

**Assessing the contribution of information technology to
development:
A social systems framework based on structuration theory
and autopoiesis**

by

Sibella Margaretha Turpin

Submitted in fulfilment of the requirements for the degree
Philosophiae Doctor (Information Technology)

in the Faculty of Engineering, Built Environment and Information Technology
at the
University of Pretoria

Pretoria, South Africa

January 2012

Abstract

CANDIDATE: Marita Turpin

PROMOTERS: Prof PM Alexander
Dr LJ Phahlamohlaka

DEPARTMENT: Informatics

DEGREE: Philosophiae Doctor (Information Technology)

KEYWORDS: ICT for development, ICT4D, socio-economic development, social systems, systems thinking, structuration theory, autopoiesis

One of the key challenges in information and communication technologies for socio-economic development (ICT4D) is that the contribution of ICT to development is difficult to describe and assess. This is particularly true when looking beyond the immediate context of an ICT4D project, to its impact on the larger social system within which the project is introduced.

This problem can benefit from a systems approach. Systems thinking is concerned with the performance of the total system, when changes are made to a part of the system. Systems thinking recognises that the performance of a subsystem relative to its own goals does not necessarily lead to increased performance of the larger system. However, in the field of ICT4D, systems approaches are seldom used, and appropriate ways to describe and assess a social system are lacking. The study aims to contribute theoretically as well as empirically to the social systems body of knowledge in ICT4D. A particular social systems approach or framework is developed, based on structuration theory and autopoiesis. The framework is attractive because it provides a way to describe and assess the sustainability and state of development of the total system.

The theoretical component of the thesis concerns the development of a social systems framework. This is done in a conceptual study that draws on systems literature and social theory.

The empirical component concerns the application of the systems framework in an ICT4D case study. A descriptive, longitudinal case study is performed in a rural settlement in KwaZulu Natal, South Africa. Data is collected by means of interviews and participant observation during several visits to the settlement. Data analysis is done making use of the concepts in the systems framework. The result of the data analysis is a description of the larger social systems where the ICT4D project is implemented, as systems served, and the ICT4D project, as serving system. By studying the mutual influences between the serving system and systems served, the contribution to socio-economic development of the serving system is assessed.

The study's research contribution is to indicate how a social systems framework can be used to assess an ICT4D project's contribution to the socio-economic development of the social systems it serves.

Acknowledgements

I hereby wish to thank everyone who has assisted me with this study, directly and indirectly. I especially want to acknowledge the following parties for their support:

- Prof Carina de Villiers at the Department of Informatics, for creating an environment that enabled my studies;
- My supervisors, for their guidance and especially for their continued faith in me: Prof Trish Alexander and Dr Jackie Phahlamohlaka;
- Various colleagues for their support and advice: Dewald Roode, Machdel Mathee, Hugo Lotriet, Elaine Byrne, Mario Marais, Johan Strydom, Alta de Waal and Jan Roodt;
- My family, for their patience and support: Andrew, Marguerite, Laura and Nina;
- Kirstin Krauss, for introducing me to Tugela Ferry, and without whose tenacity there would have been no project; and
- The people at Tugela Ferry, who have shared not only information but also themselves.

DETAILED TABLE OF CONTENTS

| | | |
|------------------|---|-----------|
| CHAPTER 1 | INTRODUCTION..... | 1 |
| 1.1 | Motivation..... | 1 |
| 1.2 | Concise overview of problem | 1 |
| 1.3 | Research undertaken | 2 |
| 1.3.1 | Research aims | 2 |
| 1.3.2 | Research strategy | 3 |
| 1.3.3 | Research contribution | 3 |
| 1.3.4 | Research questions..... | 4 |
| 1.4 | Chapter outline..... | 4 |
| 1.5 | Conclusion | 6 |
| CHAPTER 2 | ICT4D BACKGROUND RELEVANT TO PROBLEM STATEMENT | 8 |
| 2.1 | Introduction..... | 8 |
| 2.2 | Key definitions..... | 8 |
| 2.2.1 | System | 8 |
| 2.2.2 | Information system | 9 |
| 2.2.3 | Information and communications technology for development (ICT4D)..... | 10 |
| 2.2.4 | Development..... | 13 |
| 2.2.5 | Sustainability | 15 |
| 2.3 | Dealing with development and sustainability in an alternative way: introducing systems thinking | 16 |
| 2.4 | Systems thinking in IS and ICT4D | 17 |
| 2.4.1 | Themes in systems-related ICT4D publications | 19 |
| 2.4.2 | Assessment of ICT4D systems approaches | 25 |
| 2.4.3 | Revisiting the arguments for using systems thinking in ICT4D | 27 |
| 2.4.4 | The way forward: searching for a social systems description..... | 28 |
| 2.5 | Conclusion | 29 |
| CHAPTER 3 | RESEARCH METHODOLOGY | 30 |
| 3.1 | Introduction..... | 30 |
| 3.2 | Research philosophy | 30 |

