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National Intellectual Capital:

Examining the implications of intellectual capital elements in national and innovation system model context through a comparative study of Finland, Singapore and Malaysia

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Our evolving knowledge landscape

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ABSTRACT

This paper seeks to examine the relationship between intellectual capital (IC) elements – human capital, market capital, process capital and renewal capital – and innovation system models (ISMs), on a national level, to determine if specific IC elements have a higher degree of influence in supporting economic competitiveness, and if both IC and ISM mutually influence and reinforce one another. Through a detailed analysis of three countries – Finland, Singapore and Malaysia – with each representing a type of ISM, we find that each IC element has differing effects on economic competitiveness. Further, we find that there exists a common initial adoption of the focused factory ISM, and the presence of a virtuous cycle linking subsequent IC development with ISM adoption. Our study also highlights the importance and influence of contextual differences between nations on IC profiles and development, with the need to consider "necessary conditions" for success in achieving national strategic intent and economic competitiveness through the chosen ISM adoption at each stage of IC and economic development.

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KEY WORDS	Intellectual capital, innovation system model, Finland, Singapore, Malaysia
PURPOSE	The aim of this paper is to examine the relationship between intellectual capital (IC) elements and innovation system models (ISMs), on a national level, to determine if specific IC elements have a higher degree of influence in supporting economic competitiveness, and if both IC and ISM mutually influence and reinforce one another.
METHODOLOGY	This study compares the national IC of Finland, Singapore and Malaysia using the NICM model. We utilise weighted and time-based analysis, correlation analysis, and documentary analysis.
THEORECTICAL PERSPECTIVES	This paper adopts the theoretical perspective of national IC comprising of the key dimensions of human capital, process capital, market capital and renewal capital, as well as the presence of national ISMs comprising of brute force, focused factory, Hollyworld and large-scale ecosystem.
EMPIRICAL FOUNDATION	29 indicators through the use of longitudinal data spanning 14 years, from 1995 to 2008, for Finland, Malaysia and Singapore, supplemented with qualitative data from business press, research journals and various other sources.
CONCLUSIONS	Certain IC elements have a higher level of influence on economic competitiveness in the specific national context. The focused factory ISM is the common starting point for Finland, Singapore and Malaysia, albeit with initial adoption due to economic factors rather than IC awareness. Subsequent ISM adoption is influenced by contextual conditions and the IC-ISM process is reiterative, leading the countries to possess unique IC profiles that in turn require unique policies for their future.

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1 Introduction

This introductory chapter presents the motives behind the choice of research topic, leading up to explaining the purpose of this paper. It will then be rounded up with a discussion on the paper's delimitations and disposition.

In his 1997 National Day rally speech, then Singaporean Prime Minister Goh Chok Tong said, "Talent makes all the difference. To be a successful knowledge-based economy, we need **intellectual capital**. In the **information age**, human capital, not physical resources or financial capital, is the key to economic competitiveness and success" (Chuan, 1997) [emphasis added].

In the same year, Dr. Mahathir bin Mohamad, then Prime Minister of Malaysia, said at the opening of Multimedia Asia on Malaysia's Multimedia Super Corridor, "To become a developed country, according to our Vision 2020, we cannot continue with conventional manufacturing industries. We have to move into the **Information Industry**. We need to tap the talents of the whole world in order to do this. As in the past, those who respond to our invitation to invest in Malaysia will reap a rich return" (Mahathir, 1997) [emphasis added].

About a decade later, in 2006, Finnish Prime Minster Matti Vanhanen said in a speech held at the London School of Economics, "At the beginning of the Finnish EU Presidency, I was asked to sum up our three most important priorities. My answer was **innovation, innovation and innovation**" (Vanhanen, 2006) [emphasis added].

All of the three examples above have something in common – the importance of harnessing information, intellectual capital and innovation, as key to national economic sustainability and superiority. The question is, is the "key" to unlock potential and success identical for all nations? If so, why is it that Singapore and Malaysia, two countries which come from the same cultural and historical roots, can have such different outcomes to economic and intellectual capital development? Does this then hint to a unique "padlock" for each nation, which in turn requires its own unique "key"?

1.1 Background

Strategy guru, Michael Porter, writes in *The Competitive Advantage of Nations* that "the enduring competitive advantages in a global economy lie increasingly in local things –

knowledge, relationships, motivation – that distant rivals cannot match." The importance of differentiation and standing out in the global arena is further articulated in PricewaterhouseCoopers (2005)'s groundbreaking report *Cities of the Future*, which puts forth that cities can and need to develop Unique Selling / Strategic Points (USPs) to attract the desired kind of investment and talent (see Appendix A for the list of USPs). Some of these USPs, particularly those relating to culture, history and values, may not be easily duplicable and can thus be strong differentiating factors. However, most others, relating to knowledge management, architecture, mindsets, processes, can be developed by almost any nation, albeit with conscious effort and strategic focus.

In particular, knowledge is increasingly levelling the playing field between the "haves" and "have-nots" and is enabling all nations – both developing and industrialised – to envisage modern management policies and practices (Amidon, 2003). It is the one resource that not only does not get depleted, but instead increases with use (Amidon, 2003). Indeed, knowledge – often defined in terms of intellectual capital (IC) – is the source of new economic wealth (Steward, 1997; Amidon, 2003) and is the basis for future earning capabilities (Edvinsson and Malone, 1997). Given IC's oft-recognised dynamic nature, it may provide nations, in place of USPs, with "strange attractors", a dynamic type of equilibrium which represents a path on which a system moves from situation to situation without ever settling down into stagnation (Abarim Publications, 2010). In today's fast-evolving world, this non-linear approach to strategic investment may become key in helping nations stay ahead.

IC, like all other resources and assets, does not exist in a vacuum, but must be put in context in explaining and understanding its value, and thus how to optimise it. Amidon (2003) portrays IC as part of the Knowledge Value Proposition (Figure 1.1), and suggests that any management system requires striking a balance between the three aspects of economics, behaviour, and technology. IC, in this setting, is performance economics, and focuses on its measurement and monitoring to drive and incentivise the right behaviour for increased performance.

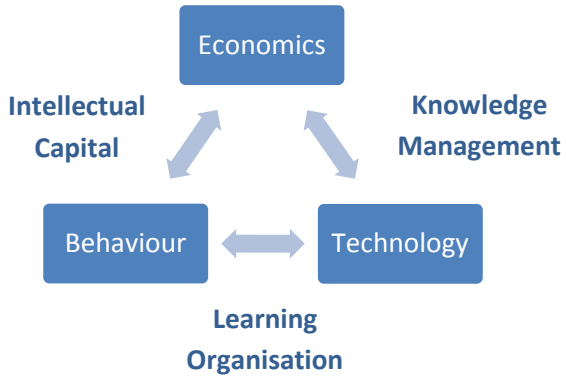


Figure 1.1: Knowledge Value Proposition (Amidon, 2003)

PricewaterhouseCoopers (2005) lists IC as one of the capitals that countries must recognise and manage as part of their strategic agenda (Figure 1.2), and further breaks down IC into its main components of human capital and organisational (or structural) capital, and its subcomponents of social capital, innovation (or renewal) capital, and process capital. Human capital speaks to the value, knowledge and know-how embedded in a country's people – its leaders, citizens, and employees. Organisational capital is what remains when everyone has gone home, i.e. the structures and principles that support everyday life (Edvinsson and Bounfour, 2005).

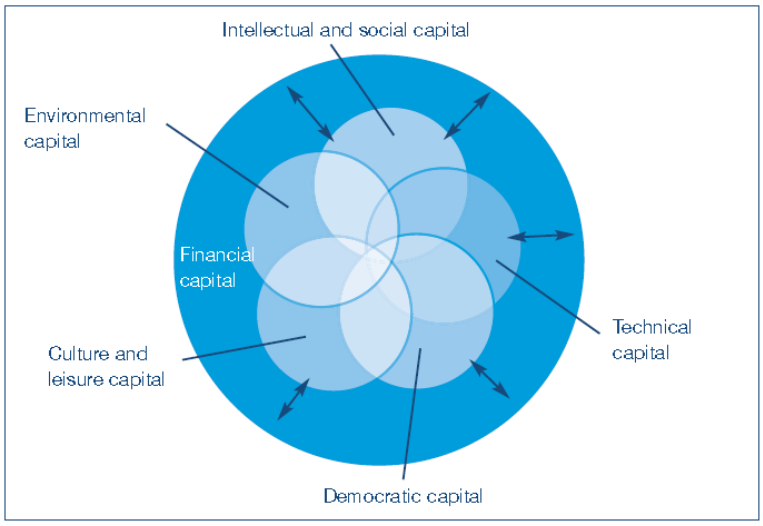


Figure 1.2: Integrating capitals (PricewaterhouseCoopers, 2005)

As such, while IC is not the sole capital of importance, it is one of increasing importance and influence in a nation's competitive advantage. In fact, Edvinsson and Malone (1997) believed that cities, and by extension countries, fail, not because they deviated from the recipe that had led them to success thus far, but rather, because they clung onto it while the rest of the world changed. Accordingly, countries must pay attention not just to tangible factors based on current measurements of success such as its gross domestic product (GDP), GDP per capita and annual growth rate, but to intangible elements that may defy current valuation. Indeed, the ability to generate value in the past is no longer the sole determinant of a nation's wealth, but the nation's potential to create value in the future, its renewal and development factors, and henceforth its IC, are becoming the bases for such forward-looking value creation.

Bontis (2004) defines the IC of a nation as the source of a nation's wealth creation, coming from the current and potential values of its citizens, corporations, institutions, societies and regions. These hidden values are the "roots for nourishment and the cultivation of future well-being". Bontis then calls for a "mapping system to describe the IC of nations and to systematically account and follow the evolution of such IC development". Malhotra (2001) argues that the leaders of national economies are trying to find reliable ways for measuring knowledge assets, and to understand how they relate to future performance of a nation. A system of variables for IC, once established, could help the policy makers in uncover the

intangible resources, their potential, and the way to better manage these resources to enable the future success of their economies.

1.2 Problem discussion

While now we can see why national IC and innovation is important, the key question is how countries can make informed decisions regarding which specific IC areas to strategically invest in. These areas should be most closely tied to national wealth for the particular country's context and economic development.

As such, this paper aims to contribute one more compass to navigate the national IC knowledge landscape with, by attempting to integrate the previously mentioned articles in a way that may aid and assist nations in strategic IC investment. While Lin and Edvinsson (2008) provide a good framework for national IC evaluation, in addition to the weighted and time-based analysis that formed the basis of their study, we will attempt to apply Ståhle and Bounfour (2008)'s correlation analysis on Lin and Edvinsson (2008)'s IC elements and indicators to determine the impact of these commonly recognised IC elements on national FC in the light of their national context. A point of departure from a pure application of Ståhle and Bounfour (2008)'s methodology is in the data – as Lin and Edvinsson (2008) uses ranked data on a scale of 1-10, correlation analysis between IC and FC will aid in determining IC competitiveness vis-à-vis other nation's performance, as opposed to Ståhle and Bounfour's use of absolute values in determining IC performance and drivers towards economic prosperity. While Lin and Edvinsson (2008) have also focused much of their discussion on top Scandinavian performers in IC, we hope to provide insight from an Asian perspective, into why Singapore, an Asian country, is also among the top ten, and why Malaysia, a close neighbour and culturally similar to Singapore, is presenting different IC results, which may help highlight how cultural and social factors can affect the journey in reaching the destination of enhanced national IC. Through using the examples of Finland, Malaysia and Singapore, each representing an innovation system model (ISM), we further aim to help illustrate how countries should adopt certain ISMs to further their specific national IC agenda, by showing if a fit exists between country and ISM, and if there are observed conditions that need to be present for the ISM to be effective.

1.3 Problem formulation

The main question this paper would like to address is thus this – how are IC elements affecting and affected by each nation's unique context and use of ISM? Answering this question may well aid nations in making specific, targeted, effective and worthwhile investments resulting in the nation's desired level of return.

1.4 Purpose

Accordingly, this paper purposes to examine the relationship between the most commonly recognised IC elements of human capital, process capital, market capital, and renewal capital that Lin and Edvinsson (2008) used to measure and rank national IC, the ISMs Kao (2009) puts forth, and the country's specific context to determine if:

1) specific IC elements play a more important influencing role on national wealth in terms of economic competitiveness depending on the nation's context and economic development; and
2) there is an impact on the presence of IC elements in the choice of ISM, and in turn an influence of the chosen innovation system on each IC element's development.

This paper hypothesizes that a virtuous expansionary cycle exists, where the adoption of ISM influences the development of certain IC elements over others, changing the country's IC profile, which then requires the adoption of a different ISM to further IC growth, all within the country's specific context (Figure 1.3). Implicit in this hypothesis is the assumption that ISMs may mark and indicate different stages of IC development and maturity.

Further, while Ståhle and Bounfour (2008) considers stages of economic development as differentiating factors, this study also considers other non-economic factors that may affect IC element influence, through the use of case studies on the three countries of Finland, Singapore and Malaysia.

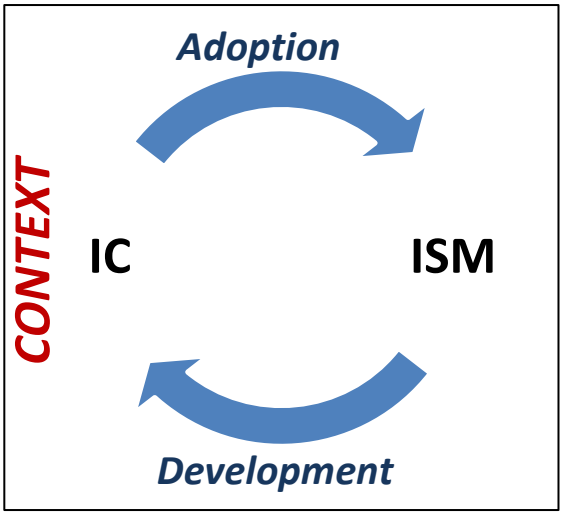


Figure 1.3: Visualising the IC-ISM reiterative process

1.5 Delimitations

This thesis will limit its study to IC, while touching only briefly on other types of national capitals where relevant. It will also confine its analysis to the three chosen case countries of Finland, Singapore and Malaysia.

1.6 Thesis outline

Chapter two provides the theoretical framework for national IC and ISMs on which this paper is based on.

Chapter three explains the methodology and data adopted by this paper, and will include a description of research approach, research methods and research process. It ends with a discussion on potential methodological problems in terms of validity, reliability and transmittability, and how they are addressed in the thesis.

Chapter four puts forth the empirical findings and corresponding weighted, time-based and correlation analyses based on the IC elements.

Chapter five delves deeper into the quantitative findings from chapter four, and relates them to documentary analyses for the three nations of our study.

Chapter six integrates the findings from all analyses together in a composite summary, and provides insights into the three countries' futures.

Chapter seven concludes this thesis with a summary of key insights, and proposes areas for further research.

1.7 Audience

Our study is targeted towards all interested in the field of IC, particularly the role of IC in national development. We also hope that this paper will provide governments and practitioners with a better understanding of the role in IC in today's knowledge economy, and beyond.

2 Theory

The following second chapter presents the theoretical context to this paper, which is three-fold – firstly, concepts behind national IC elements are explained, including the national IC perspective that this paper has chosen to adopt; secondly, the implications of context and interdependencies is described; thirdly, the ISM framework is delved into.

2.1 IC elements – Human, Market, Process, Renewal

IC is a developing field, where the distinction of IC, the components of IC, and its measurements are constantly developed, fine-tuned and updated to reflect current conditions and future trends in the knowledge arena. For the purpose of measurement, different researchers from various backgrounds have proposed different models in assessing IC at organisational and national levels. Among these models introduced for IC measurement at organisational level are:

- Skandia Navigator (Edvinsson and Malone 1997), which contains five areas of focus, i.e. (1) financial, (2) customer, (3) process, (4) renewal and development, and (5) human capital;
- Technology Broker (Annie Brooking 1996), based on benchlearning from Edvinsson, which focuses on market assets, human-centred assets, intellectual property (IP) assets and infrastructure assets; and
- Intangible Asset Monitor (Sveiby, 1997), which propose measurements of (1) growth and renewal (i.e. change), (2) efficiency and (3) stability, for each of three intangible assets of an organisation, i.e. external structure, internal structure and individual competence.

As highlighted by Lin and Edvinsson (2008), several world development organisations have proposed models for national IC measurement purposes. These models include the Knowledge Assessment Methodology (KAM) introduced by World Bank; the OCED Measurement Model; and the United Nations Economic Commission for Europe Model (ECE).

This paper adopts the IC of Nations Model modified by Bontis (2004) based on IC model proposed by Edvinsson and Malone (1997), and the National Intellectual Capital Measurement (NICM) model used by Lin and Edvinsson (2008), which is based on the most commonly used and recognised IC framework – human capital, market capital, process capital and renewal capital – and proposes a moderate set of national IC indices that is currently valid and can be

easily replicated for follow-up studies. The NICM model defines national wealth as an aggregation of financial wealth and IC of a nation. However, we consider that the wealth of a nation is not limited to financial wealth and IC, but also includes other capitals such as culture and leisure capital, democratic capital, social capital, technical capital and environmental capital, as highlighted by PricewaterhouseCoopers (2005). For the purpose of this paper, the study will focus on the IC branch of the national wealth, highlighted in blue in Figure 2.1.

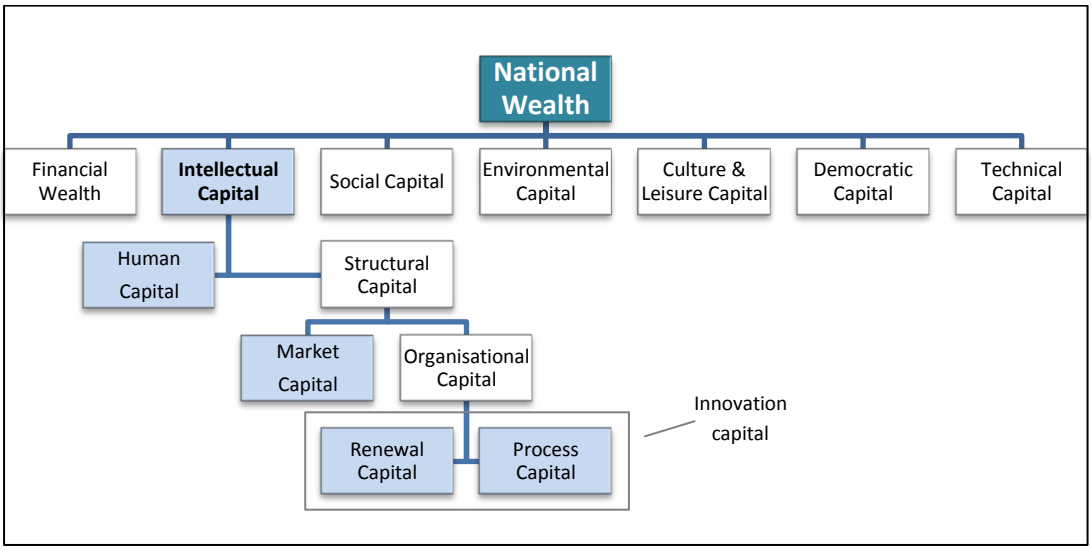


Figure 2.1: National Wealth Model, modified based on Bontis (2004), Edvinsson and Malone (1997), and PricewaterhouseCoopers (2005)

As per Lin and Edvinsson (2008), national financial wealth, or its financial capital (FC), represents the output dimension of the Input-Process-Output theory (with IC being the input), and is measured by Lin and Edvinsson (2008) using a single variable (GDP per capita adjusted by purchasing power parity).

The four IC elements of human capital, market capital, process capital and renewal capital, and the respective indicators used in their measurement, are described in the following section.

2.1.1 Human Capital (HC)

Recent theories of economic growth emphasise the role of HC as a prerequisite for economic growth processes (Krugman, 1991; Barro & Sala-i-Martin, 1995). According to Ritsila and Haapanen (2003), the know-how of population acts as a non-material input for goods and services producers, research and education institutes, trade organisations and local services. Bontis (2004) writes that the HC of a nation begins with the intellectual wealth of its citizens and refers to the knowledge, education, and competencies of individuals in realising national

tasks and goals. This definition is in line with that of the Organisation for Economic Co-operation and Development (OECD, 2001), which defines HC as the "knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being". According to the OECD (2001), HC is developed in specific cultural settings, and includes:

- acquired cognitive skills and explicit knowledge; and
- non-cognitive skills and other attributes which contribute to well-being and which can be influenced and changed by the external environment, for example through learning.

HC is developed via learning, education and training, and is thus consequently developed in the following context (OECD, 2001):

- Learning, within family and early childcare settings;
- Formal education and training including early childhood, school-based compulsory education, post-compulsory vocational or general education, tertiary education, public labour market training, adult education, etc;
- Workplace training as well as informed learning at work through specific activities such as research and innovation or participation in various professional networks; and
- Informal learning "on-the-job" and in daily living and civic participation.

In line with the above definition, Lin and Edvinsson (2008) measure HC by evaluating the nation's availability of skilled labour, degree of employee training, rate of literacy, level of enrolment in institutions of higher education, pupil-teacher ratio, number of Internet subscribers, and amount of public expenditure on education.

2.1.2 Market Capital (MC)

MC refers to the value embedded in a nation's intra- and inter-relationships, and refers to the social intelligence created by elements such as laws, market institutions and social networks (Bontis, 2004). It represents a country's capabilities in providing attractive and competitive solutions to its international clients, and a country's image in the eyes of its "suppliers" and "customers".

MC is measured by Lin and Edvinsson (2008) via each country's corporate tax's encouragement of entrepreneurship, ease of entering cross-border ventures, openness to

foreign cultures, degree of globalisation, transparency of government policy, the image that the country projects abroad, and the country's exports.

2.1.3 Process Capital (PC)

PC represents a nation's assets which support the sharing, exchange, and transformation of knowledge from human capital to structural capital (Bontis, 2004). Bontis explains these assets as non-human knowledge storehouses ingrained in a nation's information and communication technology (ICT) systems as represented by its software, hardware, laboratories, databases and such organisational structures which externalise and sustain the output of HC.

Lin and Edvinsson (2008) measure PC by evaluating the fairness of a nation's business competition environment, the efficiency of its government, its IP rights protection, the availability of capital, the number of computers per capita, the ease with which new firms can be established, and the number of mobile phone subscribers.

2.1.4 Renewal Capital (RC)

RC represents a nation's future intellectual wealth, which includes its investments and capabilities in renewal and development for sustaining competitive advantage and economic growth (Bontis, 2004). Research and development (R&D) is a key parameter in renewal capital, and this arises out of the direct relationship between the success of a country's financial systems and the effectiveness of its R&D sector. Successful R&D investment not only fuel the nation's financial strength on its balance sheet, but can also increase the efficiency of its population as a whole (Bontis, 2004).

Lin and Edvinsson (2008) measure RC through business R&D spending, basic research, R&D spending as a percentage of GDP, number of R&D researchers, level of cooperation between universities and enterprises, number of scientific articles published, and number of patents granted and recorded in both the United States Patent and Trademark Office (USPTO) and the European Patent Office (EPO).

