Alternative manufacturing developments from the semi-periphery: the case of human-centered manufacturing approach in Brazil

Gustavo Abel Guzman
University of Wollongong
NOTE
This online version of the thesis may have different page formatting and pagination from the paper copy held in the University of Wollongong Library.

UNIVERSITY OF WOLLONGONG

COPYRIGHT WARNING
You may print or download ONE copy of this document for the purpose of your own research or study. The University does not authorise you to copy, communicate or otherwise make available electronically to any other person any copyright material contained on this site. You are reminded of the following:

Copyright owners are entitled to take legal action against persons who infringe their copyright. A reproduction of material that is protected by copyright may be a copyright infringement. A court may impose penalties and award damages in relation to offences and infringements relating to copyright material. Higher penalties may apply, and higher damages may be awarded, for offences and infringements involving the conversion of material into digital or electronic form.
ALTERNATIVE MANUFACTURING DEVELOPMENTS FROM THE SEMI-PERIPHERY: THE CASE OF HUMAN-CENTRED MANUFACTURING APPROACH IN BRAZIL

A thesis submitted in partial fulfilment of the requirements for the award of the degree

DOCTOR OF PHILOSOPHY

from

THE UNIVERSITY OF WOLLONGONG

by

Gustavo Abel Carrillo Guzman, BEng, MA

Science and Technology Studies

June, 1998
I declare that work presented in this dissertation is original, except where otherwise acknowledged.

June 1998

Gustavo A. C. Guzman
ABSTRACT

The key research question of this study is to determine if Brazilian firms are applying the human-centred manufacturing approaches and if so, to explore how and to what extent this is happening. From this, two related research topics emerge: (i) how macro contextual conditions support or constrain the implementation of the HC model; and (ii) which are the main technical and organisational features of a 'tropicalized' (adapted) HC model in Brazilian firms. In order to address these questions, case studies were carried out in 10 Brazilian firms. The aim of the empirical study was to determine the form and level of human-centredness in these firms and to explore the factors affecting this. An examination was then made of the patterns of human-centred development and its links with product, process and environmental factors, identified in the literature as key influences on HC systems developments. Two theoretical approaches were used to inform the empirical component of this study in order to explain the application of New Production Systems and, specifically the Human-centred approach in the semi-periphery. Firstly, the examination at the level of the firm, integrates constructivist views of people, technology and organisation with the concept of manufacturing engineering systems as well as the organisation configuration approach. This helps to understand "how" the human-centred approach was applied in Brazil. Secondly, a political economy examination of the macro contextual factors assisted to understand "why" related questions. Key findings of this study refer to the wide range of adaptation to local conditions of new production systems. This is explained by contextual institutional factors, such as industrial relations and regional labour markets. In contrast to established human-centred theory, the degree of human-centredness in the organisational arena was not strongly linked to either (i) human-centred designed technology; (ii) to new product market variety and change; or (iii) characteristics of the firm.
Acknowledgements

Thanks God for give me health to be able to advance one step more.

Many persons contributed to the development of this work. Professor Richard Badham, my supervisor, not only gave me the initial idea but was always keen to share his research experience. I appreciate his collaboration, time, patience and good humour. Leda Gitahy, Stuart Russell, Fernando Coutinho, Lidia Segre, Richard Joseph, Antonio Bothelho, David Selden, Nair Bicalho and Stan Aungles contributed in different ways. My colleges at The Federal University of Minas Gerais, carried out my work load at Production Engineering Department while I was in Wollongong. Staff from the researched firms also collaborated in significant extent to discover valuable empirical information.

My colleagues at STS department, David Mercer, Ian Hampson, Simon Wilson and Marx Rix were always cheering to don't give up. Personnel of the Learning Assistance Centre supported me in very practical ways helping me to improve my written English.

There was also a group of persons who help me just in the right way and in the right time in matters not necessary directly linked to this work, but often basic for survival. They were highly generous supporting not only me but my family: Miranda Hicks (in Memorian), June Aspley and Joan Phillips.

Without financial support from CAPES (Higher Education Agency from the Ministry of Education, Brazilian Federal Government), this research would not have been possible.

The key reason to develop this dissertation is my family: Jussara, Rommero and Naiara to whom this work belongs. Finally, this thesis is dedicated to my parents, Raul and Estela, with love.