| | | |
|---|--|-----------|
| 3.2.1 | The subjective-objective dimension | 30 |
| 3.2.2 | The regulation or change dimension..... | 32 |
| 3.2.3 | Burrell and Morgan’s paradigms | 33 |
| 3.2.4 | Use of the research paradigms in Information Systems | 34 |
| 3.2.5 | Critique of the paradigms | 35 |
| 3.2.6 | Research philosophy of this study | 37 |
| 3.3 | The IS and ICT4D research contexts | 38 |
| 3.3.1 | Research strategies in Information Systems | 39 |
| 3.3.2 | The ICT4D research context..... | 39 |
| 3.4 | Research strategy | 42 |
| 3.4.1 | Case setting..... | 42 |
| 3.4.2 | Case study format | 43 |
| 3.4.3 | Time frame..... | 43 |
| 3.4.4 | Generalising from the case | 43 |
| 3.4.5 | Principles for conducting interpretive case study research | 44 |
| 3.5 | Using a theory | 45 |
| 3.6 | Information collection..... | 46 |
| 3.6.1 | Ethical aspects | 47 |
| 3.7 | Information analysis..... | 47 |
| 3.8 | Research audience..... | 48 |
| 3.9 | Contribution to knowledge | 48 |
| 3.10 | Limitations of the study | 49 |
| 3.11 | Conclusion | 49 |
| CHAPTER 4 SYSTEMS THINKING AND SYSTEMS APPROACHES..... | | 51 |
| 4.1 | Introduction..... | 51 |
| 4.2 | Systems thinking: background and overview | 52 |
| 4.2.1 | Departure points | 52 |
| 4.2.2 | History of systems thinking | 53 |
| 4.2.3 | Defining a system | 55 |
| 4.2.4 | Analysis and synthesis as part of a systems approach | 57 |
| 4.2.5 | Developing systems hierarchies..... | 59 |
| 4.2.6 | The benefits of a systems approach | 59 |
| 4.2.7 | Useful systems concepts for ICT4D | 60 |
| 4.3 | The various systems approaches | 61 |

| | | |
|--|--|-----------|
| 4.4 | Hard systems thinking..... | 64 |
| 4.4.1 | Systems Engineering | 64 |
| 4.4.2 | Organisational Cybernetics..... | 66 |
| 4.5 | Soft systems thinking | 68 |
| 4.5.1 | Soft Systems Methodology | 68 |
| 4.5.2 | The Multiple Perspectives Approach..... | 72 |
| 4.6 | Critical systems thinking..... | 76 |
| 4.6.1 | Theoretical background | 76 |
| 4.6.2 | Critical systems approaches: CSH and TSI | 76 |
| 4.6.3 | Critique of the critical approaches | 79 |
| 4.7 | Complexity thinking | 79 |
| 4.7.1 | Application in the systems domain: an assessment | 81 |
| 4.8 | Postmodern systems thinking | 81 |
| 4.8.1 | Assessment of postmodern systems thinking..... | 82 |
| 4.9 | Multimethodologies | 83 |
| 4.9.1 | Context, definition and motivation | 83 |
| 4.9.2 | Challenges | 84 |
| 4.9.3 | A framework for selecting methods..... | 84 |
| 4.9.4 | Assessment | 86 |
| 4.10 | Conclusion | 86 |
| CHAPTER 5 SOCIAL THEORY BUILDING BLOCKS, AND SELECTING A SOCIAL SYSTEMS THEORY..... | | 88 |
| 5.1 | Introduction..... | 88 |
| 5.2 | A mechanical view of society | 89 |
| 5.3 | Functionalism..... | 90 |
| 5.3.1 | Biological models in the social domain | 90 |
| 5.3.2 | Functionalism: an overview..... | 90 |
| 5.3.3 | Durkheim’s use of systems concepts | 92 |
| 5.3.4 | Parsons’ functionalism..... | 93 |
| 5.3.5 | Merton’s contribution | 94 |
| 5.3.6 | A critique of functionalism | 95 |