The indicators used to evaluate national HC, MC, PC and RC, as adopted from Lin and Edvinsson (2008), are presented in Table 2.2 and will be used as the basis for our study.

Human capital (HC) index	Market capital (MC) index
1. Skilled labour*	1. Corporate tax*
2. Employee training*	2. Cross-border venture*
3. Literacy rate	3. Openness of culture*
4. Higher education enrolment	4. Globalisation*
5. Pupil-teacher ratio	5. Transparency*
6. Internet subscribers	6. Image of country*
7. Public expenditure on education	7. Exports of goods
Process capital (PC) index	**Renewal capital (RC) index**
1. Business competition environment*	1. Business R&D spending
2. Government efficiency*	2. Basic research*
3. Intellectual property (IP) rights protection*	3. R&D spending/GDP
4. Capital availability*	4. R&D researchers
5. Computers in use per capita	5. Cooperation between universities and enterprises*
6. Convenience of establishing new firms*	6. Scientific articles
7. Mobile phone subscribers	7. Patents per capita (USPTO + EPO)

Table 2.2: Variables in each type of IC (Lin & Edvinsson, 2008; Lin & Edvinsson, 2010)

Remarks:

Financial capital (FC) is the logarithm of GDP per capita adjusted by purchasing power parity.
Variables marked with an asterisk are rated qualitatively using a scale of 1–10.
Definitions for the indicators are in Appendix B.

2.2 Implications of context & interdependencies

Ståhle and Bounfour (2008) provide contextual analysis to national IC measurement and evaluation, and emphasise that different elements of IC play different roles in different contexts. They performed an examination of the correlation of IC indicator levels / growth trends to gross national product (GNP) growth levels / trends for countries grouped into three categories of economic development –

(1) Developed economies (possessing high infrastructure and IC);

(2) Transitional economies (possessing elements of both high and low infrastructure and IC); and

(3) Developing economies (possessing low infrastructure and IC).

Their findings highlight that different IC elements produce different levels of sustaining effects, boosting effects, linear growth effects and exponential growth effects on national financial

wealth, depending on the country's stage of economic development. For instance, developed economies generally possess a high level of computer usage, and this IC indicator hence has significant sustaining effects to GDP growth, but limited boosting effects due to the reaching of saturation levels, hence limiting further growth in the area. This is contrasted with developing or transitional economies, which are likely to experience significant boosting effects to national economic growth by simply raising levels of computer usage within their countries.

Ståhle and Bounfour (2008) also recognised the dynamics between the IC elements themselves, with their connections described as "nonlinear and tediously complex" and notoriously difficult to capture within a single formula. This diversity and dynamic interdependencies of the IC elements cannot be ignored if one wished to obtain reliable results. Accordingly, they recommend utilising multi-dimensional analysis of individual IC elements to provide a higher degree of reliable information.

2.3 Innovation system models (ISMs)

Linked to the idea of context influencing IC development and its effective use is the concept of "innovation hot spots", which John Kao introduces in this article *Tapping the World's Innovation Hot Spots* (2009). In his article, he provides examples of cities and regions he deems as the world's innovation hot spots, as a way for companies to position themselves in and across the geographical areas that best fit with their own strategic missions, based on innovation characteristics specific to each area.

2.3.1 Definition – "What is a hot spot?"

The Merriam-Webster Dictionary defines a hot spot as "a place of more than usual interest, activity, or popularity." The Compact Oxford English Dictionary explains a hot spot as:

- a small area with a relatively high temperature.
- a place of significant activity or danger.

Accordingly, an innovation hot spot can be defined as an area or place where exceptional and significant innovation interest, activity, and popularity exist. It is a place whose citizens, leaders and organisations are energised by and into translating knowledge into action in the

form of products, services, or initiatives, the definition of innovation itself (Amidon, 2003). It is an area popular with like-minded individuals and organisations who believe in looking forward, in leveraging and developing existing knowledge (reusing) and in innovating and renewing IC (reinventing).

Kao (2009) classifies such hot spots into four main ISMs – brute force, focused factory, Hollyworld, and large-scale ecosystem.

2.3.2 The four ISMs

2.3.2.1 Model 1: Brute force

In cryptography, a brute force attack consists of attempting to break the encryption by trying every possible combination, code or password until the right one is found. In programming, brute force cracking involves using trial and error to decode encrypted data through exhaustive effort rather than employing intellectual strategies. It is often viewed as infallible, albeit time-consuming (SearchSecurity.com, 2006). In a similar vein, the *brute force ISM* involves applying massive amounts of low-cost labour and capital to a range of innovation opportunities, in the hope that the large number of ideas generated from a significant number of talented people will eventually yield valuable discoveries. China and India, the world's two most populous countries with 1.35 billion and 1.18 billion people respectively (Geohive, 2010), are classified under this model. Considering that the third populous country in the world, the United States of America (with a population of 309 million), has but one-third of India's population, China and India may just be the only two countries that qualify to using this model by virtue of their mere population size and consequent ability to apply brute force.

2.3.2.2 Model 2: Focused factory

Unlike the brute force model, which casts a wide net, the *focused factory ISM* concentrates capital, infrastructure and talent on a strategically chosen area of innovation in order to discover and apply new answers to big challenges. Countries under this model, such as Denmark and Singapore, focus their innovation efforts and investments on select industries or research areas. Also unlike the brute force model, the focused factory model can be adopted by most other countries, both emerging and developed economies alike, as long as strategic intent to innovate exists on the nation's agenda, and the country is willing to back it up with the necessary capital and resources.

2.3.2.3 Model 3: Hollyworld

In tribute to the glamorous area of Hollywood in Los Angeles, USA, the one place that never fails to captivate the dreams and desires of aspiring actors and entertainers, the *Hollyworld ISM*, as it is similarly named, also aspires to attract what author Richard Florida describes as the "global creative class". Leveraging on the axiom "like attracts like", the model hinges on what Kao describes as "the increasing returns of cool community" – the more smart and talented entrepreneurs and innovators gather into one place, the more attractive that place becomes to the rest of the global creative class. The pioneer and most famous spokes-region for this model is Silicon Valley, and other cities under the Hollyworld model include Bangalore, Helsinki and Toronto. Singapore is also classified here, with Kao describing it as the place where the focused factory and Hollyworld ISMs meet. This shows the difficulty in clearly delineating between models, and the possibility for regions and nations to adopt aspects from more than one model for their unique needs at the specific season in time.

2.3.2.4 Model 4: Large-scale ecosystem

Princeton University's WordNet defines an ecosystem as "a system formed by the interaction of a community of organisms with their physical environment". The *large-scale ecosystem ISM* thus involves the interaction and collaboration between all stakeholders in the region – government, education and research institutions, funding bodies, business and academic partnerships – in their current knowledge environment, for the support and facilitation of an overall national strategy for innovation. It is a close-knit, and sometimes self-contained system, best exemplified by Finland which sees a strong sense of shared purpose and solid, fluid alliances between government, companies and academia. One wonders, however, whether this model is only suited for small countries like Finland which need to contend less with the coordination and management problems that come with size, and are thus more able to drive through a cohesive strategy at all levels of the nation without compromising on other areas deemed critical by its citizens. For instance, for a country like China, it may need to apply a regional rather than national approach in forming an innovation ecosystem to ensure a more manageable size.

3 Methodology & Data Collection

This third chapter describes the methodology and data used to conduct the research. It then discusses how the potential methodological problems of validity, reliability and transmittability are addressed in the study.

3.1 Research approach

The study uses an analytical and deductive approach, and combines both quantitative (via weighted, time-based and correlation analyses) and qualitative (via documentary analysis) research methods to provide a coherent picture of the field of IC that, by virtue of its intangibility, cannot be captured by numbers alone. We examine the data that Lin and Edvinsson (2010)'s updated NICM model is based on, using time-based and correlation analysis to determine relationship of individual IC elements and indicators to the nation's level of economic competitiveness, and then compare the findings to Kao's ISMs, adopting three countries as case studies for this paper –

- Singapore (representing the Hollyworld ISM);
- Malaysia (representing the focused factory ISM); and
- Finland (representing the large-scale ecosystem ISM).

The lack of a representative country for the fourth model – brute force – is due to time limitations as well as recognition that this fourth model may be least applicable by other countries given its requirement for size and mass.

The study will 1) consider how IC elements and the variables they comprise of are weighted in each case country and hence ISM, 2) use time-based analysis to consider the development of each IC element and the corresponding innovation system represented by the case countries at each time period, and 3) use correlation analysis to determine the link of each IC element to FC using Ståhle and Bounfour (2008)'s methodology. In particular, the correlation analysis involves calculating the correlation coefficient for each IC element to FC (i.e. national GDP) for the time period 1995 to 2008, to determine the following effects on economic competitiveness via GDP ranking:

- *Sustaining effect*: The present *level* of the IC element correlating to the present FC *level*;
- *Boosting effect*: The present *level* of the IC element correlating to the FC growth *trend*;

- *Linear growth potential:* The *growth trend* of the IC element correlating to the present FC *level*; and
- *Exponential growth potential*: The *growth trend* of the IC element correlating to the FC growth *trend*.

Growth is calculated as the annual percentage change with respect to previous year, and growth trend as the trend value for annual growth using linear estimations.

As part of the analysis, country and cultural contexts will be provided as insight into how factors other than economic development, such as resource, social and cultural factors, influence IC development.

3.2 Data collection

Primary data comprises of both quantitative and qualitative data from the International Institute for Management Development (IMD) World Competitiveness Yearbook spanning 40 countries over a period of 14 years, from 1995 to 2008, as provided by Lin and Edvinsson (2010). Lin and Edvinsson, for consistency, integrate quantitative scores and qualitative ratings by calculating the ratio of the absolute value relative to the highest value of each quantitative variable and then multiplying it by 10 to transform the number into a 1-10 score. The data transformation procedures have been repeated for all numerical indicators of HC, MC, PC and RC. FC is represented by the logarithm of GDP per capita adjusted by the purchasing power parity of each country, calculated its ratio to the highest value and then transformed it into a 1-10 score. This thus presents data on a consistent base in terms of competitiveness and ranking vis-à-vis other nations, instead of absolute performance, which is easily measurable for quantitative factors such as "computers in use per capita", but less so for qualitative indicators such as "whether the national culture is open to foreign ideas".

Secondary data consists of business press, news articles, research journals as well as other national IC ranking studies conducted by various organisations, in a bid to supplement the primary data in providing context and relevance to the study.

3.3 Methodological problems

There are generally two key aspects for consideration when determining the ability of the research to properly contribute to the field – validity, which refers to the accuracy of the method in measuring what it is supposed to measure; and reliability, which concerns the consistency of the method in providing trustworthy and reliable results from the data, as evaluated by whether the method provides the same result each time it is applied (Wiedersheim-Paul & Ericsson, 1999). In a still emerging field like IC, there is also the aspect of transmittability to consider, which is the ability to transfer the findings from the research to another scenario or context.

3.3.1 Validity

In Lin and Edvinsson (2010)'s NICM model, which this paper adopts, with the exception of FC, each of the four component IC capitals (HC, MC, PC and RC) comprise of seven indicators. To affirm the validity of these selected indicators in measuring the four IC capitals, statistical analyses were used to test the measurement model. The resulting data analyses indicated that all the chosen indicators are significant at $\alpha = 0.05$, which correspondingly indicates that the twenty-eight selected indicators are sufficiently able to evaluate the four IC capitals. This thus affirms the present validity of the measurement model in assessing national IC based on the chosen framework of HC, MC, PC and RC.

However, IC, by its very nature, is constantly evolving, and this paper recognises that the IC indicators used to measure and evaluate national IC competitiveness may become obsolete in the next decade or so, as certain IC indicators reach saturation and hence lose their effectiveness. There will thus require the need to relook at the choice of IC indicators that comprise the four IC capitals in determining their relevance and validity for that specific point in time in the future.

3.3.2 Reliability

Reliability comes in two aspects – reliability of the data used, and reliability of the method applied to the data.

In terms of data, reliability is enhanced through the adoption of a 14-year period of analysis, which increases the length of observations and mitigates concerns regarding result outliers. The primary database from which the data is collected, the IMD World Competitiveness Yearbook, is judged to be a reliable database, and data is updated yearly, allowing for continuity in availability of information. However, it is recognised that the IC indicators which are derived from qualitative scoring is by nature subjective, and hence requires consideration in the organisation's ability to accurately capture the nation's relative position with regard to these variables. We deem IMD as having the expertise to perform this accurately, as further proven by the wide use of IMD data in various other studies in IC and national competitiveness. The information used for documentary analysis is meanwhile garnered from news reports, business press, research journals and reports performed by professional bodies, all deemed to be reliable sources of qualitative and descriptive information, and the corroboration of these different sources aid in enhancing reliability in the interpretation of the data.

In terms of method, the correlation analysis was run using Ordinary Least Squares (OLS) in the econometric program Eviews, which is a widely used program for research within the field of finance. Residual tests have been performed and have resulted in acceptable values. The authors thus deem the results from the correlation analysis as reliable. In terms of documentary analysis, our interpretations of facts and articles are unavoidably subjective, which is generally viewed as acceptable within the qualitative research tradition given the impossibility to separate personal opinions and feelings from the research question and data (Cano, 2000). However, as far as possible this paper attempts to lay out the facts as reported by reputable media and other sources, allowing for the reader to derive his or her own conclusions about the analysis and interpretation. The multicultural team of researches (comprising of a Singaporean and a Malaysian, advised by a Scandinavian) also promote "good" comparative research through the possession and application of sound substantive knowledge of the intricacies of the systems being compared by the researchers (Sanders, 1994). This aids in increasing functional equivalence by lowering the probability of intercultural misunderstandings or misinterpretations of the information at hand (Cavusgil & Das, 1997). Accordingly, the use of multiple methods to analyse and interpret the data allow for a multidimensional study of IC, which enhances reliability (Ståhle and Bounfour, 2008).

3.3.3 Transmittability

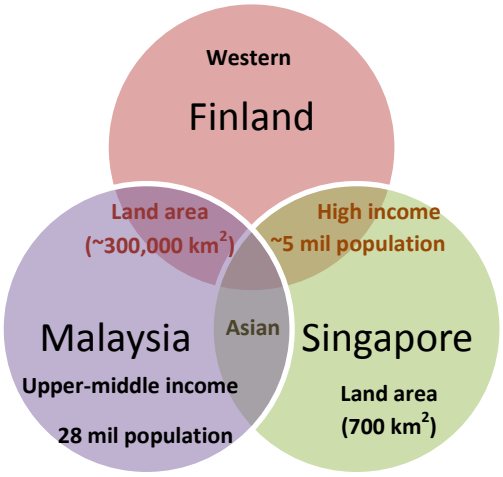
We believe that the decision to delve deep into three countries' IC states and development, as opposed to a broad-based analysis across the globe, can aid in enhancing the transmittability of the findings to other national contexts. This is in line with the use of "thick descriptions", which explain not just the behaviour, but its context as well, such that the behaviour becomes meaningful to an outsider (Geertz, 1973). This is of particular importance in the field of IC, which is dynamically related to other national capitals such as cultural, democratic, environment and social capitals, and an "IC success" cannot be evaluated in a vacuum or blindly applied to all situations without understanding the contextual interactions that contribute to the result.

4 Empirical Findings & Analysis

This fourth chapter starts with an introduction of Finland, Singapore and Malaysia and their respective ISM classifications. It is followed by a presentation of IC rankings and national characteristics, and the according weighted, time-based and correlation analyses.

4.1 A Tale of Three Countries – an overview

The choice of adopting Finland, Singapore and Malaysia is strategic – while on the surface, the Western world's Finland seems to be a separate category from the Asian world's Singapore and Malaysia, in actual fact, Finland shares some interesting similarities with both Singapore and Malaysia, while Singapore and Malaysia also overlap in other non-culturally related areas (refer to Figure 4.1 for a diagrammatic view).



	Finland	Malaysia	Singapore
Area	338,145 km^2 (64th worldwide)	329,847 km^2 (66th worldwide)	697 km^2 (192nd worldwide)
Population (as of 2009)	5,250,275 (112th worldwide)	25,715,819 (46th worldwide)	4,657,542 (117th worldwide)
Capital City	*Helsinki:* City Area: 716 km^2 City Population: 576,632 Density: 805/km^2	*Kuala Lumpur:* City Area: 244 km^2 City Population: 1,887,674 Density: 7, 736/km^2	Density: 6,682/km^2

Figure 4.1: How Finland, Malaysia and Singapore are alike / different (CIA, 2010; City of Helsinki, 2009; visitkualalumpur.com, 2010)

For instance, both Finland and Singapore are high-income countries with a population of approximately five million people; Finland and Malaysia possess a similar land area of about 300,000 square kilometres; Singapore and Malaysia come from the same historical roots (Singapore having been part of Malaysia prior to its independence in 1965) and have similar city population densities of 6,000 to 7,000 people per square kilometre. Understanding how each nation's context overlap in some areas and stay unique in others is important to interpreting the comparative analysis we will perform on the three countries from the IC and ISM perspective, and perhaps hint as to whether similar factors may explain their respective positions in terms of IC and economic development. We now proceed to briefly introduce each country in turn (refer to Appendix C for a full overview of each country).

4.1.1 Finland

Historically part of Sweden, and later of the Russian empire, Finland declared its independence in 1917. Finland was an agrarian country until the 1950s, when it started

transforming itself into an industrialised country, and then developed into a knowledge-driven economy in the late twentieth century. The FC index for Finland has remained relatively constant over the 14 years, with a minimum score of 9.47 and a maximum score of 9.64. In the world of innovation, Finland has become the forerunner in the field of ICT, primarily due to the success of the telecommunications giant Nokia. Finland is a country which does not only focus on learning from the past, but also actively anticipates and prepares for the future. Finland's success may be largely attributed to the Finns' "can-do" mindset and self-reliance, Finland's high quality education system, and the communal nature of Finnish society.

4.1.2 Singapore

When Singapore became its own sovereign state in 1965, it faced the problems of high unemployment levels, lack of sanitation, limited supply of potable water, ethnic conflicts, lack of natural resources and a small domestic market. Singapore responded by aggressively

pursuing globalisation through encouraging open trade and foreign direct investment (FDI), adopting a pro-business and export-oriented approach, building a skilled and comparatively low-cost labour force and supporting struggling industries through the use of government-linked corporations (GLCs). Within 40 years, it has emerged as an open and harmonious multi-cultural society and knowledge-driven economy that focuses on generating a high rate of innovation, adaptation, and commercialisation of new technologies, which has resulted in the production of innovative products and services at the global technology frontier (Asia Development Bank, 2004).

4.1.3 Malaysia

Malaysia was formed in 1963 from the Federation of Malaya, Sarawak, Sabah and Singapore (which was later separated from Malaysia). The country has been blessed with abundance of resources for agricultural, mining, petroleum and natural gas exploration, timber and tourism activities. Malaysians live in a multi-racial society which possesses different values, beliefs, religions, cultures and practices. Malaysia has transformed itself from a low income agrarian country (factor-driven economy) to an investment-driven economy since the 1970s, by establishing itself as a manufacturing base for leading multinational corporations (MNCs). However, in recent years, Malaysia's competitive advantage in mass and low cost production and other efficiency factors have eroded with the booming of its neighbouring developing countries. It has no other option but to attempt to transform itself into an innovation-driven economy, which would enhance its ability to produce innovative products and services and thus move up the global competitive ladder.

4.2 ISM classifications

According to Kao (2009), Finland would be classified as a large-scale ecosystem ISM, Singapore as a cross between the focused factory and Hollyworld ISMs, while Malaysia is not mentioned. For the purposes of this paper, while we adopt Kao's model classification for Finland, we chose to classify Singapore under the Hollyworld model given the nation's IC characteristics and its push for increased HC in the form of talent, while keeping in mind the focused factory model's influence on Singapore's IC elements over time. As for Malaysia, by virtue of its efforts in the past decade to focus its efforts on ICT via its Multimedia Super Corridor and national biotechnology policies, we have classified it under the focused factory model. The ISMs for Finland, Singapore and Malaysia are described in detail in the following section.

4.2.1 Finland: Large-scale ecosystem

The strong cohesive national culture may well be illustrated by Finland's innovation system (Figure 4.2) which is a closely-tied network that links producers (such as universities, research institutes and business enterprises) of new information, knowledge and knowhow, to its users (such as enterprises, private citizens and the decision-makers and authorities responsible for societal and economic development). The core of this innovation system is three-pronged – education; research and product development; and knowledge-intensive businesses and industries – with international corporations as a common thread running through the system. It is not just a regional innovation system, as is common elsewhere (such as Silicon Valley), but is a national one, highlighting a country-wide agenda and emphasis on innovation development and renewal. It is a "can-do" mindset that pervades the nation, an intangible dimension that leads to rather than simply results from quality education alone.

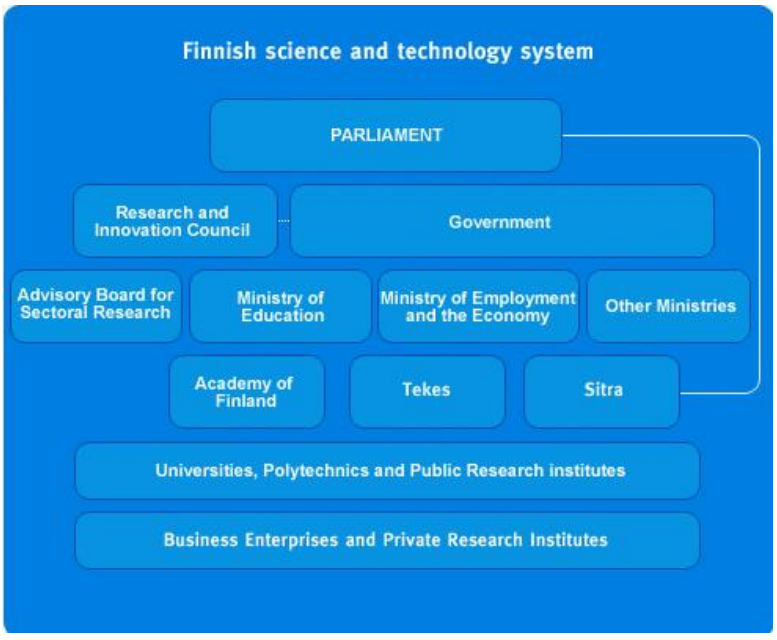


Figure 4.2: Finnish Science and Technology System (Seppälä, 2006)

As a knowledge-driven economy, the role of scientific information and breakthroughs in the societal and economic development of Finland is constantly growing, and this highlights the need for cooperation and networking intra and inter to the public and private sectors. Finland's strategic aim is to achieve sustainable and balanced social and economic development, through involving both scientific and non-scientific sectors such as economic, industrial, labour, environmental and regional policies or social welfare and health care services in innovation policies. Currently, the foremost trends in Finland relate to the integration of technological and social innovation; the increase in interdisciplinary and cross-technological activities (as evidenced by Aalto University, which was created from the merger of the three historical Finnish universities: The Helsinki School of Economics, Helsinki University of Technology and The University of Art and Design Helsinki, and hence opens up fresh opportunities and possibilities for strong multi-disciplinary education and research); and the emergence of the services sector, notably knowledge-intensive services, alongside manufacturing industry as a main factor for the welfare of society, citizens, and the economy (Seppälä, 2006).

