo)]
    ]
]

if (breed = Germanic) [
    if reaction = -1 [set commitment defaultcommGermanic - (perceivene)]
    if reaction = 0 [set commitment defaultcommGermanic]
    if reaction = 1 [set commitment defaultcommGermanic + (perceivepo)]
]

if (breed = Latin) [
    if reaction = -1 [set commitment defaultcommLatin - (perceivene)]
    if reaction = 0 [set commitment defaultcommLatin]
    if reaction = 1 [set commitment defaultcommLatin + (perceivepo)]
]

if (breed = Nordic) [
    if reaction = -1 [set commitment defaultcommNordic - (perceivene)]
    if reaction = 0 [set commitment defaultcommNordic]
    if reaction = 1 [set commitment defaultcommNordic + (perceivepo)]
]

if (breed = LaterGermanic) [
    if reaction = -1 [set commitment defaultcommLaterGermanic - (perceivene)]
    if reaction = 0 [set commitment defaultcommLaterGermanic]
    if reaction = 1 [set commitment defaultcommLaterGermanic + (perceivepo)]
]
if (breed = LaterLatin) {
    if reaction = -1 [set commitment defaultcommLaterLatin - (perceivene)]
    if reaction = 0 [set commitment defaultcommLaterLatin]
    if reaction = 1 [set commitment defaultcommLaterLatin + (perceivepo)]
}

if (breed = LaterNordic) {
    if reaction = -1 [set commitment defaultcommLaterNordic - (perceivene)]
    if reaction = 0 [set commitment defaultcommLaterNordic]
    if reaction = 1 [set commitment defaultcommLaterNordic + (perceivepo)]
}

end
to do-plot
    set-current-plot "Average Commitment"
    set-current-plot-pen "AngloSaxon"
    plot average-commitmentAngloSaxon / clicks
    set-current-plot-pen "Germanic"
    plot average-commitmentGermanic / clicks
    set-current-plot-pen "Latin"
    plot average-commitmentLatin / clicks
    set-current-plot-pen "Nordic"
    plot average-commitmentNordic / clicks
    plot 0
end
References


References


References


References


References


References


References


Agency theory relates the actions of interdependent parties, such as a company board and a CEO, or the nations and Union of Europe. Traditionally, agents have been considered as limited, introspective decision makers. In her dissertation Nurcan redeveloped this. Agents are more comprehensively formulated. The influences of external institutions are explicitly incorporated. This broader view of agent behaviour is captured by her Socio-Environmental Rationalist Agent (SERA) and its workings demonstrated through computer simulations of agents, and situations in the European Union (EU). In the words of one highly respected examiner, this is “an outstanding contribution” and “a most challenging, ambitious and interesting thesis” developed with “an extremely thorough and strongly analytical approach throughout”. Nurcan’s work has significant policy implications not just for governments but also for corporations. Her research provides an important step in advancing our fundamental understanding of agent behaviour beyond that present in existing Agency and international business research.