| | | |
|--|--|------------|
| 5.4 | Other systems contributions in social theory | 96 |
| 5.4.1 | The work of Buckley | 97 |
| 5.4.2 | Giddens and Luhmann's use of systems concepts | 97 |
| 5.4.3 | Alexander's neofunctionalism | 98 |
| 5.4.4 | Graaff's overview | 98 |
| 5.4.5 | Bailey: promoting recent systems thinking to sociologists | 98 |
| 5.5 | Giddens and social systems | 103 |
| 5.5.1 | Background: Structuration theory | 103 |
| 5.5.2 | Social systems | 110 |
| 5.5.3 | Assessment of Giddens' social system | 112 |
| 5.6 | Assessment: systems thinking in social theory | 112 |
| 5.6.1 | Reflection on systems thinking found in social theory | 112 |
| 5.6.2 | Applicability of social systems theories for use in this study | 114 |
| 5.7 | The challenge of selecting a social systems theory | 115 |
| 5.7.1 | Objective of the systems exercise | 115 |
| 5.7.2 | Nature of the social system | 116 |
| 5.7.3 | Characteristics of the social systems approach | 116 |
| 5.7.4 | Preferences of the analyst(s) | 117 |
| 5.7.5 | Presenting and motivating for a candidate | 117 |
| 5.7.6 | The way forward with a social systems theory | 120 |
| 5.8 | Conclusion | 120 |
| CHAPTER 6 AUTOPOIESIS AND ITS SOCIAL APPLICATION..... | | 123 |
| 6.1 | Introduction | 123 |
| 6.2 | Basic principles of autopoiesis | 124 |
| 6.2.1 | Unity, organisation and structure | 124 |
| 6.2.2 | Organisational closure and the role of the boundary | 126 |
| 6.2.3 | Multicellulars: introducing structural coupling | 126 |
| 6.2.4 | Structural determinism | 127 |
| 6.2.5 | Structural change: ontogeny, phylogeny and structural drift | 127 |
| 6.2.6 | Different views on a system, and the assessment of behaviour | 128 |
| 6.2.7 | The nervous system and cognition | 130 |
| 6.2.8 | Social systems | 130 |
| 6.2.9 | Language and self-reflection | 132 |
| 6.2.10 | Autopoiesis, autonomy and sustainability | 133 |
| 6.2.11 | Conclusion | 133 |