The continued emphasis on the need for horizontal cooperation can be shown in a policy report *Science, Technology, Innovation*, published in 2006 by the Science and Technology Policy Council, which formulates the nation's science, technology and innovation policies and is chaired by the Finnish Prime Minister. The report addressed the challenges faced in further developing the Finnish innovation system in terms of prioritisation of activities, international and national profilisation of research organisations, and the development of selective, foresight-based decision-making. It then put forward a program which combines the contentual, financing and structural development objectives of research and innovation. It seeks to close the gap between ideas in theory and applicability in practice by enhancing quality of research, ensuring both scientific and practical relevance, alleviating fragmentation in research, and addressing obstacles to and incentive for entrepreneurship. Importantly, particularly for Finland's relatively closed society, the council recognised that science is being globalised, whereby ideas are more easily spanning geographical boundaries, and thus a constant renewal process is required to ensure that Finland stays on the forefront of innovation.

4.2.2 Singapore: Hollyworld

Modelled as a "city within a city", the centrally-located Suntec City, one of Singapore largest commercial developments, is an architectural masterpiece fused with modern concepts and geomancy elements that speaks to a 'left-hand' layout. A world class convention centre anchors the left hand by forming its wrist, and its five office buildings form its fingers and thumb. Standing majestically in the palm of the hand is the Fountain of Wealth (Figure 4.3), the world's largest man-made fountain, thus capturing the essence of the Chinese saying "to hold the wealth of the world in one's hand." The fountain flows inward from a huge mounted brass ring, and this is significant from an Asian perspective – water symbolises life and wealth in Chinese culture, and the inward flow of the water symbolises the retention of wealth for Suntec City, and accordingly, the nation (RealDestination, 2005). We mention the Fountain of Wealth here, because it is an apt illustration of Singapore's Hollyworld ISM, which aims to attract the inflow of investments, wealth and talent, by creating a favourable environment for living and business, and positioning Singapore as *the* place to be for the creative class.

Figure 4.3: Singapore's Fountain of Wealth

In particular, Singapore is aiming to create the life sciences version of California's Silicon Valley, via the Biopolis, a biomedical R&D cluster that is targeted to be the life sciences hub of Asia. In accordance with the Silicon Valley model of "like attracting like", the Singapore government has been focused on luring global talent in the field. A few years ago, it ran a campaign through a number of life sciences journals that had a short but sharp tagline: "If you are a world-class life scientist, you are a Singaporean." The campaign worked - more than three-quarters of the two thousand scientists working at the Biopolis are overseas hires, and sixteen multinational pharmaceutical companies are planning on sending their own scientists from around the world to join Singapore's research effort (Kao, 2007).

The Biopolis has also attracted a number of life sciences superstars, among them Edison Liu, former director of the US National Cancer Institute's Division of Clinical Sciences, who

relocated to Singapore in 2001 to head the Genome Institute of Singapore; Japanese cancer researcher Yoshiaki Ito and his entire Kyoto University team, who moved to Singapore's Institute of Molecular and Cell Biology in 2002; the Biopolis' American recruits such as Nobel Prize winner Sidney Brenner from the Salk Institute, and Mark Seielstad, who left the Harvard School of Public Health to move to Singapore because the "environment was better" at the Biopolis; and Alan Colman, the man behind the first cloned sheep, Dolly. Colman rejected offers from USA and England to be based in Singapore, because the city-state was willing to back its support with funding via a $6 million grant to create insulin-producing stem cells, which can be used to treat diabetics. "I met with venture capitalists in the US and the UK and realised that it would be very difficult to fund the work I wanted to do," he explained. "But Singapore was prepared to put money into it. They're not just interested in conventional returns on investment; they're taking a long-term view. It really wasn't a difficult decision" (Luman, 2004). Colman's experience is not an isolated one. Hundreds of scientists are lured with the promise of first-class laboratories, top-notch equipment, and more than sufficient funding to pursue work that would otherwise be considered too controversial or difficult to obtain funding for in the Western world (Kao, 2007). Singapore is putting more than $2 billion into research in areas such therapeutic cloning, drug discovery and cancer research, among others, in the desire to attract and retain bioscience leaders who can in turn help train the emerging generation of Singaporean scientists and thus bolster the future of the Singapore economy.

The need to develop local talent is a pertinent one, for perhaps one of the biggest obstacles to Singapore's future is, ironically, its own people. Because of the autocratic hand of government during its formative years, its people have been trained in a culture of compliance and acceptance of government policy. With the government now encouraging a type of innovation and creativity that has been suppressed for so long, it may be a rough road ahead in developing original thought among Singaporeans. "People have had a very good deal here, but unfortunately compliance is part of the problem for the future. They don't think for themselves," says Colman. "This runs through to science."

4.2.3 Malaysia: Focused factory

Malaysia is categorised as an investment-driven economy where its economic growth is primarily production-based. In order to progress to becoming a developed nation, focused national initiatives have been launched to boost its ability to innovate and to produce high value-added products and services. Two of these national initiatives are 1) the national ICT

initiative (spanning 1996 to 2020), which includes the development of the Multimedia Super Corridor (MSC), and 2) the national biotechnology policy (spanning 2005 to 2020), named "BioMalaysia".

Multimedia Super Corridor (MSC)

Five years after the introduction of Vision 2020, one of Malaysia's major innovation initiatives, the MSC, was launched. Besides being a catalyst to achieving the Vision 2020, the MSC aims to transform the nation into a knowledge-based society by promoting R&D on ICT and increasing the usage of IT products and services. A cluster concept is applied, with a zone spanning from the Petronas Twin Towers in Kuala Lumpur's city centre to the Kuala Lumpur International Airport (KLIA) designated for the development of the MSC. The MSC area includes Putrajaya, the new administrative capital for Malaysia; Cyberjaya, the "intelligent city"; and Technology Park Malaysia (TPM). The cluster provides a conducive operating environment to attract investors and talents both locally and abroad. Companies with MSC status have access to a list of benefits stated in the Bill of Guarantees, which include:

- A world-class physical and information infrastructure;
- Unrestricted employment of local and foreign knowledge workers;
- Freedom of ownership by exempting companies with MSC Malaysia Status from local ownership requirements;
- Freedom to source capital globally for MSC Malaysia infrastructure, and the right to borrow funds globally;
- Competitive financial incentives, including no income tax for up to ten years or an investment tax allowance, and no duties on import of multimedia equipment;
- Becoming a regional leader in IP protection and cyberlaws;
- No internet censorship;
- Globally competitive telecommunications tariffs;
- Tendering of key MSC Malaysia infrastructure contracts to leading companies willing to use the MSC Malaysia as their regional hub; and
- Provision of the Multimedia Development Corporation (MDC) as an effective one-stop agency.

The MSC cluster concentrates ICT companies within an area, which drives these companies to greater specialisation, production and innovation. ICT companies, supporting industries and

related institutions (for example, Putrajaya, Multimedia University, and University of Malaya) are within close vicinity to share, transfer and benefit from the exchange of technologies and skills.

The national ICT initiatives which the MSC supports are divided into three phases, over a span of 25 years from 1996 to 2020. The initial stage (1996-2003) focuses on visioning and the construction of physical infrastructure to support ICT development. The second phase (2004-2010) places emphasis on providing "supply" to enable ICT development by increasing the numbers of knowledge workers and development of flagship applications such as electronic government, MyKad (electronic national identity card), smart school and telehealth. The final phase (2011-2020) aims at boosting "demand", whereby ICT acts as driving force for other sectors, creating socio-economic impact, driving exports, and moving Malaysia into a developed nation.

National Biotechnology Policy (NBP)

The NBP was introduced in 2005 in support of BioMalaysia, the innovation initiative focused on developing biotechnology. This policy charts 15 years of strategic biotechnology development in Malaysia, ending in the year 2020. Similar to the benefits offered to companies with MSC status, companies with BioNexus status are guaranteed a list of benefits as stated in the Bill of Guarantees.

The NBP emphasises biotechnology development in three areas:

- *Agricultural (or Green) biotechnology*, which aims at applying biotechnology platform technologies to increase plant and livestock productivity and improve their agronomic traits, and promoting biopharming;
- *Healthcare biotechnology*, which aims at utilising natural bio-resources from plant, marine and microbial origins for use in nutraceuticals, cosmeceuticals and phytopharmaceuticals, and promoting herbal medicine by harnessing local knowledge and increase vaccines production; and
- *Industrial biotechnology*, which aims at developing biocatalysts, bioprocessing, contract biomanufacturing and developing biofuel.

The NBP is implemented over three phases, where Phase 1 (2006-2010) focuses on capacity building, Phase 2 (2011-2015) on bringing science to business, and Phase 3 (2016-2020) on

globalising businesses. Similar to the MSC model, in order to promote integration of services and to foster synergies across value chain, a biotechnology cluster, Bio-XCEll, will be constructed in Iskandar Malaysia, Johor (the nearest Malaysian state to Singapore). Bio-XCell will focus on R&D, and aims to complement advanced R&D parks in Singapore such as the Biopolis.

4.3 Overview of IC rankings & national characteristics

Leveraging the data from Lin and Edvinsson (2010)'s updated IC study on 40 countries over 14 years (1995 to 2008), which evaluates each country's IC competencies based on the previously mentioned 29 criteria (see Table 2.2), we examine the IC profiles of Finland, Malaysia and Singapore based on the five dimensions of HC, MC, PC, RC and FC (see Appendix D for the countries' scores).

From the study, there was an overall global IC mean of 6.0, with Finland ranked first (IC mean of 7.81), Singapore ranked sixth (IC mean of 7.33) and Malaysia ranked 25th (IC mean of 5.56). Using a simple time-series graph over the period 1995 to 2008 (Figure 4.4), it can be seen that all three countries are upward trending in IC. Between 1995 and 2008, Singapore experienced the largest IC improvement (14%), followed by Finland (12%) and then Malaysia (9%).

In recognition that FC is more an indicator of national financial wealth than a component of IC, as is consistent with Edvinsson and Malone (1997), Bontis (2004) and PricewaterhouseCoopers (2005), it may thus paint a more accurate picture of national IC standings by considering the overall IC score without FC. In this instance, the global IC mean excluding FC (ICexFC) stands at 5.21, with Finland remaining on top in first place (ICexFC mean of 7.37), Singapore still ranked sixth (ICexFC mean of 6.70) and Malaysia moving up three places to rank 22nd globally (ICexFC mean of 4.79). The ICexFC trend lines over time also seem to correspond in gradient to the IC trend lines, indicating a rather flat FC contribution. In this light, between 1995 and 2008, Singapore still experienced the largest ICexFC improvement (19%), followed by Finland (16%) and then Malaysia (12%). From this perspective, the countries are all improving in their intellectual and innovation capabilities; however, FC has not risen exponentially in response, which could be attributable to other factors influencing FC, such as the technical, social, cultural and leisure, democratic and environmental capitals brought forth by PricewaterhouseCoopers (2005) (Figure 1.2).

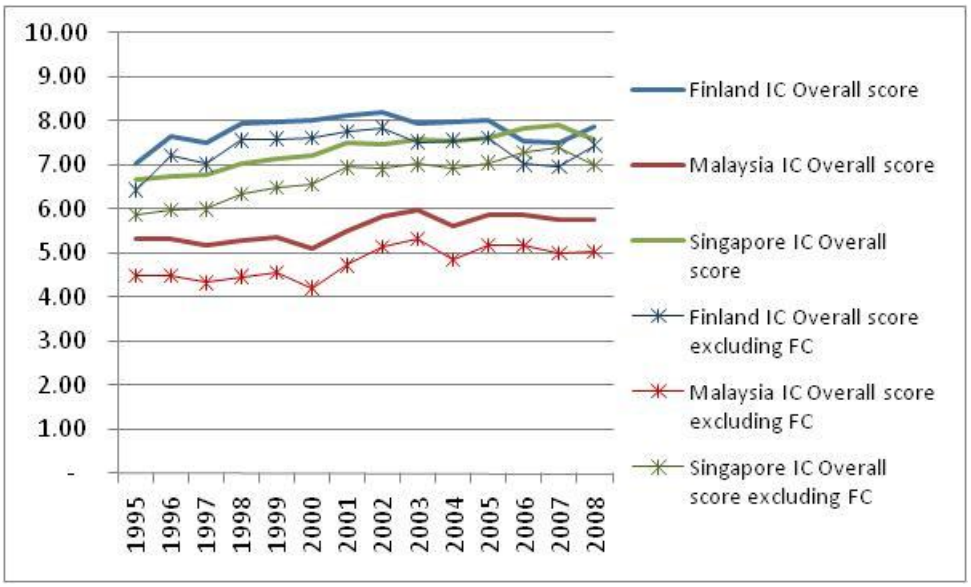


Figure 4.4: IC trends over time, with and without FC

As shown by Figure 4.4, Finland ranked top in the IC composite score for most of the 14 years, except for the years 2006 and 2007 when it was overtaken by Singapore. In 2006, Finland suffered a dip in the composite score of all four of its IC elements (i.e. HC, MC, PC and RC), in contrast with Singapore where improvements were observed over these elements. The PC for Singapore exceeded Finland for the first time in 2006, and this trend continued in 2007. As compared to 2005, Singapore in 2006 achieved the greatest improvements in its PC level, in government efficiency (11%), followed by capital availability and convenience of establishing new business (6% each). For the same period, Finland's PC experienced the greatest decrease in the same indicators, i.e. government efficiency (-32%), capital availability (-19%) and convenience of establishing new business (-15%). Other than PC's indicators, Finland suffered lacklustre competitiveness in its skilled labour (HC, -29%), transparency (MC, -23%), corporate tax (MC, -21%), employee training (HC, -17%) and cooperation between universities and enterprises (RC, -16%). Given the recent economic crisis stemming from 2008, Singapore's "drop" in IC ranking for that year may hence be due to its sensitivity to world events, and consequently the negative impact on MC and PC, its two highest contributing IC elements. This is contrasted with Finland, where MC and PC are instead its two lowest contributing IC elements, and thus its IC score is not as heavily influenced by the economic crisis as Singapore. Thus, in the absence of the crisis, Singapore may actually be in essence the leader of the three countries in terms of IC as of today. An updated IC study post-crisis would thus be revealing to see where the three countries truly lie.

4.4 Examining the link between IC characteristics & ISMs

4.4.1 Weighted & time-based analysis

When comparing the overall means of each dimension for each country along with the trends of their IC dimensions over time (Figure 4.5), a preliminary analysis reveals the following observations:

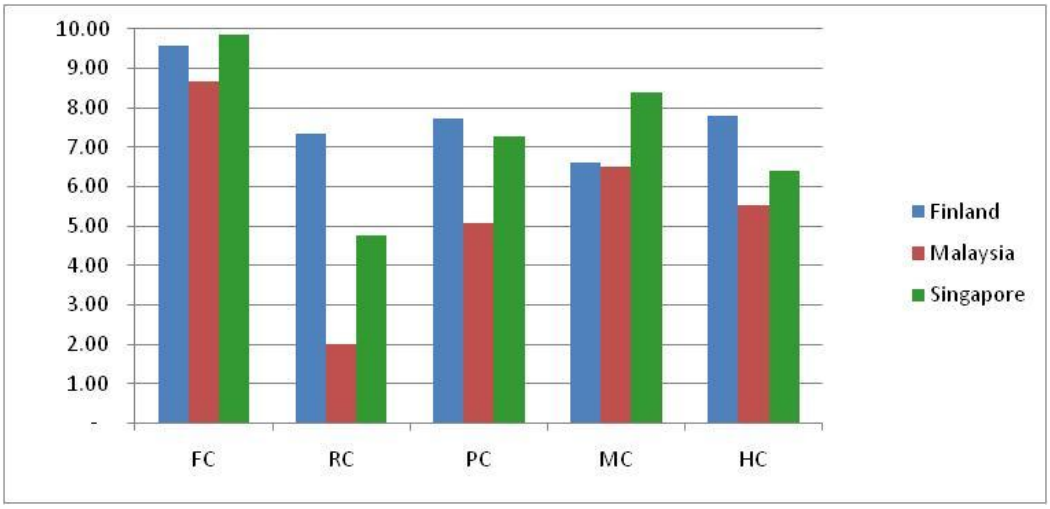


Figure 4.5: HC, MC, PC, RC and FC means for each country

- All three countries have scored well in FC (above the 80th percentile).

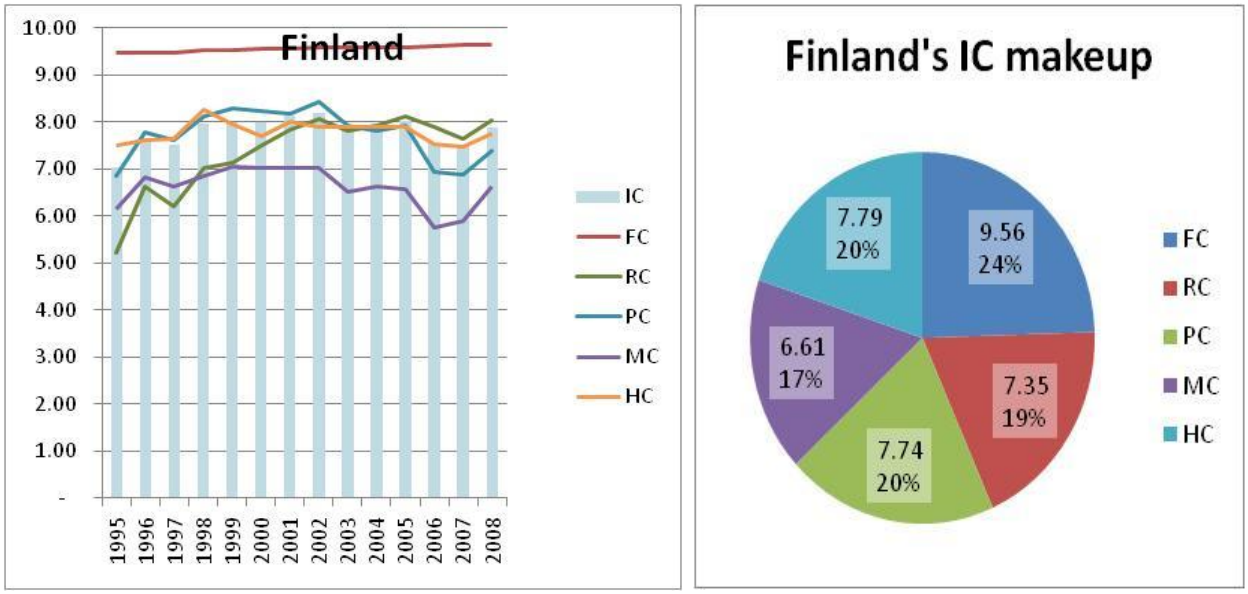


Figure 4.6: Finland's IC dimensions

- Finland (Figure 4.6), the large-scale ecosystem, has the most evenly distributed IC elements and dominates in RC and HC. It, however, loses out to Singapore in terms of FC

(and MC), indicating that its strength in IC may not necessarily be translating into timely economic gain. On a mean basis, FC contributes most to the IC score (24%), followed by HC (20%), PC (20%), RC (19%) and MC (17%).

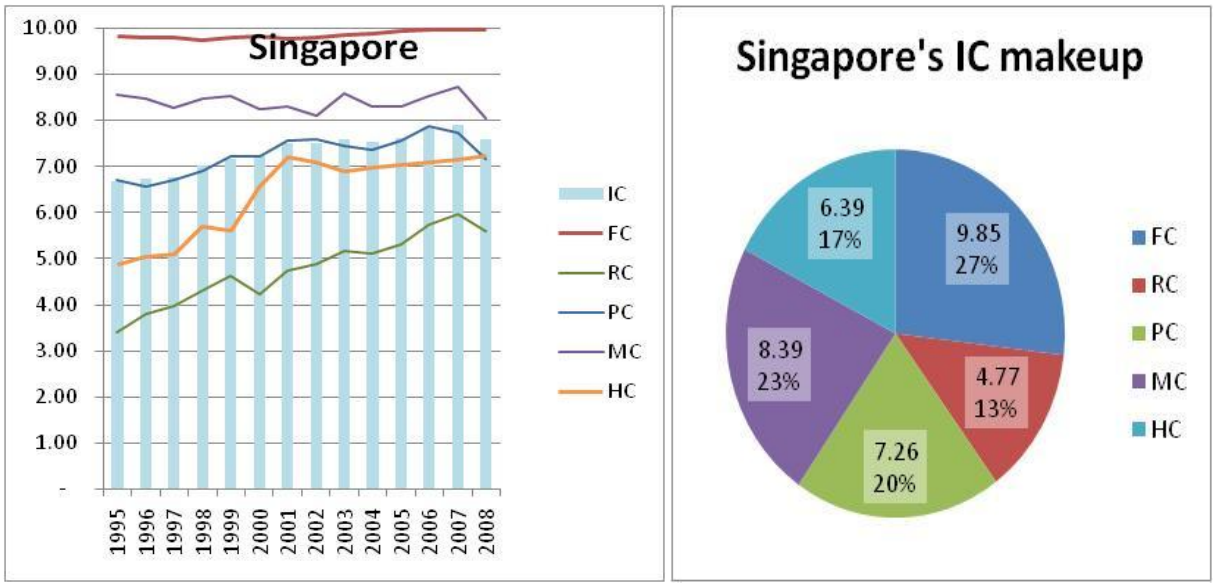


Figure 4.7: Singapore's IC dimensions

- Singapore (Figure 4.7), the Hollyworld, dominates in MC and FC, indicating Singapore's attractiveness and competitiveness, and a real economic impact from its IC. However, Singapore may need to consider increased focus on RC to ensure continued future sustainability. On a mean basis, FC contributes most to its IC score (27%), followed by MC (23%), PC (20%), HC (17%) and RC (13%).

