Interpreting the Emergence and Development of High Technology Electronics Industry Clusters in Selected Second Tier Global Regions

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Abstract

The thesis focuses on the high technology electronics industry and why and how electronics manufacturing firms emerged, developed and evolved endogenously into dense industry clusters in a limited number of selected, small and relatively isolated second tier cities. These developments occurred in small regions rather than in large established industrial centres. The high technology electronics industry typically produces small volumes of highly complex, high value-added, customisable, intellectual property-based products and systems for commercial, industrial and professional applications in sectors including food, health, security, transport, government, communications, manufacturing, defence, education and research.

The high technology electronics industry developed in parallel to the large, typically multinational firms, which mass-produce high volumes of standardised consumer electronics products for personal communication, information and entertainment. The parallel development of these two sectors provides significant contrast since the high technology electronics industry, although significantly larger in revenue and employment than the consumer electronics sector, is less understood by governments and communities.

The research examines the widely studied high technology electronics industry in Silicon Valley, California; Cambridge, UK and Austin, Texas, that by incorporating technologies developed in their universities the industry emerged and evolved over decades into dense, interconnected regional clusters of typically smaller firms and related organisations. Knowledge obtained from these exemplar clusters assists the understanding of the origin and development of high technology electronics clusters in the second tier regions of Adelaide and Christchurch. The thesis analyses and quantifies these antipodean electronics industry clusters and adds to the growing literature describing the endogenous emergence and self-organised development of technology-based firms into clusters in small and relatively remote second-tier cities and without the involvement of universities. Endogenous cluster development is contrasted with electronics industry clusters created by government programs in selected regions.

The contribution to knowledge is consistent with and builds on the work of Porter (1990b) and Mayer (2011). The thesis recognises that a stimulus other than universities occurred in Adelaide through the establishment in 1947 of Australia’s defence research and development laboratories and in Christchurch through the 1954 start-up of a two-way radio manufacturing firm. Through spin-outs and start-ups the electronics clusters in these two second tier cities have reached the highest density in their respective nations, comparing favourably with the leading global electronics industry clusters.

The thesis recognises that in small cities proximity to industry peers facilitates trust and collaboration, and that ethical and reliable behaviour of cluster members is essential in these close-knit communities. The thesis provides case studies of firm and cluster origin and development with cross-regional data comparisons and regional location quotients. Australian statistics on location quotients are not published for the electronics industry and Australian governments generally appear to be unaware of the economic value of the high technology electronics manufacturing industry.

With knowledge of electronics industry origin and cluster development government and industry can develop policies and programs for its sustainable development and its major role in the transition of the regional economy of Adelaide from its past dependence on industrial-age manufacturing to its future through knowledge-age industry.
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List of Abbreviations