To all them 'muchas gracias'
CONTENTS

Exhibits viii
Abbreviations x

INTRODUCTION

Chapter 1 Introduction 1

1.1 The research question and justification 3
1.2 Human-centredness: a brief concept 7
1.3 Challenges and opportunities of the HC theory 14
1.4 Contents Outline 16

Chapter 2 Methodological Notes 20

2.1 Research Strategy 21
2.2 Research Logic 26
2.3 The Underlying Assumptions of the present research 30
2.4 Conclusions 42
PART II  HCMS IN BRAZIL: AN EXPLORATORY STUDY

Chapter 6  Introduction
6.1 General features of researched firms

Chapter 7  The Horizontal Dimension
7.1 The extent of horizontal cellularisation
7.2 Product customisation feasibility and the horizontal dimension
7.3 Cell type and the horizontal dimension
7.4 Batch size and the horizontal dimension

Chapter 8  The Vertical Dimension
8.1 Introduction
8.2 Direct manufacturing indicators
8.3 Indirect manufacturing indicators
8.4 Wider organisation structure indicators

Chapter 9  HCMS in Brazil: Scope of Restructuring
9.1 A Shopfloor level examination
9.2 A Firm level examination
9.3 HC restructuring: A re-assessment
9.4 Testing criteria for assessing Human-centredness
9.5 General design orientations and productivity levels
9.6 HCMS Under Different Product/market, Design and Manufacturing Strategies
  9.6.1 Introduction
  9.6.2 Theoretical notes
  9.6.3 The empirical evidence
  9.6.4 Discussion

Chapter 10  Conclusions
10.1 Introduction
10.2 Typology of Brazilian firms
10.3 Variety of Configurations within HC-oriented firms
10.4 Common elements of HC-oriented firms
10.5 Evidence of weakness of general explanations of the HC development
10.6 The persuasive influence of Brazilian national conditions
10.7 Brazilian HC-oriented firms in perspective