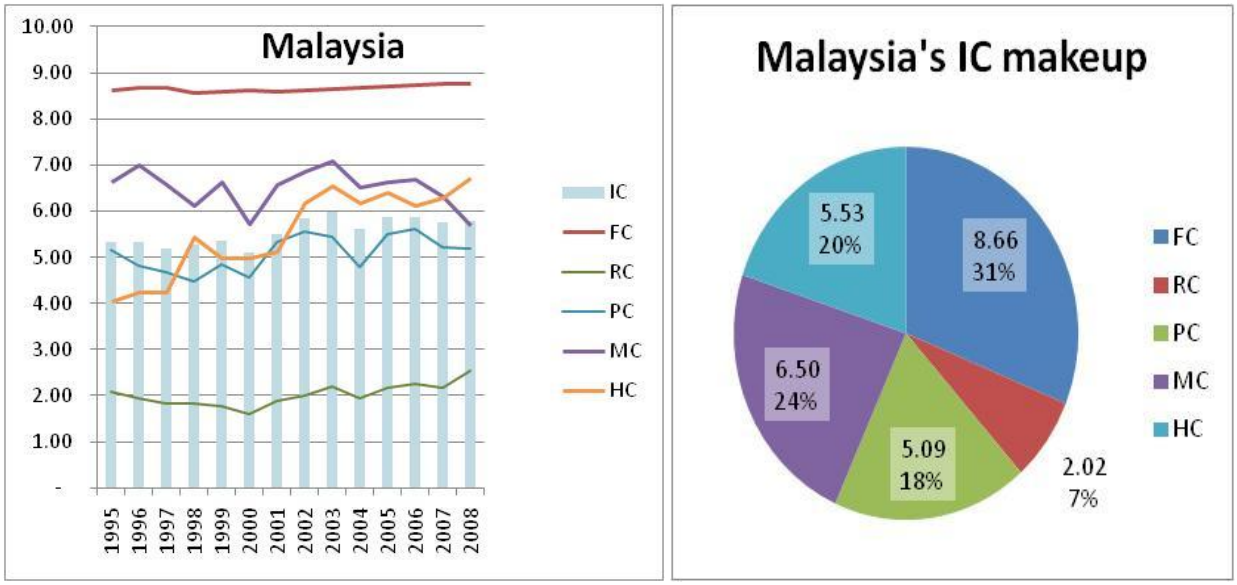


Figure 4.8: Malaysia's IC dimensions

- Malaysia (Figure 4.8), the focused factory, has the largest variations in IC element scores, and RC and PC significantly lag behind Finland and Singapore. It is also worth noting that while it lags behind in all its IC elements, its MC is almost equal to Finland, and with both

Finland and Malaysia losing in terms of FC to MC-dominant Singapore, it suggests that MC is an important influence on FC. Also, Malaysia's HC has shown the largest increase among all its IC dimensions, suggesting that in line with its focused factory ISM, it has developed its HC within the chosen area of focus. As in the case of the other two nations, in terms of mean scores, Malaysia's FC contributes most to its IC score (31%). It is then followed by MC (24%), HC (20%), PC (18%) and RC (7%).

Table 4.9 summarises the weight of each IC element for the three countries in study.

IC dimension weights

	Finland			Singapore			Malaysia		
1st	**FC**	24%	9.56	**FC**	27%	9.85	**FC**	31%	8.66
2nd	**HC**	20%	7.79	**MC**	23%	8.39	**MC**	24%	6.50
3rd	**PC**	20%	7.74	**PC**	20%	7.26	**HC**	20%	5.53
4th	**RC**	19%	7.35	**HC**	17%	6.39	**PC**	18%	5.09
5th	**MC**	17%	6.61	**RC**	13%	4.77	**RC**	7%	2.02

Table 4.9: IC element weights for the 3 countries

From this preliminary study, we have arrived at three hypotheses that may explain the relationship between how the IC elements are weighted, and the ISM adopted by each country:

Hypothesis 1: Large-scale ecosystem is denoted by a relatively even scoring of IC elements, suggesting even development and interconnectiveness between IC elements.

Hypothesis 2: Hollyworld is denoted by wider gaps between IC element scores, with focus on developing HC, on an existing strong MC base. (Hollyworld's main intent is to attract talent, and given Singapore's sharp increase in HC, it would seem to further prove this. The current superiority in MC could be a residual from Singapore's focused factory ISM roots, which is in line with attracting of investments to the country.)

Hypothesis 3: Focused factory is denoted by the widest gaps between IC element scores, with focus on MC and in turn leading to FC gains (though there may be a timelag in seeing FC gains), with supplementary focus on HC to support the chosen area of investment and innovation.

4.4.2 Correlation analysis

To complement the above weighted and time-based analysis, we conducted a correlation analysis to determine the sustaining effect, boosting effect, linear growth potential and exponential growth potential contribution of each IC element on the nation's financial wealth, i.e. its FC. A high correlation between *sustaining effect (IC level verses FC level)* and FC may indicate that the particular IC element/indicator has become necessary to maintain economic competitiveness, whereas *boosting effect (IC level verses FC growth trend)* correlation may mean that any enhancement to the IC element/indicator can help boost up economic competitiveness further. *Linear growth potential (IC growth trend verses FC level)* correlation may indicate that continued IC increments is important to sustain economic competitiveness, while *exponential growth potential (IC growth trend verses FC growth trend)* may assert that continuous IC growth and increase in ranking strongly reinforces economic competitiveness, and every additional effort put into strengthening the IC drivers can affect the economy positively.

In this analysis, it is important to keep in mind that firstly, correlation does not determine cause-effect – it merely prescribes a relationship that exists between the two factors. In this case, there may be instances where IC growth is a consequence of FC growth, for instance increasing R&D investment when the economy is booming. In other instances, which is more pertinent to the nation in terms of strategic investment, is where investment in IC can lead to FC and economic growth. It is important then to identify these IC investments which are key towards sharpening the nation's competitive edge.

Secondly, boosting effects and exponential growth potential are conditional on certain environmental and economic background factors. For instance, boosting effects are antecedent on previous IC growth, and as the IC indicator reaches a substantially high level, the boosting effect becomes saturated and the IC indicator loses its effectiveness (i.e. there is a limit to how much more it can positively affect the economy). For example, when internet subscription reaches the 90^{th} percentile, there becomes little room for further growth; accordingly, with most of the population being internet-savvy, further increments in internet subscription have a smaller impact on the economy, as opposed to a nation with internet subscription reaching only the 30^{th} percentile. Further, high IC presumes advanced infrastructure and upholding the momentum of financial resources, and as such, analysing advanced IC indicators (for example those closely tied to exponential growth potential) from the perspective of "necessary

conditions" may prove beneficial. Exponential growth potential is linked to the capability to uphold the momentum of (continuous) IC growth and competitiveness, as well as the presence of the indicator-specific "necessary conditions". In particular, it relates to the inter-dependencies between IC elements and indicators, where in order for a specific IC indicator to grow or be further enhanced, it requires the growth and enhancement of other IC indicators, for example how internet subscriptions is reliant on computer availability.

Keeping the above in mind, the correlation analysis produced interesting results, which are presented in graphical form in Figure 4.10 (refer to Appendix E for the analysis in numerical form).

According to Ståhle & Bounfour (2008), saturated IC indicators (marked by high sustaining effects and low boosting effects) were found in the economies that have both a high level of GNP per capita and low-medium GNP growth rates. They note that saturation can occur in two ways – firstly, when IC indicators turn into necessary pillars of developed economies, and secondly, when IC indicators are bound to time and context due to the limited lifetime of technological relevance. Though this seems to present itself in the nation with the highest FC mean of 9.85, Singapore (moderate sustaining effects and lack of boosting effects for all its IC elements), Finland, with only a slightly lower FC mean of 9.56, has sustaining effect on economic competitiveness from only RC (albeit a high correlation) but has boosting effects from all its IC elements. This could be testament to Finland's ecosystem, which seeks continued renewal and knowledge enhancement, and is key to keep from reaching non-value-adding saturation. In Finland's case, the continuous growth all its IC elements, in particular PC (r = 0.46), is key to strongly reinforcing its economic competitiveness, and the high exponential growth potential correlation may signal the positive recognition and utilisation of IC interdependencies within its innovation ecosystem (Hypothesis 1).

In Singapore's case, all its IC elements are key to sustaining its FC competitiveness. Increments to HC (r = 0.52) and RC (r = 0.03) and enhancements to PC (r = 0.32) may provide reinforcement to economic competitiveness, and PC, which denotes the national infrastructures in place to sustain and externalise the output of human capital, may in particular be important for Singapore to better leverage and harness its HC, which is of focus given the Hollyworld ISM of attracting the best talent, and further supports Hypothesis 2. Its seeming IC saturation (presence of sustaining effects and lack of boosting effects) however hints to

Singapore needing to follow in Finland's footsteps by ensuring continuous knowledge renewal and enhancement.

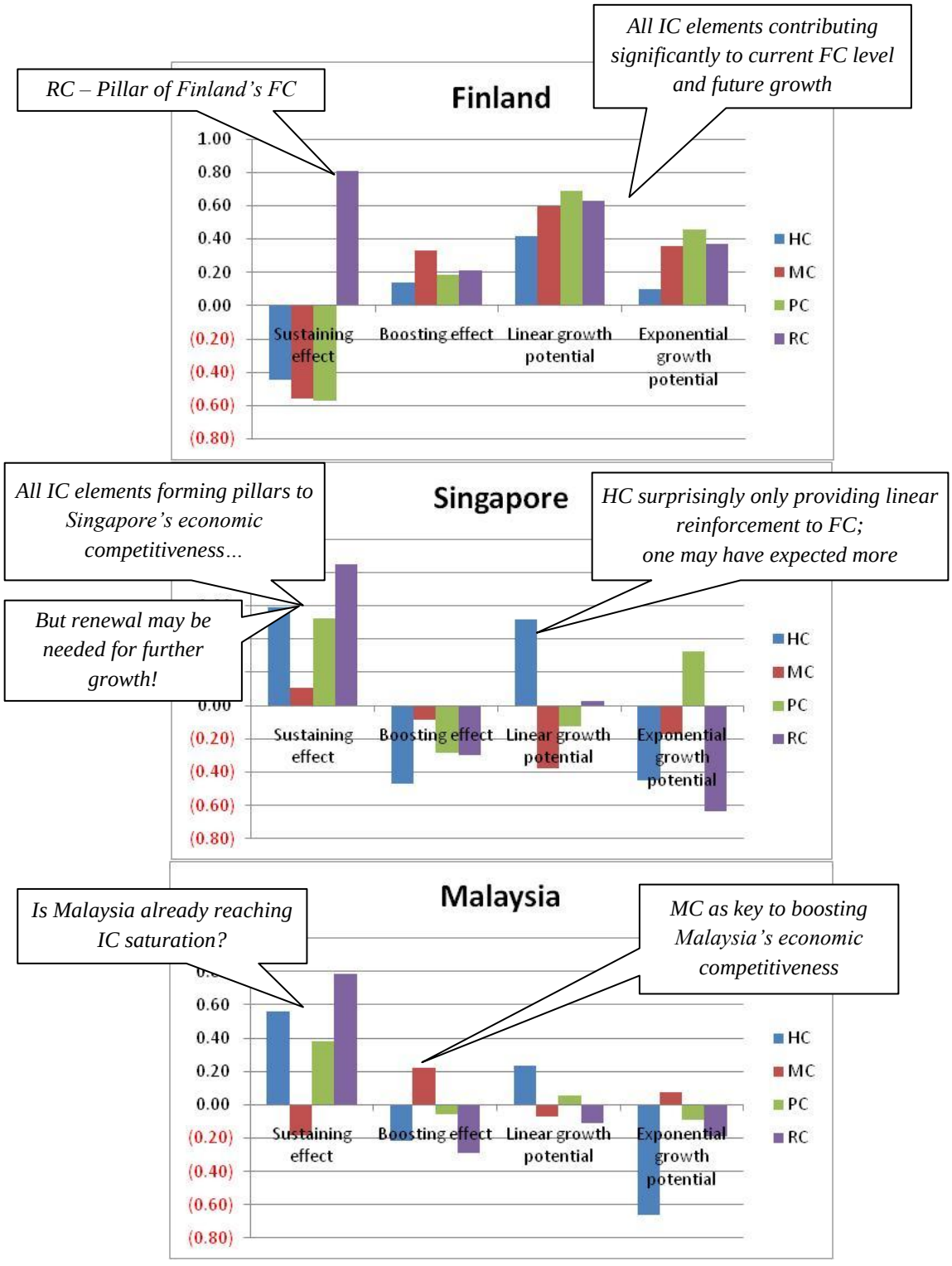


Figure 4.10: Results of correlation analysis between FC and IC elements

Malaysia, like its neighbour Singapore, also has all its IC elements (except MC) providing sustaining effects to the nation's economic competitiveness. Increments in HC (r = 0.24) and

PC (r = 0.05) performance also seem to help maintain FC ranking. As for MC, it is instead potentially driving further economic growth via boosting effects (with a mere increment in MC ranking leading to a boost in economic competitiveness) (r = 0.22) and exponential growth potential (continuous MC growth reinforcing economic competitiveness) (r = 0.08). This seems to correspond with Malaysia's focused factory model (Hypothesis 3), with the nation focusing on MC and investing specifically in the innovation area of ICT, while HC is developed to support this effort. Consequently, Malaysia may already be facing IC saturation arising from the limited lifespan of technology, and may hence need to look to other forward-looking strategic IC investments which are pertinent for the future.

5 Detailed Examination of IC Elements of Finland, Singapore & Malaysia

The following fifth chapter proceeds with a detailed examination of IC elements at indicator level, relating documentary analyses for the three countries to the weighted, time-based and correlation quantitative analyses from the fourth chapter.

As Amidon (2003) notes, story-telling as a documentation and deployment mechanism has allowed for highly complex concepts and results to be readily transferred. Accordingly, keeping in mind that IC is very much an intangible field that both practitioners and academics alike are on a quest to effectively measure and quantify, this paper now delves into the qualitative aspects of each country, and, through documentary analysis, tells each nation's story in terms of past, present and future, to provide perspective on each nation's IC profile in relation to its context. The following section will relate to the previously mentioned weighted, time-based and correlation analyses to allow the reader to understand each nation's context and policies and provide explanatory value to the results of the quantitative analyses. Key highlights are then presented in point form at the end of each subsection to aid the reader's navigation through the stories, with text in black and red respectively denoting the positive and negative aspects that each country faces in the specific IC areas.

5.1 Human Capital (HC)

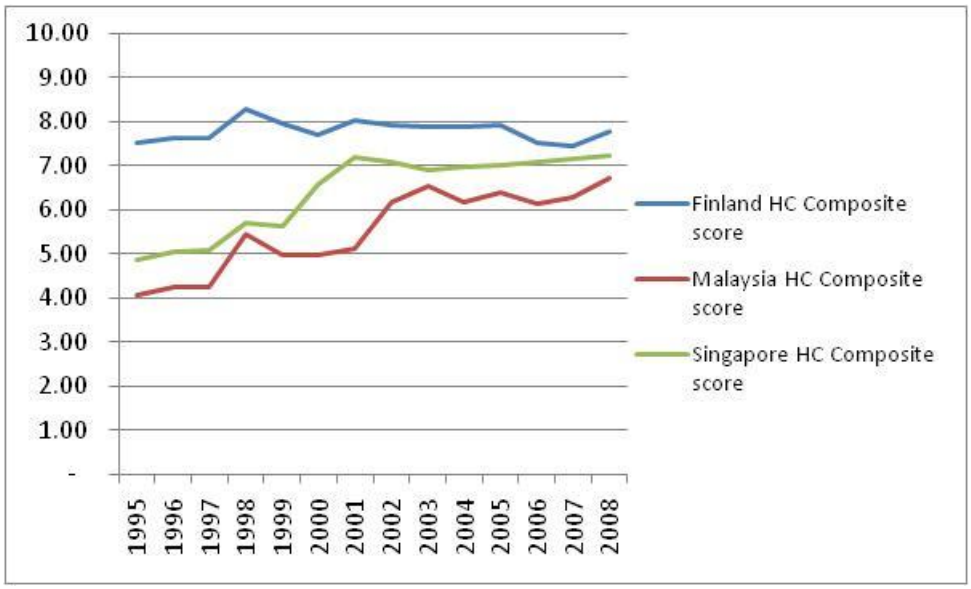


Figure 5.1: HC trends for Finland, Malaysia and Singapore

IC	Criteria	Finland	Malaysia	Singapore
HC	**Composite score**	**7.79**	**5.53**	**6.39**
HC	Public expenditure on education	7.74	6.26	4.30
HC	Skilled labour	6.86	5.86	6.82
HC	Literacy rate	9.90	8.70	9.18
HC	Higher education enrolment	7.24	2.51	7.58
HC	Pupil ratio	6.03	5.53	4.19
HC	Internet subscribers	9.36	3.34	5.85
HC	Employee training	7.38	6.50	7.14

Table 5.2: Means of HC indicators for Finland, Singapore and Malaysia

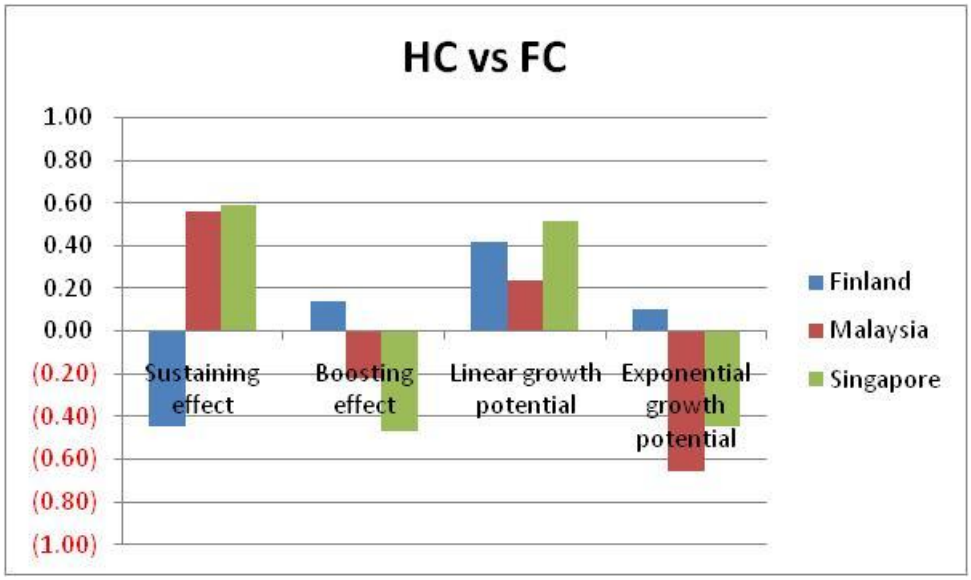


Figure 5.3: Results of correlation analysis between FC and HC

5.1.1 Finland

Figure 5.4: Trends of HC indicators for Finland

Finland has been a forerunner in the area of HC, maintaining within the 70th and 80th percentile, and outperforming Singapore and Malaysia on all indicators in term of mean results (except for higher education enrolment, where Singapore fares better at 7.58 verses Finland's mean of 7.24). Finland has been particularly strong in the area of education (which is a main driver of HC), with the World Economic Forum ranking Finland's tertiary education number one in the world. According to the OECD's latest statistics, in 2005, Finland spent 6.0% of its gross domestic product on educational expenses which is slightly more than the OECD average of 5.8%, thus contributing to its high public expenditure on education mean of 7.74. Finland's investment in education also seems to have paid off – in the OECD's Program for International Student Assessment (PISA), Finland has consistently obtained top rankings, with Finnish 15-year-olds coming in first in science and mathematics, and second in literacy in the 2006 PISA study[1]. In 2007, at primary school level, the average class size was 20, with a student-teacher ratio of 15:1, though this increased to 18:1 in 2008 (OECD, 2009; StateUniversity.com, 2010). The Finnish emphasis on giving students the attention they need to develop and the philosophy that "no child should be left behind" is further illustrated by the provision of an additional teacher in class to help students who struggle in a particular subject, while keeping all pupils within the same classroom, regardless of their ability in the subject. The Finns also believe in providing an enjoyable environment for learning, with Finnish children starting main school only at age seven, in the belief that they learn best in their

[1] Singapore & Malaysia did not previously participate in previous PISA studies, but Singapore will begin its participation in the PISA study starting 2009.

childhood years when they are playing, and are keen to start learning by the time they enter school. They also spend the least number of hours in the classroom in the developed world, which underlines the Finnish stand that learning is lifelong and can take place anywhere, not just within the confines of the school (Burridge, 2010).

Despite Finland being a "poster child" for how to run schools, thus explaining high literacy rates and superior HC rankings, 21% of Finish young adults between the ages of 20 to 24 are not working or studying, a worryingly high percentage when compared to other OECD countries. In addition, with an estimated number of 20,000 young people in the age range of 15 to 19 not going to school or work despite incentives to do so, in 40 years these marginalised and excluded people will total up to 160,000. Not only is the younger Finnish generation not fully taking advantage of the Finnish education system, the pool of skilled people is further depressed as a result of the other big challenge facing Finland today – its ageing population. According to IMF estimates, Finland will be the first country in the world where the majority of voters are over 50 years old, and the country is expected to pass this milestone in 2010, while one-third of the voting population will be over 65 by 2030 (CFF, 2005). The increasing proportion of older employees which are soon reaching retirement can in turn lower the availability of skilled labour and the effectiveness of employee training. Finland's risk of stagnating in HC while other countries catch up seems to be evidenced by this paper's analysis, with Singapore and Malaysia showing a steeper HC upward trend as opposed to Finland's flatter trendline over time. Further, Finland's HC, in relation to FC, has the lowest boosting effect (r = 0.14), linear growth potential (r = 0.24) and exponential growth potential (r = 0.10) among all its IC elements, suggesting that there may be something lacking in HC that needs to be addressed.

Finland's HC: Key highlights

- Strong education system
- "No child is left behind"
- High PISA rankings
- 21% of Finish young adults not working or studying
- Ageing population

5.1.2 Singapore

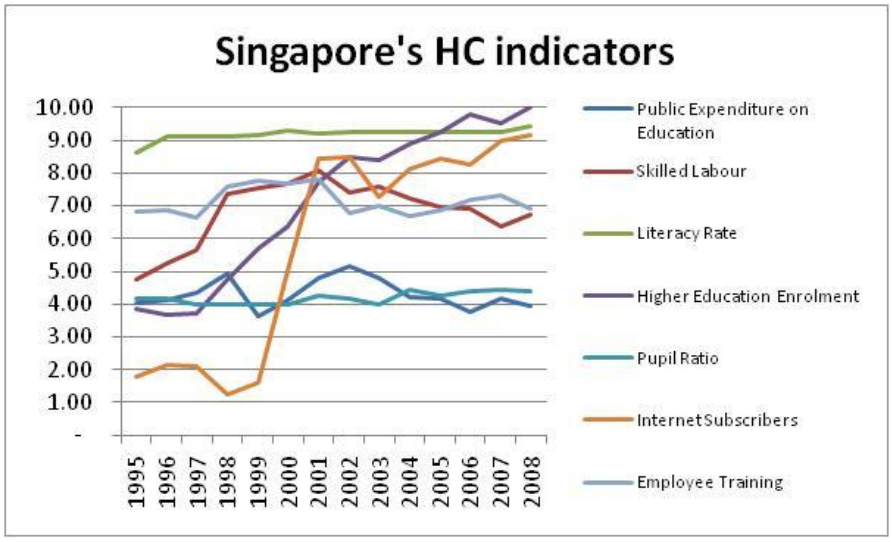


Figure 5.5: Trends of HC indicators for Singapore

While Singapore may not be as highly ranked in HC as Finland, it has shown a staggering 49% improvement within 14 years from 1995 to 2008, with its HC indicator increasing from 4.86 in 1995 to 7.23 in 2008. This is contributed mostly by the sharp jumps experienced in higher education enrolment (3.84 to 10), internet subscribers (1.80 to 9.18), and skilled labour (4.77 to 6.72).