ABS Australian Bureau of Statistics
AEEMA Australian Electrical and Electronics Manufacturers Association
ANZSIC Australian and New Zealand Standard Industry Classification
ATI Austin Technology Incubator
AWA Amalgamated Wireless (Australasia) Ltd
CAGR Compound Annual Growth Rate
CEO Chief Executive Officer
CIC Cambridge Instrument Company Ltd
CSI Cambridge Scientific Instruments
CSIRO Commonwealth Scientific and Industrial Research Organisation
CTT Canada’s Technology Triangle
DEC Digital Equipment Corporation
DETE Department of Enterprise, Trade & Employment, Ireland
DME Distance Measuring Equipment
DSTO Defence Science and Technology Organisation
EASA Electronics Association of South Australia
EIAA Electronics Industry Action Agenda
EIA Electronics Industry Association
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>FDI</td>
<td>Foreign Direct Investment</td>
</tr>
<tr>
<td>FTC</td>
<td>Federal Telegraph Company</td>
</tr>
<tr>
<td>Forfás</td>
<td>Board for Enterprise, Trade, Science, Technology and Innovation</td>
</tr>
<tr>
<td>GACC</td>
<td>Greater Austin Chamber of Commerce</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GERD</td>
<td>Gross Expenditure on Research and Development</td>
</tr>
<tr>
<td>GFC</td>
<td>Global Financial Crisis</td>
</tr>
<tr>
<td>GOVERD</td>
<td>Government expenditure on research and development</td>
</tr>
<tr>
<td>GSP</td>
<td>Gross State Product</td>
</tr>
<tr>
<td>HETI</td>
<td>High Technology Electronics Industry</td>
</tr>
<tr>
<td>HTO</td>
<td>High Technology Organisation</td>
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<tr>
<td>IC</td>
<td>Integrated Circuit</td>
</tr>
<tr>
<td>IC²</td>
<td>Institute for Innovation, Creativity and Capital, University of Texas at Austin</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communications Technology</td>
</tr>
<tr>
<td>IDA</td>
<td>Irish Development Authority</td>
</tr>
<tr>
<td>ILS</td>
<td>Instrument Landing Systems</td>
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<tr>
<td>IT</td>
<td>Information Technology</td>
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<tr>
<td>IP</td>
<td>Intellectual Property</td>
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<tr>
<td>IPO</td>
<td>Initial Public Offering</td>
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<tr>
<td>JVSV</td>
<td>Joint Venture Silicon Valley,</td>
</tr>
<tr>
<td>LFR</td>
<td>Less Favoured Region</td>
</tr>
<tr>
<td>LIS</td>
<td>Local Innovation System</td>
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<tr>
<td>LQ</td>
<td>Location Quotient</td>
</tr>
<tr>
<td>LRWE</td>
<td>Long Range Weapons Establishment</td>
</tr>
<tr>
<td>MCC</td>
<td>Microelectronics and Computer Technology Corporation - Austin, Texas</td>
</tr>
<tr>
<td>METI</td>
<td>Ministry of Economy, Trade and Industry, Japan</td>
</tr>
<tr>
<td>MIT</td>
<td>Massachusetts Institute of Technology</td>
</tr>
<tr>
<td>MITI</td>
<td>Ministry of International Trade and Industry, Japan</td>
</tr>
<tr>
<td>MNC</td>
<td>Multi-national Company</td>
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<tr>
<td>MSA</td>
<td>Metropolitan Statistical Area (USA)</td>
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<tr>
<td>MSTC</td>
<td>Master of Science in Technology Commercialization (Adelaide and Austin)</td>
</tr>
<tr>
<td>NAICS</td>
<td>North American Industry Classification System</td>
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<td>NIS</td>
<td>National Innovation System</td>
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<tr>
<td>Acronym</td>
<td>Full Form</td>
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<tr>
<td>NOMIS</td>
<td>National Online Manpower Information System</td>
</tr>
<tr>
<td>NTB</td>
<td>New Technology Based [Firms]</td>
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<tr>
<td>RIS</td>
<td>Regional Innovation System</td>
</tr>
<tr>
<td>SIC</td>
<td>Standard Industrial Classification (UK)</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
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<tr>
<td>SME</td>
<td>Small and Medium Enterprises</td>
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<tr>
<td>SRI</td>
<td>Stanford Research Institute (Palo Alto)</td>
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<tr>
<td>STC</td>
<td>Second Tier City</td>
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<tr>
<td>TNC</td>
<td>Transnational corporation</td>
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<tr>
<td>TIA</td>
<td>Technology Industry Association</td>
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<td>UK</td>
<td>United Kingdom</td>
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<td>UN</td>
<td>United Nations</td>
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<td>USA</td>
<td>United States of America</td>
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<td>UT</td>
<td>University of Texas</td>
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<tr>
<td>VC</td>
<td>Venture Capital</td>
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<tr>
<td>WIGO</td>
<td>What is Going On</td>
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<tr>
<td>WRE</td>
<td>Weapons Research Establishment</td>
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</table>
Research Plan Diagram

Interpreting the Emergence and Development of High Technology Electronics Industry Clusters in Selected Second Tier Global Regions

Chapter 1. Introduction

* Emergence, Why?
* Development, How?
* Variations, Where?

Chapter 2. Literature Review

* Industry origin
* Cluster development
* Cluster types/attributes
* Knowledge-Age
* Location
* Regions
* Second Tier Cities
* National, Regional, Local Innovation Systems
* Triple Helix
* Government/Institutions/Individuals
* Proximity and Isolation
* Untraded Interdependencies
* HTEI Clusters/Entrepreneurship

Chapter 3. Methodology

* Develop and implement pilot survey
* Assessment of pilot survey results
* Develop and implement major survey
* Develop and produce case studies

Chapter 4. Research Findings and Discussion

* Analysis of survey results and identification of key themes
* Evaluation of the emergence of electronics clusters by two distinct processes over two widely separated time periods
* Case studies on the growth of selected electronics clusters
* Provide data for industry program and policy development

Chapter 5. Conclusion and Research Directions

* Addressing the aim and the research questions
* Contribution to knowledge and policy implications
* Further suggested research directions
Declaration by Candidate

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name, in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name, for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

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