| | | |
|---|---|------------|
| 6.3 | Application in the social domain | 134 |
| 6.3.1 | Attempts to develop a social autopoiesis theory | 135 |
| 6.3.2 | The “scientific” stream: Zeleny and Hufford | 135 |
| 6.3.3 | Luhmann’s social theory | 137 |
| 6.3.4 | The use of autopoiesis as a metaphor | 140 |
| 6.3.5 | The work of Hejl and Kay | 141 |
| 6.3.6 | The contribution of Mingers | 142 |
| 6.3.7 | Fuchs’ use of Giddens | 145 |
| 6.3.8 | A spectrum of social applications | 146 |
| 6.3.9 | Reflection | 147 |
| 6.3.10 | Way forward for a systems framework | 148 |
| 6.4 | Conclusion | 149 |
| CHAPTER 7 SOCIAL SYSTEMS FRAMEWORK | | 150 |
| 7.1 | Introduction | 150 |
| 7.2 | Preparatory work: background and assumptions | 151 |
| 7.2.1 | Background sketch on the community | 151 |
| 7.2.2 | Assumptions and simplifications | 152 |
| 7.3 | Outline of the social autopoiesis model | 153 |
| 7.3.1 | Giddens’ structuration theory as the autopoietic engine | 153 |
| 7.3.2 | General autopoiesis elements | 161 |
| 7.3.3 | Systems framework: summary and synthesis | 166 |
| 7.3.4 | Use of the framework for data collection and analysis | 168 |
| 7.4 | Conclusion | 169 |
| CHAPTER 8 CASE STUDY BACKGROUND AND ASSUMPTIONS: A CONTEXTUAL OVERVIEW | | 170 |
| 8.1 | Introduction | 170 |
| 8.1.1 | Information collected | 171 |
| 8.2 | Demographic overview | 171 |
| 8.2.1 | Demographic data from the 2001 census | 172 |
| 8.2.2 | Reflection on census data | 174 |
| 8.2.3 | Information from Msinga local municipality | 175 |
| 8.2.4 | Reflection on background information | 177 |
| 8.2.5 | Visual representation: Tugela Ferry | 177 |

| | | |
|---|--|------------|
| 8.3 | The Zulu community..... | 179 |
| 8.3.1 | Historical overview..... | 179 |
| 8.3.2 | Discussion: Zulu community | 184 |
| 8.4 | The Tugela Ferry mission | 185 |
| 8.4.1 | Historical overview..... | 186 |
| 8.4.2 | Current activities..... | 189 |
| 8.4.3 | Reflection: mission community | 192 |
| 8.5 | Rich picture of current situation | 193 |
| 8.6 | CATWOE descriptions..... | 194 |
| 8.6.1 | CATWOE description of Zulu community | 195 |
| 8.6.2 | CATWOE description of mission community | 195 |
| 8.7 | Contextual background on the ICT4D project..... | 197 |
| 8.7.1 | Introduction | 197 |
| 8.7.2 | Historical context..... | 197 |
| 8.7.3 | The Tugela Ferry ICT4D project | 199 |
| 8.7.4 | CATWOE description: serving system | 203 |
| 8.7.5 | Conclusion..... | 204 |
| 8.8 | Assumptions and simplifications | 206 |
| 8.8.1 | Being functionalist or interpretive | 206 |
| 8.8.2 | Selecting the Zulu and mission communities as systems of interest..... | 207 |
| 8.8.3 | Zulus and the mission: separate social systems or not..... | 208 |
| 8.8.4 | The question of boundaries..... | 208 |
| 8.8.5 | Organisational closure and autopoietic nature of systems | 210 |
| 8.8.6 | Homogeneity in the Zulu and mission communities | 210 |
| 8.8.7 | An assumption related to the serving system..... | 211 |
| 8.9 | Conclusion | 212 |
| CHAPTER 9 DESCRIPTION OF SOCIAL SYSTEMS..... | | 213 |
| 9.1 | Introduction..... | 213 |
| 9.2 | Empirical data gathered | 214 |
| 9.2.1 | Revisiting the research methodology..... | 214 |
| 9.2.2 | Nature of data collected | 214 |
| 9.2.3 | Data collection methods | 215 |
| 9.2.4 | Time period..... | 218 |
| 9.2.5 | Ethical matters encountered..... | 219 |