While public expenditure on education has remained relatively low and flat (mean of 4.30, representing a mere 2.9% of GDP spent on education as at 2007 according to Unesco, a drop from 2001's 3.7% of GDP), the investments made by Singapore in education seems to have been targeted and focused based on the nation's changing needs. For instance, in response to increasing globalisation and the opening up of China and India, which were adversely impacting Singapore's competitiveness in the low cost-manufacturing sector, new education initiatives were introduced in 1997 to move Singapore from a factor-driven economy into a knowledge-based society that can better contribute to the services industry in Singapore. These initiatives include "Thinking Schools, Learning Nation" which was introduced to encourage creative thinking and a wider ranging curriculum; and "IT Masterplan", which aimed to have students use information technology as an education tool. Singapore is also known for the quality of its education. Singapore's public schools have a distinctive record of high standards in teaching and learning, illustrated by international comparative studies such as the Third International Mathematics and Science Study that showed the majority of students from Singapore schools outperforming the international average in Science and Mathematics.

Students in Singapore have also excelled in international competitions such as International Olympiads (Mathematics, Physics, Chemistry and Biology) and world debating championships (English), beating their counterparts from other countries to clinch top prizes and distinctions (Government of Singapore, 2006).

This continued emphasis on education speaks to its constantly high ranked literary rate (mean of 9.18), and is complemented by its rising higher education enrolment, i.e. the percentage of its population that has attained at least tertiary education. According to Unesco's *Global Education Digest 2009*, the government spent nearly 1% of Singapore's GDP on tertiary education in 2007. This is roughly equivalent to one-third of its education budget, which is a high proportion when considering that half of the 102 countries represented in the Unesco report spend between 10% and 20% of their education budget on tertiary education. This reflects the Singapore's government's continued belief in the need for a skilled and educated labour force, as articulated by a recent report from the Economic Strategies Committee's Subcommittee on Fostering Inclusive Growth, which expects 35% of the resident workforce to be degree holders by 2020, up from 27% currently. Given that there are currently only three local universities (with an upcoming fourth one to be opened in 2011) to cater to this goal, it begs the question as to whether so many can graduate from so few local opportunities. The answer may lie in the popular alternative taken by many students in Singapore today – studying abroad. The same Unesco report states that 11.3% of Singapore students, which represents more than 18,000 students, were studying abroad in 2007, with most studying in Australia (52%), USA (21%) and UK (18%).

Conversely, encouraging its students to study abroad has proven to be a double-edged sword – while it has increased the education qualifications of its citizens, it has also led to a "brain drain" of local talent. Singapore's Minister Mentor (MM) Lee Kuan Yew noted that with every year that Singaporeans give up their citizenship and takes out their savings, it means "losing about, at the top end, 1000 a year, which is about – if you take the top 30 percent of the population – about four or five percent" (Oon, 2008a). MM Lee also believed that the outflow of local talent will continue to rise because "every year, there are more people going abroad for their first or second degree" (Oon, 2008b). This could perhaps explain why the supply of skilled labour has a flatter gradient than higher education enrolment, indicating that local students may be staying abroad for their careers. However, Singapore, a country with immigrant roots, has always maintained a policy of welcoming and attracting foreign talent,

which has helped to boost the pool of available skilled labour. Prestigious government scholarships provided by research institutions such as the Agency for Science, Technology and Research (A*Star) support this cause, with at least 15% of A*Star's scholarships awarded to foreign applicants under the condition that they take up Singaporean citizenship in the course of their studies (Iswaran, 2008). To encourage the recruitment and retention of foreign talent by the private sector, Singapore has put in place tax incentives such as the Overseas Talent Recruitment Scheme, which allows for tax deductions for the relocation and recruitment expenses incurred in the hiring of top foreign talent (Asia Trade Bulletin, 2008), as well as the Not-Ordinarily Resident Scheme, which is designed to grant favourable tax concessions to senior executives. Immigration policies have also aligned to this goal, as illustrated by the introduction of a new Personalised Employment Pass scheme in January 2007, which allows the holder to stay in Singapore in between jobs for up to six months, in order to allow him/her to evaluate new employment opportunities, and hence supports the retention of Employment Pass calibre holders that would otherwise have had to leave Singapore.

The abrupt rise in internet subscription between 1999 and 2001 (1.62 to 8.46) could very much be a result of Singapore's IT2000 strategic plan. The plan, titled "IT2000 - A Vision of an Intelligent Island" and put forth by the National Computer Board in 1992, aimed to have all 750,000 households in Singapore connected to a comprehensive computer network by the year 2000 with the compulsory instalment of broadband coaxial and optical fibre networks (Choo, 1997). This will be further elaborated under the discussion on PC's computer access indicator, but it is worth noting that as at 2009, the internet penetration rate in Singapore is 72.4%, ranking it 25th in the world (Internet World Stats, 2010) [2].

HC is key in sustaining Singapore's economic competitiveness (r = 0.59), and in ensuring future competitiveness (r = 0.52), though, given Singapore's historical reliance on its people, HC is surprising not positively correlated to boosting and renewal effects, perhaps suggesting that structural and process factors may be increasingly important in supplementing and effectively harnessing the talent and creativity of individuals. Singapore will also need to deal with the combined challenges of an ageing

Singapore's HC: Key highlights
- Emphasis on developing its only resource - humans
- High local literary rate
- Attracting foreign talent
- Ageing population
- Loss of local talent

[2] In terms of internet penetration, Finland is ranked ninth (83.5%) and Malaysia, 40th (65.7%).

population and loss of local talent to global shores, while attracting the best global talent to its own shore, to ensure a sustainable pool of HC to tap from.

5.1.3 Malaysia

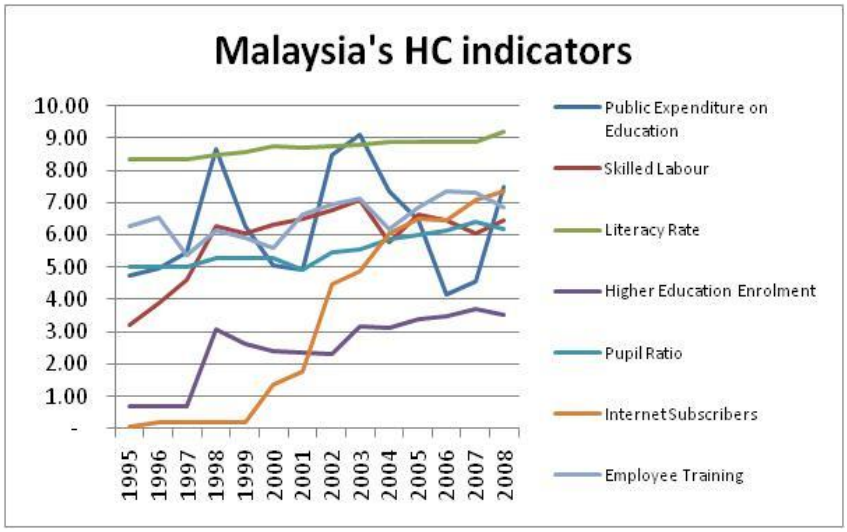


Figure 5.6: Trends of HC indicators for Malaysia

Though Malaysia has recorded the lowest composite score for HC among the three countries in our study, it has however shown the greatest improvement of 66% over the span of 14 years, increasing from 4.05 in 1995 to 6.72 in 2008, with HC also contributing most to FC's linear growth potential (r = 0.24). This growth in HC is in line with the aim of Malaysian government to develop the country's people and to nurture a "first-class mentality" among its citizens to achieve Malaysia's Vision 2020.

In contrast with Finland, which was timely in capturing the boom of ICT in the 1990s and recorded a full score of 10 in terms of internet subscription from 1995 to 1998, Malaysia scored less than 1 for the same period. Recognising the importance of ICT in the nation's economic development, then Prime Minister of Malaysia, Dr. Mahathir bin Mohamad, launched Malaysia's ICT initiative, the MSC, in 1996. The MSC is modelled after Silicon Valley and aims to transform Malaysia to a knowledge-driven economy. The government's intensive efforts, coupled with the mushrooming of ICT-related industries, served to increase the awareness of the public sector, businesses and general public towards the importance and convenience in using IT tools, thus popularising the use of the Internet among Malaysians. This trend is clearly illustrated by the exponential increase of internet subscribers within a period of 10 years, from a score of just 0.20 in 1999 to 7.35 in 2008.

The other HC indicator which recorded a dramatic improvement is higher education enrolment. Despite a low mean of 2.51 (both Finland and Singapore recorded means of above 7), the higher education enrolment indicator score increased from 0.71 in 1995 to 3.51 in 2008. This improvement could be attributable to a number of interrelated factors, mainly growth in the number of local public and private universities and colleges, increase in awareness of the importance of knowledge workers, and the growing need for knowledge workers for the development of the MSC. For instance, following the launch of the MSC in 1996, the Multimedia University (MMU), Malaysia's first private university with its main campus located in Cyberjaya, was established to "serve as a catalyst for the development of the high-tech ICT industry of the nation" (Multimedia University, 2010). Within a span of 10 years from 2000 to 2009, MMU has nurtured more than 22,000 graduates. At present, MMU, in collaboration with the ICT industry, is hosting thirteen research centres which are focused on niche areas such as nanotechnology, microsystems, biometrics, virtual reality, microwave and telecommunications, engineering, photonics, advanced robotics and business.

The number of local public universities has meanwhile increased by more than two-fold, from nine in 1995 to twenty in 2008. The private higher education sector has also boomed as a result of the Private Higher Education Institutions Act 1996. Prior to 1996, private higher learning institutions were not allowed to confer their own degrees, and thus could only prepare students for externally conferred degrees. The Private Higher Education Institutions Act 1996 was passed to recognise the important role played by qualified private higher educational institutions in providing knowledge workers to the job market. This Act has resulted in the mushrooming of private universities, colleges and foreign branch campus universities, thus contributing to the rapid growth of higher education enrolment.

Despite improvements in higher education enrolment, there are increasing concerns as to whether Malaysia's higher educational institutions are producing the right graduates for the job market and economy. As highlighted by Ridu (2007), local graduates are finding it hard to secure jobs. Consequently, the Malaysian government has launched a number of programs to re-train the unemployed graduates to meet the demand of job market. Examples of these retraining programs include Training and Attachment Program for Unemployed Graduates (SSL), Graduate Reskilling Scheme (GRS) and Graduate Training Scheme (GTS).

Malaysia's ability to provide skilled labour has been fluctuating over the years. The indicator score began as low as 3.21 in 1995, then peaking at 7.10 in 2003, before dropping to 6.46 in 2008. This may be due to a "brain drain" in Malaysia, especially in the service sector. As Malaysia's Deputy Foreign Minister, A. Kohilan Pillay, noted, 304,358 Malaysian migrated during the 18-month period from March 2008 to August 2009, with the main reasons for migration being career, business and social factors (Wong, 2009). Additionally, approximately half of the Malaysians who work abroad are professionals. Accounting firms, for instance, continuously lose talented local professionals to overseas competitors and other offices in the international network. Malaysian-trained accountants are highly sought after by other countries due to their familiarity with International Financial Reporting Standards (IFRS), coveted languages skills (English, Mandarin, and Malay) and cultural sensitivity due to living in a multi-racial environment (Tay, 2010). The continuous loss of local talent to foreign economies is a problem which needs to be addressed, particularly in a country which already has a small pool of skilled workers and is in urgent need to retain these talents for its own development.

Accordingly, while Malaysia has taken great strides forward in terms of its HC over the 14 years, there are a number of structural problems in Malaysia's education system that need to be addressed before the country is able to achieve a real breakthrough. Since its independence in 1957, there has been little evolution of Malaysia's education system to cater the changing needs of the country in the face of globalisation. The 3R basic education concept introduced in the 1960s, which emphasises on "(R)eading, W(R)iting, and A(R)ithmetic", remains the focus of education until now. Similar to the education models of other Asian countries, Malaysia has an examination-oriented education system and a high pupil-teacher ratio of about 40:1 in its schools. Performance in the national formal examinations is the key determinant on whether a student is able to move a step higher up the education ladder. This examination-oriented education system has resulted in increased pressure on teachers, parents and students, with most parents arranging multiple after-school tuitions for their children to ensure that their children achieve good scores in their examinations. The immense attention on examination results and rigid learning environment has resulted in "education outputs" that lack creativity and innovation, which is of concern if Malaysia wishes to effectively become a knowledge- and innovation-driven economy.

Malaysia's HC: Key highlights

- IC element with greatest improvement
- Vision 2020: First class mentality
- Boom in higher education
- Possible "brain drain"
- Unemployed graduates

5.2 Market Capital (MC)

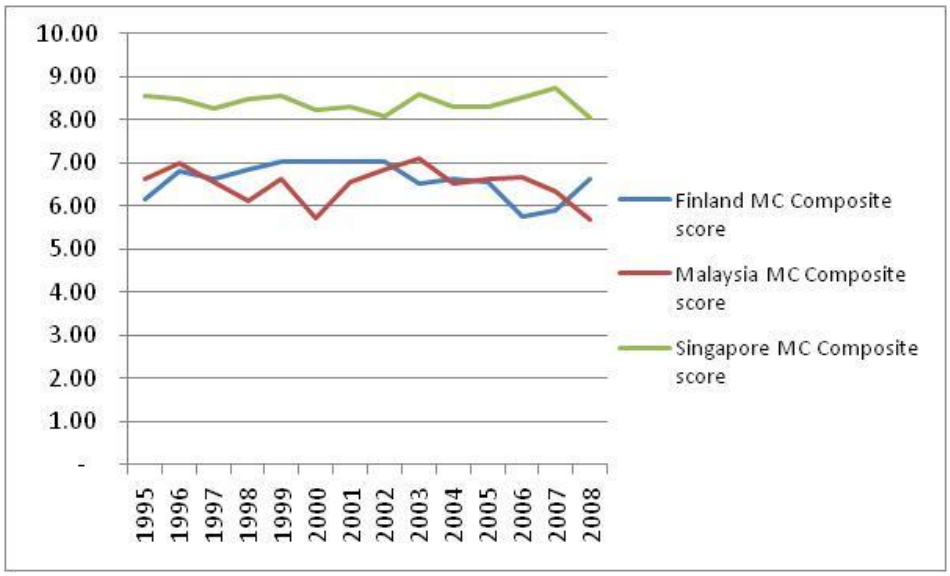


Figure 5.7: MC trends for Finland, Malaysia and Singapore

IC	Criteria	Finland	Malaysia	Singapore
MC	**Composite score**	**6.61**	**6.50**	**8.39**
MC	Corporate tax	6.25	6.80	7.70
MC	Cross-border ventures	8.95	6.82	8.79
MC	Openness of culture	6.87	7.01	8.07
MC	Globalisation	7.25	6.25	7.83
MC	Transparency	7.21	5.72	7.54
MC	Image of country	7.60	6.78	8.74
MC	Exports of goods	2.16	6.13	10.00

Table 5.8: Means of MC indicators for Finland, Singapore and Malaysia

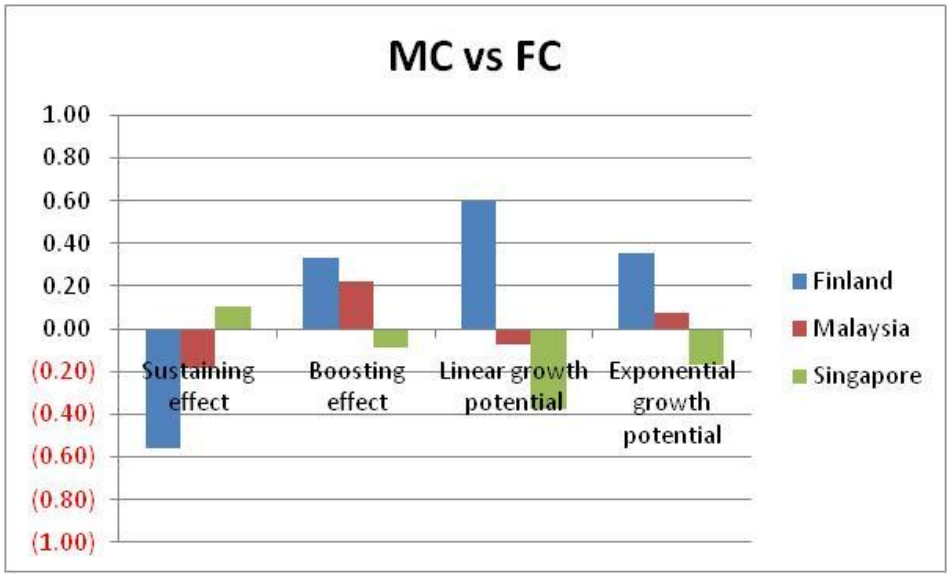


Figure 5.9: Results of correlation analysis between FC and MC

5.2.1 Finland

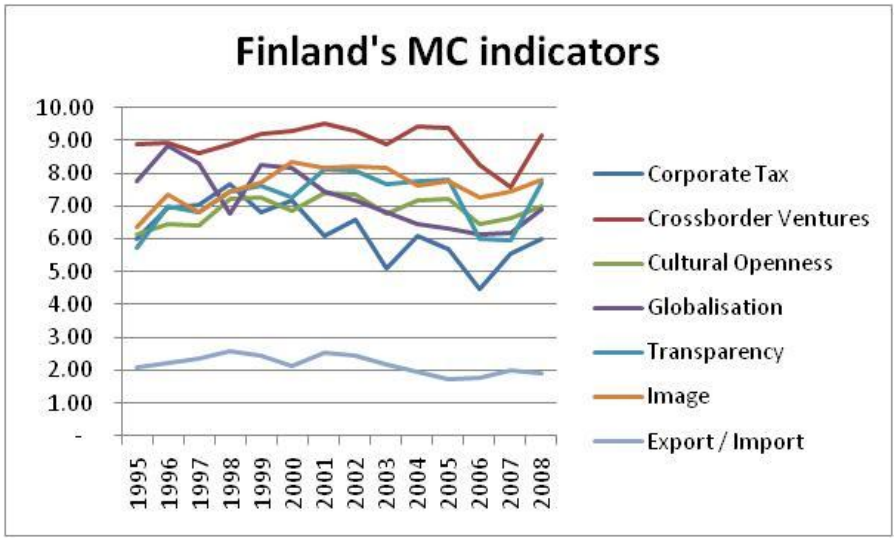


Figure 5.10: Trends of MC indicators for Finland

Though Finland's MC mean score of 6.61 is lower than Singapore's mean of 8.39, Finland's MC is highly correlated to its FC in terms of boosting effects ((r = 0.33), linear growth potential (r = 0.60) and exponential growth potential (r = 0.36).

Finland's mean score in terms of cross-border ventures is 8.95, signifying the high level of freedom it has in negotiating international transactions with its foreign partners. Finland scored means of above 7 for country image (mean of 7.60), attitude towards globalisation (7.25) and transparency (7.21). Finland is among the best functioning and most transparent institutions in the world, ranked only after Singapore in the World Economic Forum's *2009/2010 Global Competitiveness Report* (GCR). Finland has portrayed a positive country image in terms of business development, which is evident from the low levels of corruption, government instability and crime and theft attributed to Finland by the GCR. However, despite its high mean score in terms of attitudes towards globalisation, the indicator is downward trending, falling from its peak of 8.84 in 1996 to 6.88 in 2008, illustrating that it has lost ground in this aspect as compared to its peers.

Finland scored a mean of 6.87 for its openness to foreign culture and 6.25 for how its corporate tax regime encourages entrepreneurial activity. An exceptional low mean of 2.16 is recorded for Finland's exports of goods, which is contrasted with a score of 10.00 for Singapore and 6.13 for Malaysia.

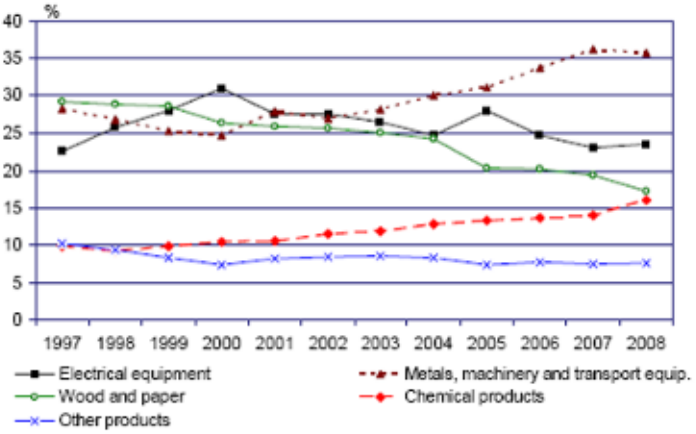


Figure 5.11: Proportion of Export by Product Type from 1997 to 2008 (Source: National Board of Customs, Finland Statistic Unit 2009)

As show in Figure 5.11, there is a downward trend in the proportion of exports contributed by electrical equipment and wood and paper, two of the main contributors to Finland's export in the 1990s. In addition, most of Finland's exports in year 2008 (74%) were concentrated in Europe. The low score in Finland's exports and the concentration of exports-by-region seems to signify a "closed" system within Finland, which may ironically be due to the success of its large-scale ecosystem ISM as highlighted in Section 4.2.1, where it successfully utilises a systemic and network approach in its innovation system. It is interesting to note that while Finland has effectively integrated various institutions in the country to foster innovation, it lags in boosting its relational capabilities in dealing with its international clients, with its MC score being the lowest among all its IC elements. Finland may thus need to improve the effectiveness of its social intelligence and provide competitive solutions to its international clients.

Finland's MC: Key highlights

- Well-functioning and transparent
- Low corruption, government instability, crime and theft
- Exceptional low score in exports, exports concentrated in Europe
- Possibly "closed" system

5.2.2 Singapore

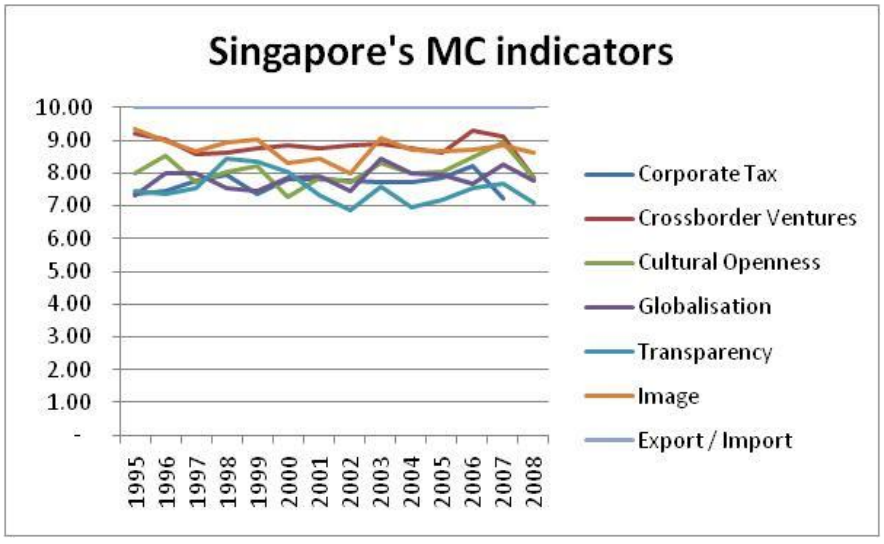


Figure 5.12: Trends of MC indicators for Singapore

Singapore is an obvious frontrunner in MC among the three countries (mean of 8.39), and its superiority is reflective of the country's emphasis on globalisation and FDI. All of its indicators are highly rated and relatively flat, with export of goods standing out as a straight 10 for all the years in analysis. One reason for Singapore's economic success is its strategic location – the island is surrounded by major global economic players, with Japan and China to its north, India to its west, and Australia to its south-east. The port of Singapore has successfully leveraged on this geographical strength, and with its fast processing of foreign shipments and rapid customs clearance processes, it has been consistently ranked as the world's busiest port, along with competitors Hong Kong and Shanghai (Kelly, 2008). According to the CIA Factbook, in 2009, Singapore's exports amounted to an estimated $268.9 billion, representing 152% of the country's GDP for the same year. It is worth noting that Singapore also relies heavily on imports, with imports lagging exports by only $23.9 billion in 2009. This illustrates Singapore's use of 'entrepot' trade, whereby it purchases raw materials and refines them for re-export. Singapore's exports comprise primarily of machinery and equipment (including electronics), consumer goods, pharmaceuticals and other chemicals, and mineral fuels, and its main export partners are Hong Kong (11.6%), Malaysia (11.5%), USA (11.2%), Indonesia (9.7%) and China (9.7%) (CIA, 2010c).