Appendix A: Questions for guiding interviews

Bibliography
List of Exhibits

1.1 HCMS: A firms level outline
2.1 Number of persons formally interviewed
2.2 Four paradigms for the analysis of social theory
4.1 The shaping of manufacturing engineering systems
4.2 Manufacturing Engineering systems: a configurational processual approach
4.3 Comparison between ideal types of HC workgroups and non-HC workgroups
4.4 Technological manufacturing configuration model
4.5 Organisational manufacturing configuration model
4.6 Strategic congruence between technological, organisational and product-market configurations
5.1 HC concepts: the macro contextual view
5.2 World ranking of countries in terms of industrial activity
5.3 Classification of competitive and non-competitive industrial sectors
6.1 General features of researched firms
6.2 Firms output profile
7.1 The extent of horizontal cellularisation
7.2 Product customisation feasibility
7.3 Horizontal cellularisation and product customisation feasibility
7.4 Cell development stages
7.5 Horizontal cellularisation extent and cell type
7.6 Horizontal cellularisation extent and batch size
8.1a Key manufacturing organisational dimensions: A non-HC approach
8.1b Key manufacturing organisational dimensions: A HC approach
8.2 Manufacturing organisational structure index
8.3 Production order system index
8.4 Means of production control index
8.5 Responsibility for output index
8.6 Cell work organisation index
8.7 Detail scheduling index
8.8 Production follow up index
8.9 Direct manufacturing indicators
8.10a Direct manufacturing indicators: tayloristic types
8.10b Direct manufacturing indicators: low level of human-centredness
8.10c Direct manufacturing indicators: medium/high levels of human-centredness
8.11 Indirect manufacturing indicators
8.12a Indirect manufacturing indicators: tayloristic types
8.12b Indirect manufacturing indicators: low level of human-centredness
8.12c Indirect manufacturing indicators: medium/high levels of human-centredness
8.13 Organisational integration index
8.14 Hierarchical level index
8.15 Wider organisation structure index
8.16 Skill level index: empirical data
8.17 Reward system index
8.18 Reward system index: empirical data
8.19 Career path index
8.20 Career path index: empirical data
8.21 Training index
8.22 Participation index
8.23a Participation index-1: empirical data
8.23b Participation index-2: empirical data
8.23c Participation index: empirical data
8.24 Wider organisation structure indicators: Empirical Data
8.25 Wider organisational structure indicators: an aggregate examination
8.26 HC oriented firms at each indicator group
9.1 Comparative organisational strategies at shopfloor level
9.2 Comparative organisational strategies at firm level
9.3 Firms vertical restructuring: empirical data
9.4 Human centredness: inter-firm comparison
9.5 Human-centred oriented firm
9.6 Tayloristic oriented firms
9.7 Neo-tayloristic oriented firms
9.8 General design orientations and productivity levels
9.9 Product and market matrix
9.10 Product-market design profiles strategies
9.11 Product and market strategies: empirical evidence
10.1 General design orientation and the firms' features
10.2 General design orientation and production scale
10.3 General design orientation and production scope
10.4 General design orientation and product customisation feasibility
### Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMT</td>
<td>Advanced manufacturing technology</td>
</tr>
<tr>
<td>APS</td>
<td>Anthropocentric production systems</td>
</tr>
<tr>
<td>BRITE</td>
<td>Basic research in industrial technologies for Europe</td>
</tr>
<tr>
<td>CAD</td>
<td>Computed-aided design</td>
</tr>
<tr>
<td>CAM</td>
<td>Computer-aided manufacturing</td>
</tr>
<tr>
<td>CIM</td>
<td>Computer integrated manufacturing</td>
</tr>
<tr>
<td>CLP</td>
<td>Capitalistic labour process</td>
</tr>
<tr>
<td>CNC</td>
<td>Computer numerical control</td>
</tr>
<tr>
<td>CPU</td>
<td>Central process unit</td>
</tr>
<tr>
<td>DQP</td>
<td>Diversified quality production</td>
</tr>
<tr>
<td>ESPRIT</td>
<td>European strategic program for research and development in information technology</td>
</tr>
<tr>
<td>EURAM</td>
<td>European research for advanced materials</td>
</tr>
<tr>
<td>HC</td>
<td>Human-centred</td>
</tr>
<tr>
<td>HCMS</td>
<td>Human-centred manufacturing systems</td>
</tr>
<tr>
<td>IBGE</td>
<td>Instituto Brasileiro de geografia e estatistica</td>
</tr>
<tr>
<td>FAST</td>
<td>Forecasting and assessment in Science and Technology</td>
</tr>
<tr>
<td>FDI</td>
<td>Foreign direct investment</td>
</tr>
<tr>
<td>FMS</td>
<td>Flexible manufacturing system</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross domestic product</td>
</tr>
<tr>
<td>GNP</td>
<td>Gross national product</td>
</tr>
<tr>
<td>GT</td>
<td>Group technology</td>
</tr>
<tr>
<td>ITC</td>
<td>Indigenous technological capability</td>
</tr>
<tr>
<td>ISI</td>
<td>Import substitution industrialisation</td>
</tr>
<tr>
<td>JIT</td>
<td>Just-in-time</td>
</tr>
<tr>
<td>MES</td>
<td>Manufacturing engineering systems</td>
</tr>
<tr>
<td>MNC</td>
<td>Multinational companies</td>
</tr>
<tr>
<td>NC</td>
<td>Numerical control</td>
</tr>
<tr>
<td>NCMT</td>
<td>Numerical control machine tool</td>
</tr>
<tr>
<td>NIC</td>
<td>Newly industrialised country</td>
</tr>
<tr>
<td>NPC</td>
<td>New production concepts</td>
</tr>
<tr>
<td>NSI</td>
<td>National systems of innovation</td>
</tr>
<tr>
<td>OEM</td>
<td>Original equipment manufacturer</td>
</tr>
<tr>
<td>PCF</td>
<td>Product customisation feasibility</td>
</tr>
<tr>
<td>PPC</td>
<td>Production planning and control</td>
</tr>
<tr>
<td>R &amp; D</td>
<td>Research and development</td>
</tr>
<tr>
<td>SBIC</td>
<td>Study of the Brazilian industrial competitiveness</td>
</tr>
<tr>
<td>SENAI</td>
<td>Servico nacional de aprendizado industrial</td>
</tr>
<tr>
<td>SOE</td>
<td>State-owned enterprise</td>
</tr>
<tr>
<td>SPC</td>
<td>Statistical process control</td>
</tr>
<tr>
<td>STS</td>
<td>Science, Technology and Society</td>
</tr>
<tr>
<td>S &amp; T</td>
<td>Science and technology</td>
</tr>
<tr>
<td>TNC</td>
<td>Transnational companies</td>
</tr>
<tr>
<td>TQM</td>
<td>Total quality management</td>
</tr>
<tr>
<td>TU</td>
<td>Trade union</td>
</tr>
<tr>
<td>UMIST</td>
<td>University of Manchester institute of science and technology</td>
</tr>
<tr>
<td>WIP</td>
<td>Work in-process</td>
</tr>
</tbody>
</table>