| | | |
|------------------------------------|--|------------|
| 9.3 | Relationship between data collection, data analysis and theory development | 219 |
| 9.4 | Revisiting and applying the systems framework | 221 |
| 9.5 | Description of system served: the Zulu system | 222 |
| 9.5.1 | A structurational view | 223 |
| 9.5.2 | Autopoiesis concepts | 229 |
| 9.5.3 | Sustainability | 230 |
| 9.6 | Description of system served: the mission system | 231 |
| 9.6.1 | A structurational view | 231 |
| 9.6.2 | Autopoiesis concepts | 236 |
| 9.6.3 | Sustainability | 237 |
| 9.7 | Mutual influences: Zulu and mission systems | 237 |
| 9.7.1 | Using the systems framework to describe mutual influences | 237 |
| 9.7.2 | Some general system-related matters | 240 |
| 9.8 | Description of the serving system | 241 |
| 9.8.1 | A structurational view | 242 |
| 9.8.2 | Autopoiesis concepts | 250 |
| 9.8.3 | Sustainability | 251 |
| 9.9 | Mutual influences: serving system and systems served | 252 |
| 9.9.1 | Influence of the serving system | 252 |
| 9.9.2 | Influences on the ICT4D team | 254 |
| 9.9.3 | Assessment of serving system's impact on development | 255 |
| 9.10 | Summary of findings | 256 |
| 9.10.1 | Implications for future ICT4D projects | 258 |
| 9.11 | Conclusion | 259 |
| CHAPTER 10 CONCLUSION | | 260 |
| 10.1 | Introduction | 260 |
| 10.2 | Summary of research: problem, planning and execution | 260 |
| 10.2.1 | Revisiting the problem | 260 |
| 10.2.2 | A possible systems framework | 261 |
| 10.2.3 | Empirical research | 261 |

| | | |
|-------------------|---|------------|
| 10.3 | Assessment of research undertaken | 261 |
| 10.3.1 | Incremental contributions of this study..... | 262 |
| 10.3.2 | Assessment of conducting an interpretive field study..... | 262 |
| 10.3.3 | Assessment of theoretical contribution | 265 |
| 10.3.4 | Own assessment of challenges faced | 270 |
| 10.4 | Opportunities for further research..... | 271 |
| 10.5 | Final remarks, and revisiting the main research question..... | 272 |
| REFERENCES | | 273 |

LIST OF FIGURES

| | |
|--|-----|
| Figure 1.1: Chapter outline..... | 6 |
| Figure 2.1: Four paradigms of ICT4D research | 13 |
| Figure 3.1: The four sociological paradigms | 34 |
| Figure 4.1: The relation between various “schools” of systems thinking | 54 |
| Figure 4.2: Systems approaches mapped to Burrell and Morgan’s sociological paradigms ... | 62 |
| Figure 4.3: The Systems Engineering lifecycle..... | 65 |
| Figure 4.4: Systems Engineering: the design phase | 66 |
| Figure 4.5: A flow diagram of the Soft Systems Methodology | 70 |
| Figure 4.6: An inquiry system | 72 |
| Figure 4.7: A new decision-making paradigm for DSS | 75 |
| Figure 5.1: Society, with some of its social institutions | 91 |
| Figure 5.2: Dimensions of the duality of structure | 110 |
| Figure 6.1: A spectrum of positions on social autopoiesis..... | 146 |
| Figure 7.1: Giddens’ dimensions of the duality of structure | 155 |
| Figure 7.2: Giddens’ dimensions as by Mendelsohn and Gelderblom | 155 |
| Figure 7.3: Overview of the systems framework | 166 |
| Figure 8.1: Visual representation of Tugela Ferry town | 178 |
| Figure 8.2: Map of South Africa’s homelands in the 1950s | 183 |
| Figure 8.3: The Zulu and mission social systems..... | 186 |
| Figure 8.4: Rich picture of Zulu and mission communities in Msinga | 194 |
| Figure 9.1: Iterative process of data collection, analysis and theory development | 220 |
| Figure 9.2: The strengthening influences among the social systems of interest..... | 256 |

LIST OF TABLES

| | |
|--|-----|
| Table 2.1: Searches for systems-related work in ICT4D publications | 19 |
| Table 2.2: Systems views and approaches found in systems-related ICT4D papers | 21 |
| Table 4.1: Comparing the categorisations of systems approaches..... | 61 |
| Table 4.2: Systems approaches related to problem contexts | 63 |
| Table 4.3: Framework for mapping methods..... | 85 |
| Table 5.1: Giddens' levels of action | 106 |
| Table 7.1: Elements of the social systems framework..... | 167 |
| Table 8.1: Comparative summary of selected demographic data for Msinga municipality .. | 174 |
| Table 9.1: Elements of the social systems framework..... | 221 |
| Table 9.2: Direct and secondary beneficiaries of IT literacy training..... | 254 |