Singapore is also aware of the need to possess and project an effective and conducive business environment in its determination to remain a key player in international trade. Singapore has succeeded in this, receiving numerous acclaims for its government policies in encouraging business development, such as being ranked first in the world by World Bank's *Doing Business 2010* report for the fourth year running in terms of ease in doing business[3]. In the same report, Singapore is also ranked first when it comes to trading across borders, which speaks to the other high-ranked indicator – cross-border ventures (mean of 8.79). The government further attracts investments through a competitive tax regime with one of the lowest tax rates in the world, with the corporate tax rate to be reduced from 18% in 2009 to 17% in 2010, and hopes to encourage entrepreneurial activity by granting new start-ups incorporated in Singapore 100% tax exemption on the first $100,000 of normal chargeable income, and a further 50% tax exemption on the next $200,000 of normal chargeable income, within the first three years of the company's incorporation, subject to certain qualifying conditions. Singapore has also not just acted quantitatively, but qualitatively as well – in the

[3] In the report, Finland was ranked 16th, while Malaysia, 23rd.

World Bank report, Singapore is ranked fifth in the world when measured in terms of ease in paying taxes by a small to medium-sized company[4].

A unique aspect to Singapore, in which it dominates above Finland and Malaysia, is its openness to foreign culture (mean of 8.07) and attitude towards globalisation (mean of 7.83). To understand why Singapore has been so successful on these two fronts, one must look to its past. Singapore can arguably be founded based on the principle of openness to foreigners and foreign ideas. When Sir Stanford Raffles claimed Singapore as belonging to the British East India Company in 1819, it was an island populated with only about a hundred indigenous people. He thus proceeded to import the people that he needed to build a proper society, and Singapore became the melting point of immigrants from China, Europe, India and Indonesia. This has formed the basis of the multi-cultural nation that it is today. According to Singstat, Singapore's government statistics arm, the population of Singapore stands at 4.99 million as of 2009, of whom 75% (3.73 million) are Singaporean citizens or permanent residents ("Singapore Residents"). 74.2% of Singapore residents are Chinese, 13.4% Malays, 9.2% Indians, and the remaining 3.2% comprise of Eurasians, Arabs and other groups (Singstat, 2009). The United Nations projects that globally, Singapore would have the sixth highest proportion of international migrants in 2010, comprising 42% of its population and making up 50% of its service sector (United Nations, 2009). In such an international environment, generations grow up in an environment of cultural diversity and racial tolerance, learning to adapt and understand different cultures and backgrounds. Accordingly, receptiveness towards globalisation, foreign culture and ideas become a given in Singapore, a tiny nation that has its success based on remaining relevant and in touch with the world, and on making the foreign feel at home.

Despite Singapore's success and prominence in MC, MC has only shown a single and albeit small correlation to FC, in terms of sustaining effects (r = 0.10). This could be a result of MC having become a necessary pillar to Singapore's economic competitiveness, and hint to the requirement to look to other complementary IC factors which can further enhance and boost its economic competitiveness to yet another level.

Singapore's MC: Key highlights

- Forerunner in FDI and globalisation
- Strategically located geographically
- 1st in Ease of Doing Business, Cross-border Ventures
- Low tax rate 17 % (2010)
- Open to foreigners and foreign ideas

[4] For the same indicator, Finland was ranked 71st, and Malaysia, 24th.

5.2.3 Malaysia

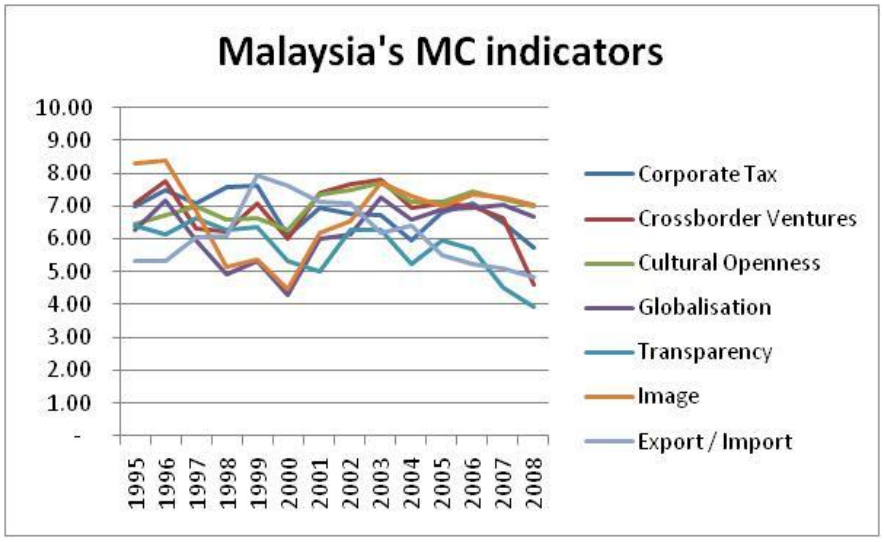


Figure 5.13: Trends of MC indicators for Malaysia

MC contributes the most to Malaysia's overall IC score, with a composite mean of 6.50, the highest among its four IC elements. All seven MC components in Malaysia recorded means of 5 and above, indicating an above-average competitive and attractive environment in the eyes of foreign investors. While its composite MC score is lower than Singapore, it has fluctuated in comparison to Finland. Throughout the 14-year time span, however, the MC composite score has improved for Finland, but has been downward trending for Malaysia. This is an interesting observation, given that, for Malaysia, MC is the only IC element that has not reached saturation (indicated by a lack of sustaining effect on FC), and supplies both boosting effects (r = 0.22) and exponential growth potential (r = 0.08) to FC, which thus indicates that there is room for MC to contribute in increasing Malaysia's future economic competitiveness.

When examining the MC indicators, the indicator means for corporate tax, cultural openness and exports of goods for Malaysia are higher as compared to those of Finland, which may be attributable to Malaysia's unique social and economic development background. In contrast to Finland's homogenous society, Malaysia comprises of many different ethnic groups. This multi-racial society in Malaysia has created a nation which is sensitive, flexible and open towards different cultures, values, religions and practices.

In terms of its economic development, Malaysia has applied the "East Asian" model and has fostered international trade to sustain its growth and reduce poverty. The composition of Malaysia's exports has evolved dramatically since its independence. In the 1970s, Malaysia's

exports relied heavily on agricultural products, particularly rubber, palm oil and forestry products. These three products contributed to as much as 55% of total exports, while a mere 12% came from manufacturing. However, from the 1980s onwards, in response to the urgent need to battle poverty and create job opportunities, Malaysia began focusing on attracting FDI, through various sweeteners such as tax incentives, convenience in profit remittance and capital repatriation. These incentives, along with an abundance of cheap labour and absence of labour unions in electronics and electrical (E&E) industry in Malaysia, resulted in a number of leading E&E MNCs originating from USA, Japan and Europe setting up their production bases in Malaysia. This has led to manufactured goods replacing agricultural products in becoming Malaysia's main source of exports, with 74% of total export contributed by manufactured goods in 2008, particularly E&E goods.

In addition, Malaysia has been active in regional and global partnerships to enhance its trading network, investment opportunities, production networks and cooperation on financial and industrial fronts. Regional groupings which Malaysia has been active in include the Association of South-East Asian Nations (ASEAN) and Asia-Pacific Economic Cooperation (APEC).

Despite encouraging means of above 5 for all its MC indicators, it is worrying to note that five out of seven of its MC indicators are downward trending. Malaysia's competitiveness in terms of corporate tax regime, ease of cross-border ventures, transparency of government policy, country image, and exports of goods have become lacklustre over the years. In particular, government transparency has experienced the greatest decrease in indicator score, plunging to 3.94 in 2008 from 6.42 in 1995. The 2008/2009 GCR categorised the presence of favouritism in decisions of government officials as a one of the competitive disadvantages in the Malaysian government institution. Malaysia may thus need to "clean up its act" in these areas in order to fully realise the potential that MC can bring to the nation's economic competitiveness.

Malaysia's MC: Key highlights

- Multi-racial society: sensitive, flexible and open
- Attract FDI, reduce poverty
- Move from agricultural to MNCs' production base
- Active in regional and global partnerships
- 5 out of 7 indicators downward trending
- Government transparency and favouritism

5.3 Process Capital (PC)

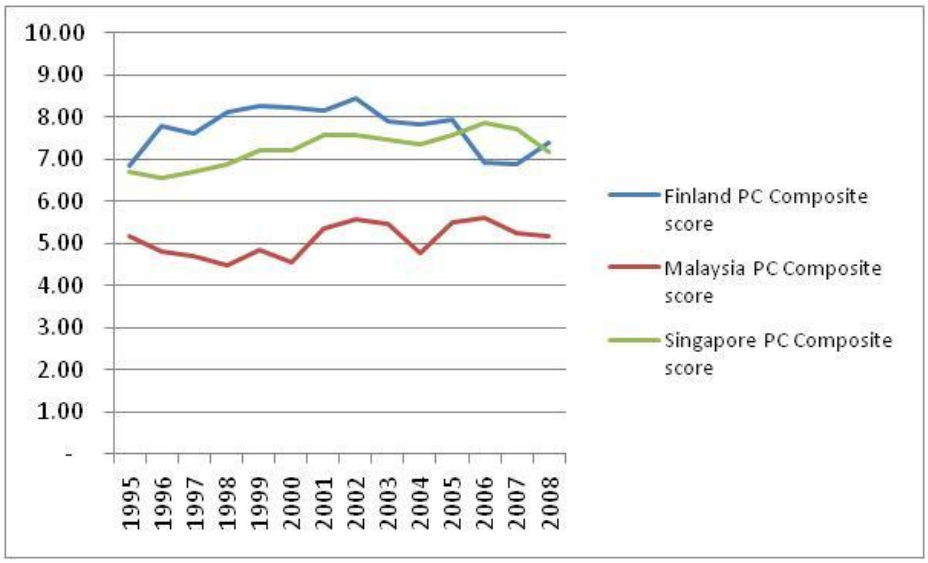


Figure 5.14: PC trends for Finland, Malaysia and Singapore

IC	Criteria	Finland	Malaysia	Singapore
PC	**Composite score**	**7.74**	**5.09**	**7.26**
PC	Business competition environment	7.55	5.44	6.56
PC	Government efficiency	6.16	4.44	6.94
PC	IP rights protection	8.09	5.99	8.01
PC	Capital availability	7.46	6.58	7.20
PC	Computers in use per capital	8.89	2.20	7.35
PC	Convenience of establishing new firms	6.89	7.32	7.88
PC	Mobile phone subscribers	9.05	3.77	7.04

Table 5.15: Means of PC indicators for Finland, Singapore and Malaysia

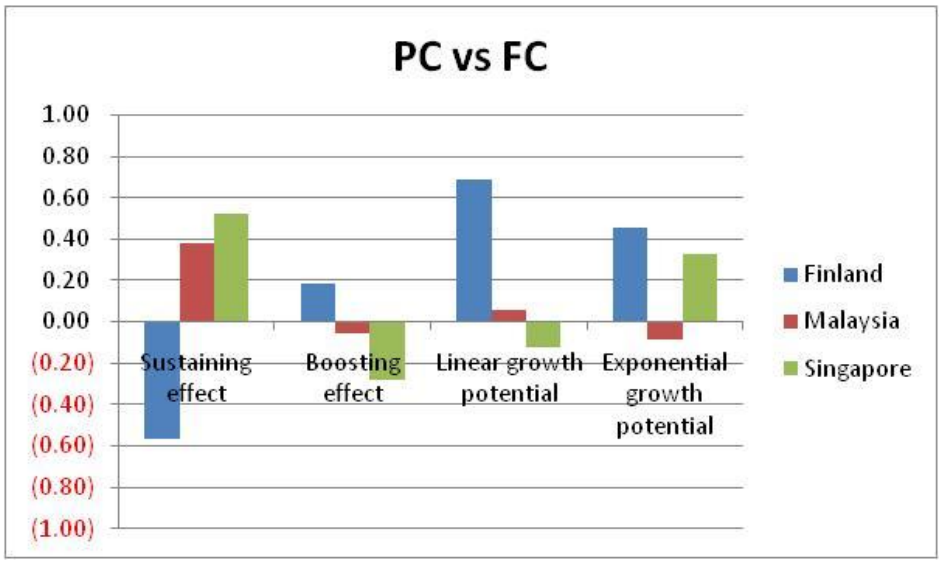


Figure 5.16: Results of correlation analysis between FC and PC

5.3.1 Finland

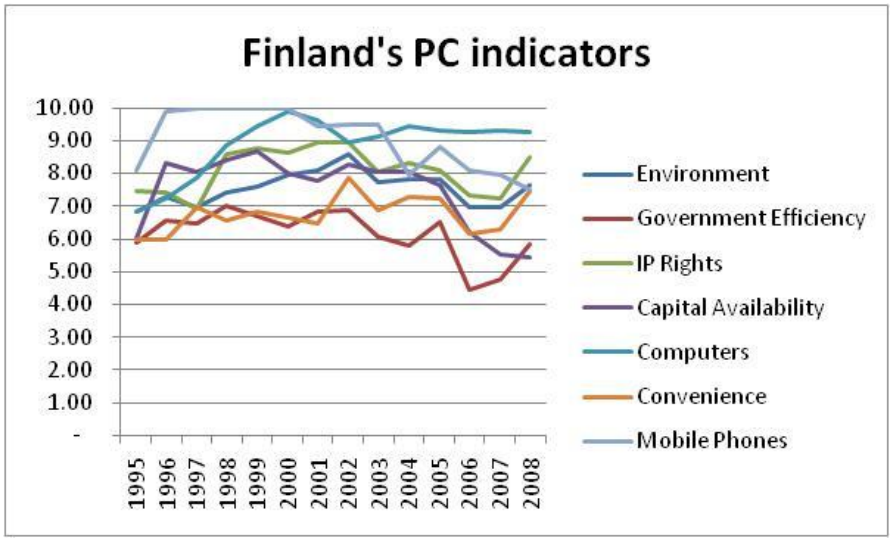


Figure 5.17: Trends of PC indicators for Finland

Finland scored a mean of 7.74 for PC, the highest PC score among the three countries. PC is the second most important factor which contributes to Finland's overall IC score, and is also the IC element that contributes most to its FC linear growth potential (r = 0.69) and exponential growth potential (r = 0.46).

Finland achieved a mean of 9.05 for mobile phone subscriptions. This indicator scored a top score of 10 from 1997 to 2000, but dropped gradually to 7.52 in 2008, perhaps as a result of the rest of the world catching up in terms of mobile phone usage. Computers in use per capita improved from 6.83 in 1995 to 9.28 in 2008, with a maximum score of 9.88 in 2000 and a mean of 8.89. The high usage rates for mobile phones and computers may be attributable to the success of ICT production in Finland, especially from Nokia, since the 1990s.

In recent years, however, Finland has lost ground on its ability to utilise ICT. According to Finland's Committee for the Future (CFF), it was ranked 17th globally on prevalence and usage of ICT and the internet (3-competitiveness), and 12th on ICT usage in public administration (e-government) (CFF, 2002). As technology matures, ICT production may expand and/or move to new locations. Thus, it is the ICT usage, not its production, which is pertinent for a nation's long-term economic growth.

Finland scored means of above 6 for other institutional environment factors such as IP rights protection (mean of 8.09), business competitive environment (mean of 7.55), capital

availability (mean of 7.46), convenience of establishing new firms (mean of 6.89) and government efficiency (mean of 6.16). Operating under the Nordic Civil Law regime, Finland is well-known for its protection on property rights and quality of judicial system to prevent unfair competition. Its business competitiveness, however, is hindered by high labour costs in hiring and firing. Financial restructuring in Finland occurred in 1993, after it joined the European Economic Area, with its banking and capital markets reformed to cater for financial availability to support the growth of ICT cluster. By the year 2000, 67% of the Helsinki stock exchange and over 90% of Nokia's shares were foreign owned, thus indicating increased openness to foreign markets.

Finland's PC: Key highlights

- Success of ICT
- IP protection and good judicial system
- Increased openness to foreign markets
- Lost ground on ICT utilisation
- High labour cost in hiring and firing

5.3.2 Singapore

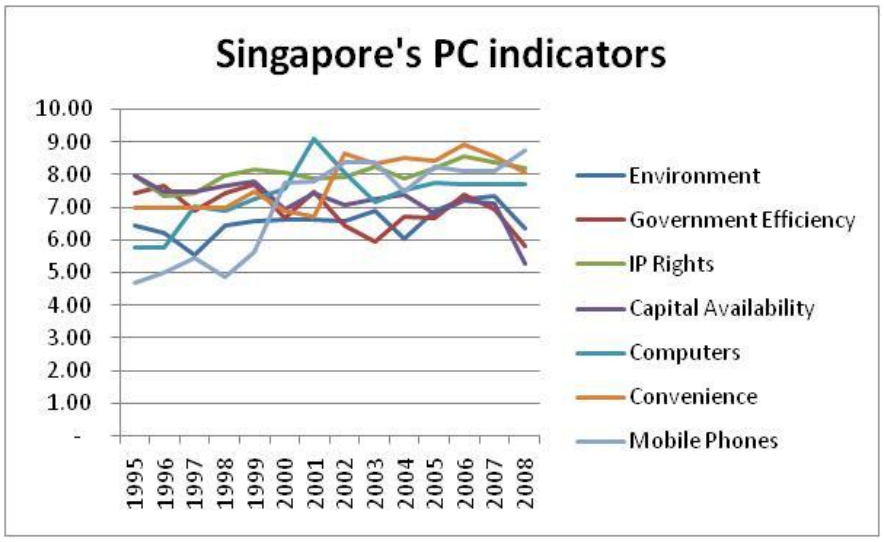


Figure 5.18: Trends of PC indicators for Singapore

Though Singapore lags slightly behind Finland with a mean of 7.26 for PC, it seems to be making an effort to continually improve performance in this area, as indicated by the slightly upward trending line. This is contributed mainly by the convenience of establishing new firms (mean of 7.88), protection of IP rights (mean of 8.01) and mobile phone penetration (mean of 7.04). The support towards entrepreneurship in particular is revealed through the first indicator, with Singapore ranked highly in the 2010 World Bank report for ease in starting a business (ranked fourth), employing workers (ranked first), getting credit (ranked fourth) and protecting investors (ranked second), all key components to kick-starting new businesses. The steep

increase in mobile phone subscription from 1998 onwards could be a result of the deregulation of the Singapore telecommunications industry in 1997 (Richardson, 1997), and with increased competition came better and more attractive mobile phone offerings for customers. According to the International Telecommunication Union, as of 2008, Singapore's mobile telephone penetration rate was 138%, the highest among the three countries (Finland 128.8%, Malaysia 102.6%).

Computer availability and usage is also one other indicator that has seen a net increase over the years, with a mean of 7.35. The IT2000 plan, which was key in driving accessibility to computers and the internet, was formed in 1992 in the recognition that Singapore's traditional role as a broker facilitating commercial exchanges among regional and global economies required a transformation. The vision was for Singapore to become one of the first countries in the world to have an advanced nationwide information infrastructure which interconnects computers in nearly every home, school and workplace (NCB, 1992). As then Minister for Information and the Arts George Yeo noted, "Geography will matter less in the future. We must therefore think of new ways to retain our position as a hub. Over the next 20 to 30 years, we must make sure that we have the new infrastructure to remain a junction for goods, services, people, information and ideas. If we succeed, we will be one of a number of great cities in the Pacific Century. If we fail, other hubs will displace us and we will be relegated to a backwater" (Rodan, 1998). With the emphasis on putting in place this new infrastructure, where computers become necessities, computer access increased from 74% in 2003 to 83% in 2009, and computer usage reaching 71% in the same year (IDA, 2010).

It is interesting to note, however, the rather steep decline experienced by the last three indicators from 2007 to 2008 – business competition environment (mean of 6.56), government efficiency (mean of 6.94), and capital availability (mean of 7.20). Though this may be unduly influenced by the economic crisis, it may also hint at the perception of excess government intervention through government policy and GLCs, which are seen as instruments to protect the nation's overall economic wellbeing, whether or not the steps taken are beneficial for the individual companies that form the private sector. The bureaucracy and costliness in doing business is further captured in the 2010 World Bank report, where Singapore lags behind others in the areas of enforcing contracts (ranked 13th) and registering property (ranked 16th). Though Singapore has attempted to ease property registration by improving its computerised system, the process still involves three procedures and five days, as opposed to Norway's fully

electronic system which allows land transfer to take place in just an hour. The enforcement in contracts in Singapore, while fast and efficient, costs almost 26% of the claim, whereas it costs just 12% in Thailand and 6% in Iceland (Yahya, 2009). In the case of capital availability, its decline may be more due to lack than to cost, as indicated by Singapore's thin capital market, with only 763 listed companies with a market capitalisation of S$681 billion[5] on the Singapore Stock Exchange as at March 2010, as compared to NASDAQ's 3,120 listed companies with a market capitalisation of US$3.9 trillion as at May 2007 (Wong, 2007).

While PC, like MC, shows a sustaining effect relationship with FC (r = 0.52), it differs in additionally providing exponential growth potential correlation (r = 0.32). Accordingly, if Singapore is able to improve on the areas of weakness in PC, such as environment for business competition, easing up of government bureaucracy, and capital availability, there is the possibility of further boosting its economic competitiveness. As mentioned earlier, while Singapore has a solid and high-grade supply of HC, its potential can only be fully tapped and leveraged on with the supporting processes and infrastructure, i.e. PC, in place.

Singapore's PC: Key highlights

- High mobile phone subscriptions due to deregulation of telecommunications industry
- IT2000: To be forerunner in advanced nationwide information infrastructure
- Possible excess government intervention, bureaucracy
- Thin capital market

5.3.3 Malaysia

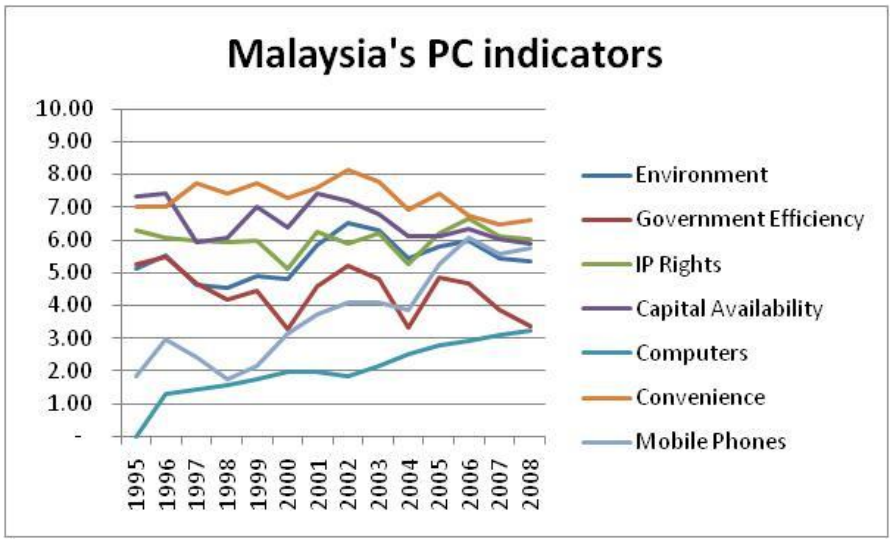


Figure 5.19: Trends of PC indicators for Malaysia

[5] Exchange rate is approximately 1.5 SGD to 1 USD.

Malaysia recorded a mean of 5.09 for its PC, the lowest score among the three countries, and aside from sustaining effects, Malaysia's PC has only a small linear growth potential effect on its FC (r = 0.05). The PC composite score for Malaysia started with 5.17 in 1995, fluctuated throughout the 14 years, and ended with the same score of 5.17 in 2008.

While above-average means are recorded in terms of business competition environment, IP rights protection, capital availability and convenience of establishing new firms, these indicators are also trending downward, with the exception of its business competition environment, which experienced a slight improvement in indicator score from 5.12 in 1995 to 5.34 in 2008. The steepest decrease is observed for government efficiency, with the score plunging from 5.27 in 1995 to 3.37 in 2008. The 2008/2009 GCR listed a number of competitive disadvantages which relate to Malaysia's PC, including IP protection, judicial independence, efficiency of legal framework, protection of minority shareholders' interest, financial market sophistication, regulations on securities exchange, effectiveness of anti-monopoly policy, number of procedures and time required to start a business, prevalence of trade barriers and burden of customs procedures.

In line with the 2008/2009 GCR, which listed mobile phone subscription and computer usage as competitive disadvantages for Malaysia, both of these indicators recorded means of below 4. The indicator scores for both computers in use per capita and mobile phone subscription have, however, improved over the years, with indicator scores increasing from below 2 in 1995 to 3.25 in 2008 for computers in use and to 5.74 for mobile phone subscription. This increase may be attributable to a number of factors, which include the ICT initiatives launched by the government, tax incentives for personal computer purchases, and reduction in the purchase prices of computers and mobile phones over the years.

One of the factors hindering investors in their attempts to raise capital and seek listing status in Bursa Malaysia, Malaysia's stock exchange, is the need to meet the 25% public spread requirement to "Bumiputera" (or indigenous group) under the Bursa Malaysia Listing Rules. A higher percentage of public spread of 50% is further required for companies with Malaysian-based operations. Recognising

Malaysia's PC: Key highlights

- Tax incentives to purchase computer
- Reduction of computer prices over time
- Specific "Bumiputera" shareholding requirement for listing purpose

the concerns of investors and in order to encourage capital and talent investments from leading foreign investors in the fields of ICT and biotechnology, exemption to this requirement is granted for companies with MSC or BioNexus status. In addition, the sixth Prime Minister of Malaysia, Datuk Seri Najib Razak, freed the services sector by ending the 30% Bumiputera equity rule in the hope of improving Malaysia's competitiveness.

5.4 Renewal Capital (RC)

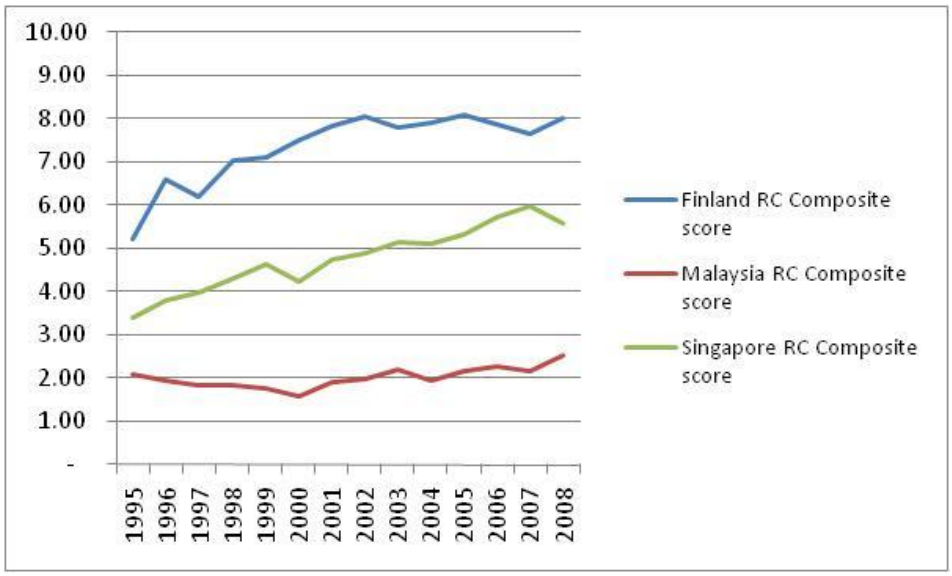


Figure 5.20: RC trends for Finland, Malaysia and Singapore

IC	Criteria	Finland	Malaysia	Singapore
RC	**Composite score**	**7.35**	**2.02**	**4.77**
RC	Business R&D spending	6.57	0.16	3.11
RC	Basic research	7.39	6.27	7.35
RC	R&D spending /GDP	8.23	1.22	5.01
RC	R&D researchers	9.28	0.47	4.92
RC	Cooperation between universities and enterprises	7.05	4.83	6.38
RC	Scientific articles	7.93	0.17	5.12
RC	Patents per capital	5.56	0.07	1.87

Table 5.21: Means of RC indicators for Finland, Singapore and Malaysia

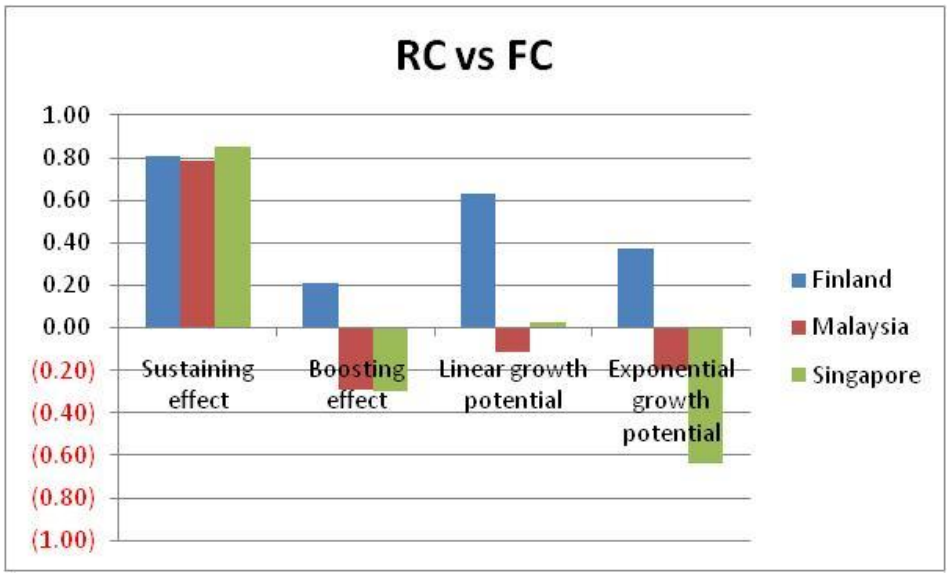


Figure 5.22: Results of correlation analysis between FC and RC

5.4.1 Finland

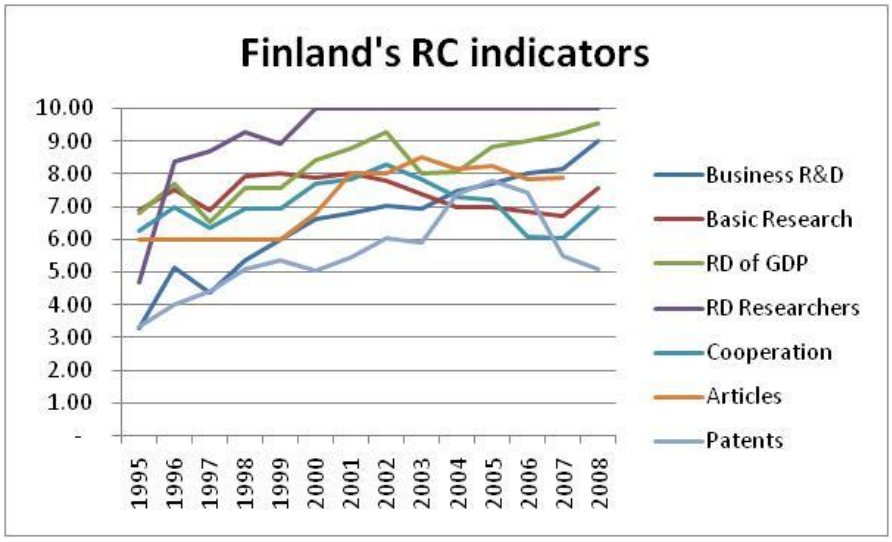


Figure 5.23: Trends of RC indicators for Finland

Not only does Finland's RC have all four sustaining (r = 0.81), boosting (r = 0.21), linear growth potential (r = 0.63) and exponential growth potential (r = 0.37) effects on its FC, it is vastly higher ranked with a mean of 7.35 as compared to Singapore (4.77) and Malaysia (2.02).

This is especially attributed to the amount it invests in R&D both as a nation (R&D of GDP at 80th percentile) and at business level (business R&D spending mean of 6.57). In 2007, Finland spent 3.45% of its GDP on R&D, as compared to an OECD average of 2.26%. In 2008, Finland increased its R&D spending to 3.7% of GDP, making it the country with the highest R&D expenditure as a percentage of GDP in the OECD after Sweden (Statistics Finland, 2009). Business R&D spending has also shown the steepest trend of increase over the years, and this could be attributed to the explosion of the telecommunications industry in the late 1990s and the focus that Nokia placed on telecommunications and GSM technologies development. Nokia accounts for almost one third of total Finnish investment in R&D and the R&D it carries out in Finland constitutes half of all Finnish corporate R&D. While the Finnish Parliament recognises Nokia's central role in Finland's innovation and renewal system, with its influence not only in terms of finance, but as well as on education and learning, know-how proliferation, and corporate R&D carried out by other firms (CFF, 2005), it is sobering to note that without Nokia's contribution, Finnish R&D investment would fall below the OECD average. With the telecommunications industry facing saturation and Nokia's Swedish rival Sony Ericsson struggling to survive, one wonders if Finland is simply over-reliant on Nokia,

and if the country can sustain itself, not just in terms of renewal, but even in terms of economic viability, if Nokia were to one day fall.

Another dimension to Finland's RC is the presence of R&D researchers, which Finland has been ranked top in since 2000 (scoring 10 on the index in our comparative study). Despite this, the number of patents has been dropping in recent years, suggesting that while there may be creativity and invention, the transfer of these into commercially viable products (evidenced by patents), which is key to innovation, may be somewhat lacking. There is also a concern that Finland may be losing its creative class to conservative materialism, which is increasingly taking over Finnish society. Workplace managers, rather than promote initiative and creativity, are preferring to closely supervise their subordinates' activities in a bid for increased focus on efficiency, which may rob the creative class of the space and oxygen it needs to dream, create and innovate (CFF, 2005). 18th century writer Alexander Tytler believed that all great nations re-enact an inevitable cycle that takes them from bondage through liberty to abundance, and then from complacency through dependence back into bondage (Kao, 2007). This very cycle may be afflicting Finland, with Finnish people abandoning the creation of new things and instead defending established positions, maintaining routines or enjoying the fruits of earlier work (CFF, 2005). With more choosing routine stability over creative chaos, a recent study conducted by the Committee for the Future and the Society of Finnish Labour in early 2005 suggested that Finland would have lost 150,000 creative people within a year – the proportion of the Finnish population that comprises of the creative class has been falling, from 22% in 2002 to only 17% in 2005. This loss of creativity, essential for innovation and renewal, is of cause for concern for Finland.

Cooperation is also an interesting indicator to observe in the context of Finland's innovation ecosystem, which by definition illustrates a symbiotic and mutually-reinforcing relationship between all stakeholders in the nation, particularly universities and companies. The indicator, which measures knowledge transfer between academia and corporations, has fluctuated between the 60th and 80th percentile, with an overall mean of 7.05. While high, it is perhaps surprising that the indicator is not even higher, given that Finland is often used as a role-model for an innovation system that is closely knit with strong relations between the parties involved. This may

Finland's RC: Key highlights

- High R&D expenditure (3.45% of GDP)
- Symbiotic and mutually-reinforcing relationship between national stakeholders
- Over-reliance on Nokia
- Potentially losing the creative class to conservative materialism

hint towards the need for Finland to transform from its present closed ecosystem, to an open breeding ground of sorts, which welcomes investment and innovation from both local and global sources.

5.4.2 Singapore

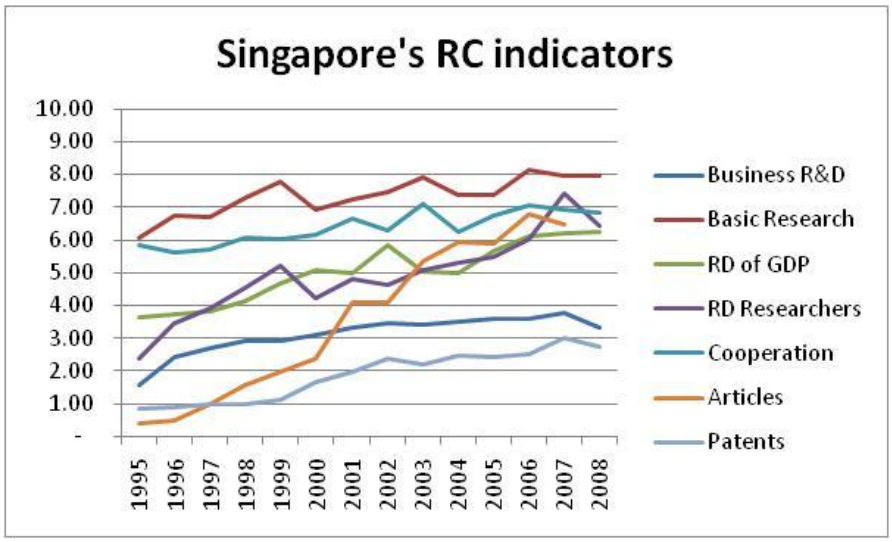


Figure 5.24: Trends of RC indicators for Singapore

Singapore is an interesting case study in the potential gap between perception and reality. Though it may ranked lower than the 50th percentile in RC (mean of 4.77), Singapore has often been used an example of a nation committed to innovation. According to the latest BCG/NAM/MI International Innovation Index, jointly produced by The Boston Consulting Group (BCG), the National Association of Manufacturers (NAM) and The Manufacturing Institute (MI), Singapore has been ranked first in innovation leadership, with Finland, the RC superpower in our study, ranking only seventh in the same study [6](Andrew *et al*, 2009). Kao, in his book *Innovation Nation*, cites Singapore as the country closest to achieving true "innovation nation" status. So where does Singapore truly stand?

In our study, Singapore has fared well in terms of basic research (mean of 7.35) and cooperation between universities and enterprises (mean of 6.38). This reflects Singapore's integrated national innovation policy which connects education, workforce training, global

[6] To rank the countries and states, the study measured both innovation inputs and outputs. Innovation inputs included government and fiscal policy, education policy and the innovation environment. Outputs included patents, technology transfer, and other R&D results; business performance, such as labour productivity and total shareholder returns; and the impact of innovation on business migration and economic growth (Andrew *et al*, 2009).

competitiveness and R&D based on a common agenda of innovation. In true Singaporean fashion, institutions have been set up in support of this vision. For instance, SPRING Singapore is the government agency dedicated to developing innovative companies and nurturing a competitive sector for small-to-medium enterprises (SMEs). It collaborates with SMEs in financing, access to markets, technology and innovation, and the development of capabilities and management. SPRING Singapore further acts as the national standards and accreditation body, developing and promoting the use of internationally recognised standards and quality assurance to facilitate trade and boost competitiveness. One such certification is the Singapore Innovation Class (I-Class), which was launched in 2002 as the certification for the Business Excellence Niche Standard (Innovation). It provides national recognition for organisations which have management systems and processes in place to achieve excellence through innovation, and hence encourages organisations to enhance their innovation management capabilities (Government of Singapore, 2009).

Perhaps the most famous example of Singapore's belief in research as key to the nation's long-term economic development and emphasis on effective knowledge transfer between corporations and academia is the Biopolis (Figure 5.25). Opened in 2003, the Biopolis is an integrated R&D complex focused on biomedical science. It spans across two million square feet of space and houses nine public research institutes and R&D laboratories of biotechnology and pharmaceutical companies. By providing proximity to public and private sector research, the Biopolis provides common infrastructure such as research facilities, equipment and amenities to facilitate the synergy of scientific ideas, encourage cross-disciplinary collaborative research and lowering the entry barrier for companies to set up operations here (Yeoh, 2008). The Biopolis is located within a region called One North, which is marketed as "Singapore's icon of the knowledge economy", and is a 500-acre district close to the National University of Singapore, National University Hospital, and Singapore Polytechnic, thus further aiding collaboration between universities and biomedical firms. A*Star is also committed to

Figure 5.25: Singapore's Biopolis

supplying the Biopolis with top talent, embarking on an aggressive programme to encourage more Singaporeans to pursue graduate studies locally as well as in top universities overseas. A*Star's scholarship programs are aimed at providing an important pipeline of R&D talent for Singapore in the coming years, and setting the stage for these scholars to return to Singapore to continue and further their research careers. This may well have contributed to the 9% growth in total number of researchers, from 25,033 in 2006 to 27,301 in 2007, and prospects for these researchers are promising, with the private sector employing 59% of all researchers. Accordingly, these efforts have translated into Singapore's upward trending score in terms of R&D researchers (mean of 4.92).

Singapore's R&D spending as a percentage of GDP has also been climbing over the years, from 1.9% in 2000 to 2.6% in 2007 (Lai, 2007), and its mean score is currently at the 50th percentile (5.01). While Singapore's R&D spending is now slightly above the OECD average of 2.3%, Singapore has typically benchmarked its performance against other R&D intensive countries such as Finland and Sweden, and is aiming to further raise its overall spending on R&D to 3.5% by 2015. To achieve this target, the government is focusing on encouraging R&D by the private sector , which as at 2007 contributes to 66.8% of total R&D spending (Huang, 2010). This is important, given that Singapore has been lagging in terms of business R&D spending on a global level (mean of 3.11), and the awareness of this fact has in turn contributed to its upward trend over the years of analysis. In recent years, increases in private sector R&D spending have outpaced public sector R&D spending, with the private sector R&D expenditure increasing by 28.6% from S$3,293 million in 2006 to S$4,235 million in 2007, while public sector R&D expenditure increased by 22.6% from S$1,717 million in 2006 to S$2,104 million in 2007. Unlike Finland, Singapore's business R&D expenditure is not primarily contributed by one single company. Instead, private sector R&D expenditure is dominated by the manufacturing sector, which accounted for S$2,987 million or 70.5% of total private sector R&D expenditure in 2007. Within manufacturing, the electronics sector was the largest source of growth, increasing its R&D spending by 61.7% in 2007, and also contributed most to R&D expenditure by the manufacturing sector (73.1% in 1997). The semiconductor sector and the information communications and consumer electronics sector were, in turn, the largest contributor to R&D spending by the electronics sector. This large R&D contribution by the manufacturing and electronic sectors makes sense, given that manufacturing, one of Singapore's primary exports, accounted for 26% of Singapore's GDP in 2009, and is led by the

electronics sector, which comprises 31.5% of Singapore's manufacturing output in 2009 (U.S. State Department, 2010).

With Singapore's obvious efforts in RC, our study shows a highly positive relationship with FC in terms of sustaining effects (r = 0.85), but a small relationship to FC's linear growth potential (r = 0.03). This seems to indicate that while RC is highly important in sustaining current levels of economic competitiveness, further increments in RC may not have much impact. This could be due to the fact that Singapore has only focused on innovation in recent years, and thus the effects have not yet been translated into FC gains. Alternatively, Singapore's RC development may be just keeping pace, rather than gaining ahead, on a global scale, and to effectively boost competitiveness, there may be a need for Singapore to look at charting new territories for innovation, rather than simply following in the footsteps of innovation trendsetters.

Singapore's RC: Key highlights

- Government agencies which encourages innovation and research
- Biopolis: Attractor of top scientific talent
- Increasing R&D/GDP spending: 2.6% (2007) to 3.5% (2015)
- Possible need to chart new territories for innovation

5.4.3 Malaysia

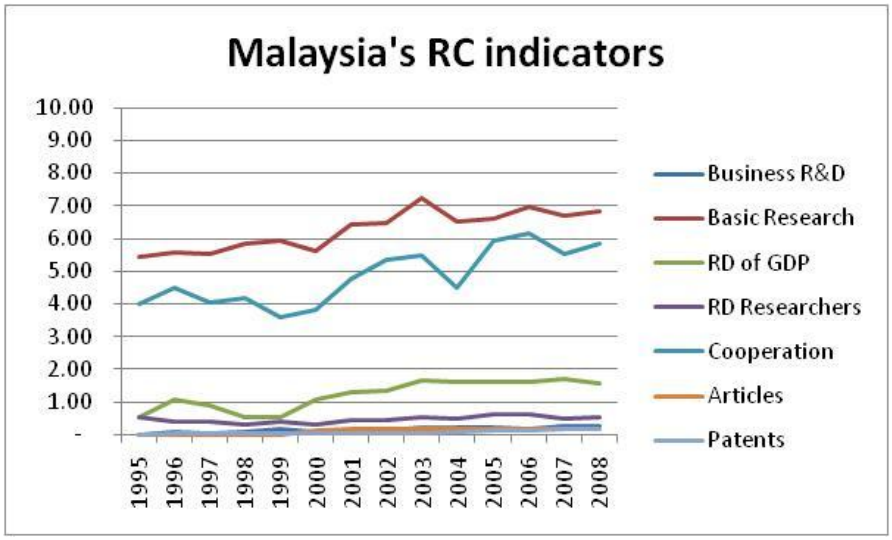


Figure 5.26: Trends of RC indicators for Malaysia

Despite efforts from policies makers to increase awareness of the importance of R&D and innovation in generating value added products and services, Malaysia still lags far behind in terms of its RC competitiveness. Among the four IC elements, Malaysia recorded the biggest gap in its RC (mean of 2.02) as compared to Finland (mean of 7.35) and Singapore (mean of

4.77), and its RC is also the only IC element that does not have any effect on FC other than sustaining effects.

Seven out of eight of Malaysia' RC indicators recorded below-average means. Basic research is the only indicator with an above-average mean of 6.27. This score has increased from 5.43 in 1995 to 6.84 in 2008, indicating an improvement in basic research, mainly in the field of ICT, which would support Malaysia in enhancing its long-term economic development. Though cooperation between universities and enterprises has also improved over the years, from a score of 4.00 in 1995 to 5.85 in 2008, university-industry linkages are still too weak to properly support the integration of research and innovation system, and this remains one of the challenges that Malaysia continues to face (World Bank, 2007).

The indicators of business R&D spending, number of R&D researchers, number of scientific articles and total patents granted per capita all recorded means of less than 1, while public R&D expenditure recorded a mean of 1.22, indicating that Malaysia is ranked one of the weakest countries in the world in these aspects. This is further evidenced when comparing Malaysia with Finland and Singapore – in 2006, R&D spending as a percentage of GDP for Malaysia was less than 1%, as compared to 3.4% for Finland and 2.3% for Singapore. In the same year, full-time R&D researchers in Malaysia numbered 0.4 for every thousand people, while Finland and Singapore numbered 7.7 and 5.7 respectively. While Malaysia has attracted significant FDI over the years and served as a "factory" for leading multinational E&E companies, the indicator score for business R&D spending remains low, highlighting that these foreign companies do not conduct much R&D in Malaysia or acquire much high value-added goods and services from Malaysian companies (World Bank, 2007).

The low scores and stagnant growth in terms of R&D researchers, the publishing of scientific articles, and the number of patents granted per capita may be a result of a lack of interest or opportunities in pursuing science and technology courses in Malaysia.

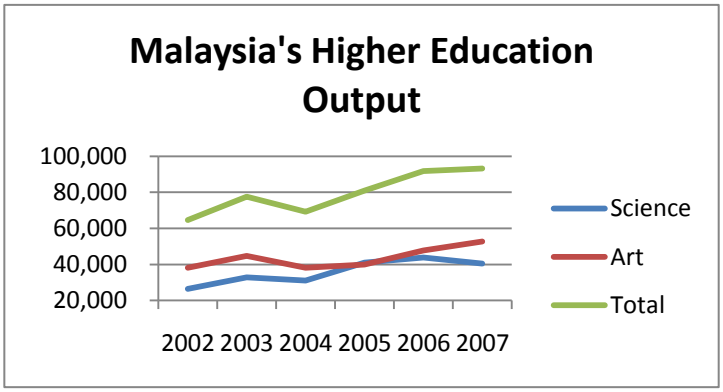


Figure 5.27: Malaysia's Higher Education Output by Major (Ministry of Higher Education Malaysia, 2008)

As Figure 5.27 illustrates, despite Malaysia's attempts to generate more interest in ICT and science, majority of the graduates from local public and private universities are still choosing to major in Arts (for example, Law, Economics, Business, Accounting, and Social Sciences), rather than Science (for example, Information Technology, Medicine, and Computer Science) and Technical (for example, Engineering). It thus seems to indicate that there exist some deep-rooted cultural and mental barriers that Malaysia must overcome to be successful in its pursuit to become a truly knowledge-driven economy.

Malaysia's RC: Key highlights

- Basic research mainly in ICT
- Full-time R&D researcher numbering 0.4 in 1000 (Finland 7.7, Singapore 5.7)
- Majority of graduates major in "Arts" stream
- Poor university-industry linkage

6 A Composite Summary

This sixth chapter combines the quantitative analyses and documentary analyses from the fourth and fifth chapters into a composite summary, before providing a glimpse into a prospective future for the three countries of our study.

To aid in understanding how the various findings from the three countries link together, we have constructed Figure 6.1 to showcase how IC ranking, IC correlation, and each country's economic context relate to one another in terms of national IC benchmarking.

While Finland and Singapore have small differences in overall IC ranking, Finland's advanced position on the curve is indicative of the correlation effects of all its IC elements in current and future terms, while Singapore's IC elements are highly lacking in boosting and growth potential effects, with the exception of HC and PC, thus hinting that it is close to saturation point and in need of renewal. Malaysia is in a similar position to Singapore, albeit at an even lower stage of IC and with room to grow in terms of MC.

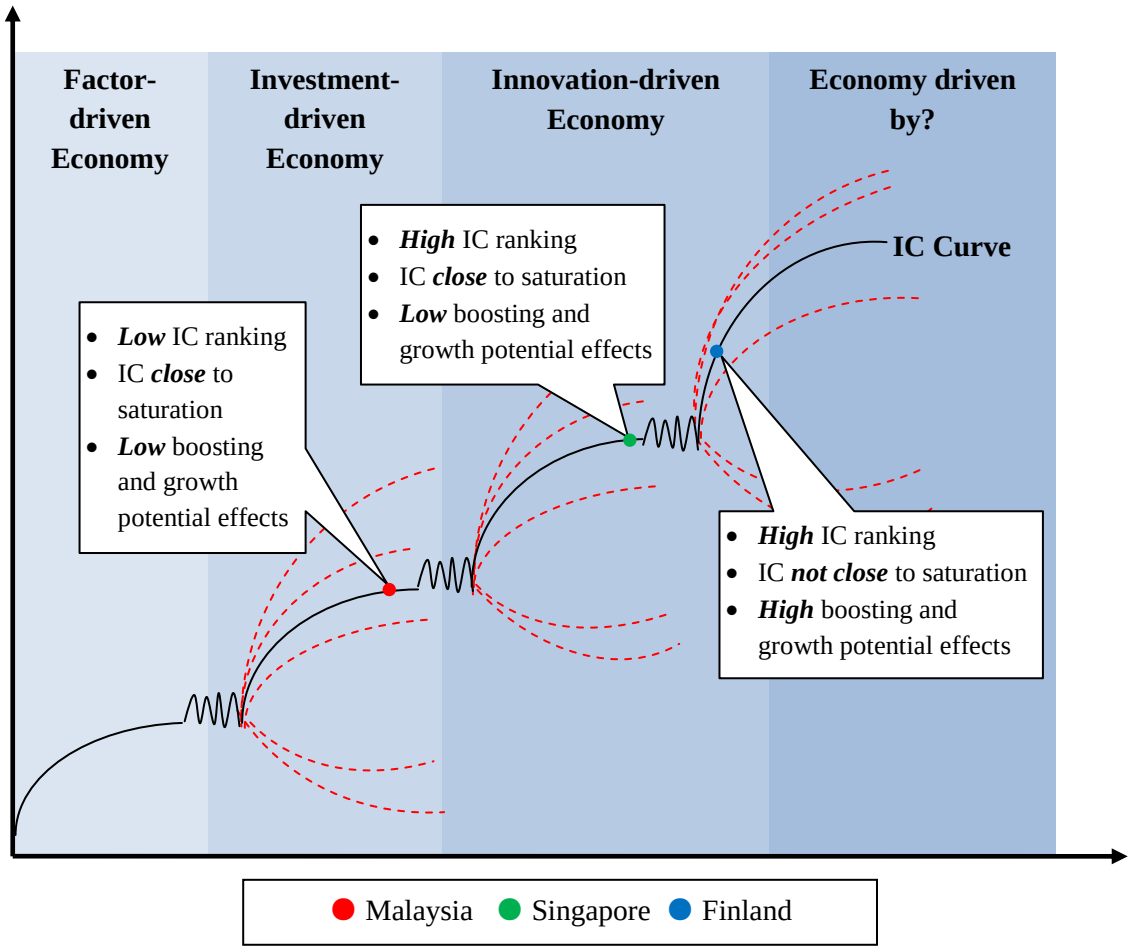


Figure 6.1: Possible evolvement of the IC curve based on dissipative structure theory

The reader may also have observed that the graph is gleaned from the complexity theory of dissipative structures. As in accordance with chaotic systems, a dissipative structure operates in a semi-stable state based on non-linear logic, and is exemplified by its ability to absorb considerable amounts of external pressure in some instances, while small disturbances can cause radical change to the structure in other cases (Burnes, 2005). In awareness of the dynamic, complex and non-linear nature of IC, we observe that the three nations in our study will go through a period of exponential IC progress before nearing the "dissipative" phase that is often caused by external events, but which require action on the part of the countries in determining how they will proceed. In this sense, Finland is placed on the upward slope in recognition of how all its IC elements are providing current and future fuel to its economic competitiveness in terms of boosting effects and growth potential effects. However, as both Singapore and Malaysia seem to be nearing saturation, they are positioned on the tapered slope, close to a "dissipative" phase, indicating that the nations are facing a critical juncture and will need to consider how best to move forward.

6.1 Innovation virtuous cycles

Our analysis has further allowed us to gain a better understanding of how the three countries' IC profiles and ISMs have impacted each other, as illustrated by Figure 6.2. In our detailed analysis of the countries, we have observed certain commonalities in each of their innovation journeys – firstly, their initial ISM adoption seems to be the focused factory model, with Finland focusing innovation in forestry, Singapore in manufacturing and electronics, and Malaysia in ICT; and secondly, this ISM adoption was influenced less by an awareness of strategic national IC and more by economic considerations from initially being in factor-driven economies. For instance, with forestry being Finland's main initial source of economic growth, it would make sense for it to focus its early innovation efforts in that area, while for Malaysia, ICT was considered a route in which to obtain economic competitive advantage, albeit ICT being closer to IC taxonomy than forestry or manufacturing. Despite this common beginning, all three proceeded on unique paths, which may be a consequence of two effects – their IC profiles, and the influence of other national capitals on the process.

For Finland, the existence of a strong HC and PC base was enhanced through an increasing emphasis on renewal and innovation in all facets via RC, and thus brought it from being a focused factory to a large-scale innovation ecosystem, which in turn led to the development of

all its IC dimensions. Conversely, Singapore harnessed its strong HC and MC base (aided by its geographical location) via PC to take on the Hollyworld model, focusing on attracting key talent for newly targeted areas of innovation such as life sciences. This increased focus on research in a key area in turn developed its HC and RC capabilities.

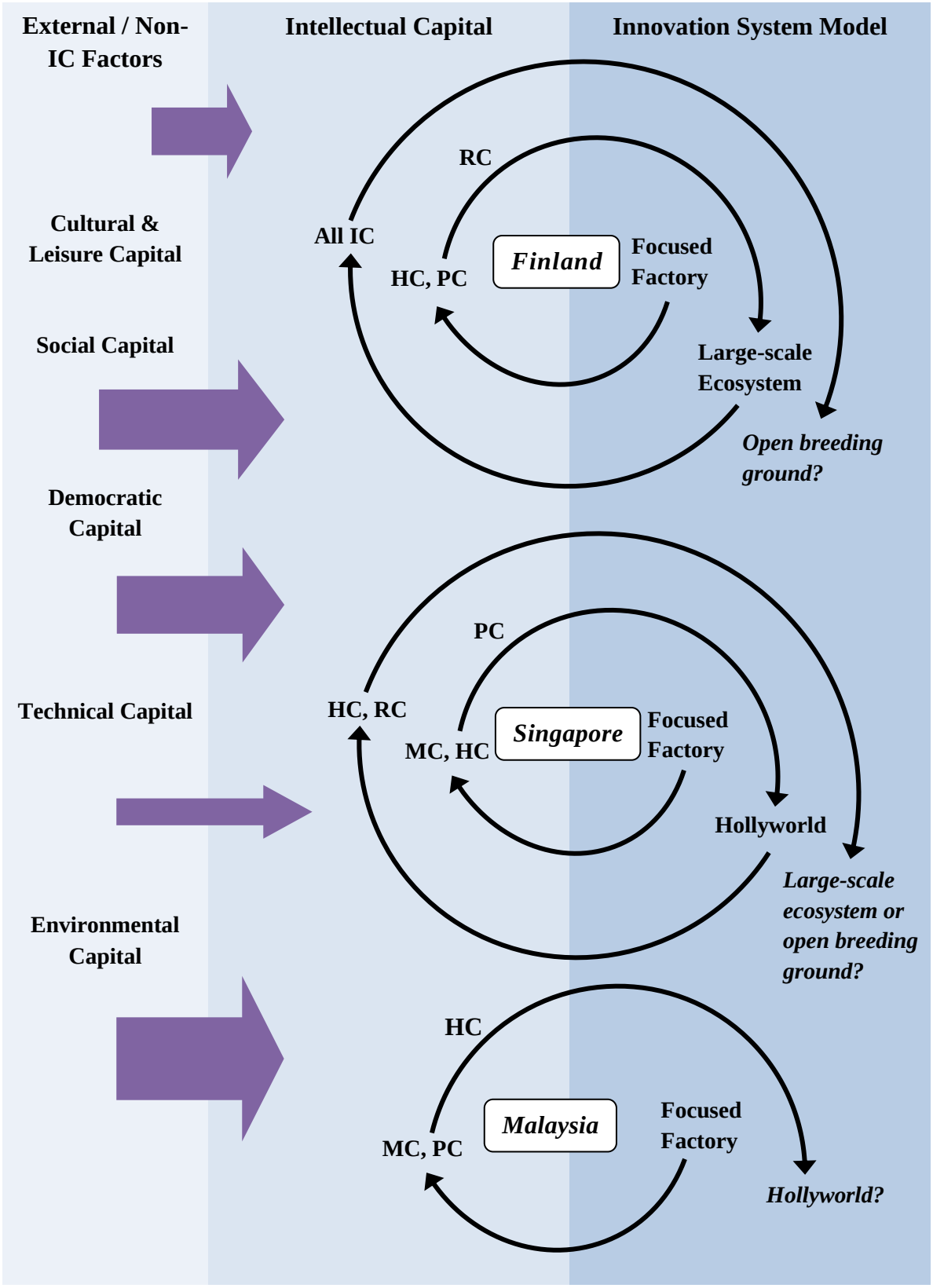


Figure 6.2: Development of IC profiles and ISMs for Finland, Singapore and Malaysia

Malaysia, however, seems to be struggling to move beyond the focused factory model despite efforts put in by the government into building the infrastructure to facilitate ICT development, such as the MSC, and develop talent through the MDC and specific higher education institutes such as the MMU.

Malaysia's struggles and Singapore's success despite similar cultural and historical backgrounds, and Finland and Singapore's divergent but successful paths, and where each country stands on the IC curve per Figure 6.1, may consequently be further explained by other non-IC factors that influence and are influenced by IC, such as the national capitals that PricewaterhouseCoopers (2005) puts forth. Examples of such effects include the following:

Cultural & leisure capital

- Singapore and Malaysia's Asian and Confucian-influenced cultures which emphasise hierarchy, hard work and collectivism, may explain their education systems, which involve remedial lessons and tuition, streaming of students based on levels of ability, longer hours of lessons, and larger pupil-teacher ratios. However, the resulting over-reliance on authority may also be a pitfall in terms of developing self-thought.
- Finland's cultural reserve and reticence may explain its "closed" society and lack of MC.
- Finland's homogenous population could also have been a key factor in fostering unity and commitment to cooperate and collaborate, hence facilitating the development of the ecosystem approach.

Social capital

- Singapore's emphasis on foreign talent may conversely be affecting its social capital, with its local people feeling underappreciated and undervalued by their own country and thus lowering their sense of belonging. Increased openness towards globalisation, while aiding acceptance of foreign ventures, may also actually exacerbate the problem of local alienation by "driving" locals away to offshore greener pastures.
- Social unrest and inequality between the different races and the resulting disunity in Malaysia may prove to be a major challenge for the nation in implementing its policies, IC related or otherwise, effectively, thus possibly explaining its lacklustre performance.

Democratic capital

- The hierarchal Asian culture prevalent in Singapore and Malaysia may hint as to why Singapore's autocratic style of government leadership and politics is so successful as compared to Malaysia's more democratic and multi-party government political environment.
- The heterarchal Western culture prevalent in Finland, where every party is able and given space to contribute, may conversely facilitate its ecosystem, multi-stakeholder approach to innovation, and the government in turn is thus able to provide its citizens with more freedom of choice and thought.

6.2 What's next for the three countries

Up till now we have seen the courses which the three nations have taken, and where they stand as of today. What then, is next for the three countries? This section summarises the countries' key challenges and, in consideration of the observations gained from our analysis, we also put forth steps we would like to see the countries take to combat these challenges in preparation for the future (see Table 6.3 for a snapshot, and Appendix F for the full detailed write-up).

Country	Key IC element	Current ISM focus	What's needed next
Finland	RC	Large-scale ecosystem	"Open breeding ground"
Singapore	HC	Hollyworld	Passionate citizens
Malaysia	MC	Focused factory	"Brain drain" to "brain gain"

Table 6.3: Finland, Singapore and Malaysia – current snapshot and looking ahead

6.2.1 Finland

Finland has achieved great success in transforming from a factor-driven economy to its current innovation-driven economy. Finland operates in a large-scale ecosystem innovation system, where an ecosystem refers to a self-sustaining system, capable of maintaining itself with nothing requires from outside except for energy or light. However, in order to stay at the forefront of innovation, Finland needs to explore the advantages of innovation in a world without borders, and perhaps move from a large-scale ecosystem to an innovation breeding ground, through leveraging on existing network benefits while attracting the right talent and investment for renewal and then exporting innovation internationally. As reported by the Academy of Finland, one of the areas which need to be addressed is the low level of

international involvement in Finnish research system, where only 3% of researchers in Finland are foreigners, as compared to 10% or more in Sweden, the Netherlands, etc. This shows that the innovation ecosystem Finland operates in is a "closed" system – while it has developed Finland's HC, PC and RC, there is less emphasis on the MC dimension, and its "closed-ness" does not attract foreign talent like the Hollyworld innovation model does. The ability to sustain the critical creative mass required for innovation is particularly pertinent, when low numbers of foreign researchers are coupled with other internal HC issues, such as an ageing population. Moving forward, Finland needs to develop its capabilities in providing competitive solutions to its international clients, and foster interaction between Finland and the global society. While our study has shown that Finland has obtained high scores in HC, PC and RC, it faces a low MC, particularly in the export dimension. This calls for increase of Finland's ability to bring true globalisation to the country. Accordingly, it may thus need to develop beyond an ecosystem, to an "open breeding ground", which speaks to not just the development of innovation on local soil, but the welcoming of foreign investment and collaboration, which can further lead an even faster rate of "innovation breeding" than it is now experiencing.

6.2.2 Singapore

HC – the platform on which this tiny nation was built – has served Singapore well. But our analysis seems to indicate that the emphasis on HC from the perspective of talent may no longer be enough. As Amidon (2005) writes, "the real architectural issue may not be a matter of expertise, skills, or know-how; it may be a matter of psychology, how they are motivated to innovate." If having passionate and motivated citizens is what it takes, Singapore may be in trouble. While Singapore's pro-immigration policies and emphasis on foreign talent have served it well in a time when people were less mobile and more inclined to put down their roots after a major move, the increasing state of globalisation has made talent, both local and foreign, highly mobile. This may result in a generation choosing to go where "the grass is greener" and where they feel more appreciated, after having grown up feeling being alienated by its own leaders in favour of foreign talent. As Singapore Member of Parliament Indranee Rajah noted recently, "If you think of Singapore as a family, the Singapore citizen is the biological child asking why do you care for my foster brother and sister more than me?" (Saad, 2010). This sense of alienation and favouritism towards the foreign "foster child" may in fact be one reason why a large number of students who study overseas are increasingly choosing to stay abroad and work instead of returning home. They also cite reasons such as a lack of job opportunities, a stressful environment and overly fast-paced living, and a lack of appreciation

of their talent by local firms (AsiaOne, 2009b). A dispassionate and disconnected next generation may thus be Singapore's greatest challenge yet, and may explain the "make it or break it" crossroad it seems to now be facing in terms of IC. The old ways of simply attracting talent may now no longer suffice – perhaps the Singaporean ISM should be evolved beyond Hollyworld, which connotes a temporal involvement based on level of attraction, into a true ecosystem and breeding ground that can allow its own internal talent to feel treasured and at home in.

Interestingly, "building a distinctive global city and an endearing home" is one of the recommendations put forth by Singapore's Economic Strategies Committee (ESC) as a priority for Singapore in the next decade (see Appendix F2 for details on the seven recommendations by the ESC). In a bid to allow Singapore to be less clinically business-like and more culturally dynamic, the ESC recommends looking towards the softer side to growth, by emulating cities such as New York and London in becoming a "leading cultural capital" and a "distinctive global city". The ESC provides the rationale that people are attracted to such cultural centres "not because of the specific economic activities they conduct but because people want to be there… Being a global city and a meeting point in Asia for enterprise, talent, cultures and ideas will be a source of competitiveness and growth in its own right" (Kolesnikov-Jessop, 2010). Accordingly, the ESC suggests achieving this by attracting and nurturing diverse pools of talent and making Singapore a hub in Asia for thought and practice leadership, developing Singapore into a leading cultural capital by investing more in supporting the arts and making Singapore more competitive as an art trading hub, and providing the best quality of life in Asia. Again, however, this recommendation seems to have an underlying agenda of attracting foreign talent, which is not wrong in itself, and is perhaps continually necessary for a small nation such as Singapore. But as Senior Minister Goh Chok Tong himself noted, Singapore needs to find ways to create a sense of bond and belonging among the next generation (AsiaOne, 2009a), and engage them in a way that creates commitment to seeing to the future well-being of the country of their birth. Otherwise, the benefits of other recommendations such as intensifying efforts to ingrain an innovative mindset among the younger generation of Singaporeans would simply not flow to the tiny nation.

6.2.3 Malaysia

Malaysia has successfully transformed itself from a factor-driven economy into investment-driven one, and the next quantum leap, if successful, would be becoming an innovation-based

economy. Operating under the focused factory ISM, Malaysia has concentrated its efforts on national innovation initiatives such as ICT and biotechnology and applying the "cluster" concept in positioning ICT and biotechnology companies, their supporting industries and other institutions in close proximity to one another to enable knowledge exchange and timely support. The first significant national innovation initiative, the MSC, was a good starting point for other innovation initiatives due to the increased role of ICT globally. The second national innovation initiative, BioMalaysia, has rightly capitalised the resources uniquely available to Malaysia, for example the richness of its biodiversity and the availability of palm oil for biofuel. However, current and future national innovation initiatives can only be successful if the required physical infrastructure and IC elements are in place.

In recent years, Malaysia has seen continuous emphasis by policy makers on the importance of innovation and the nurturing of a "first class mentality". While all four IC elements in Malaysia have scored lower than Finland and Singapore, Malaysia's HC has shown a heartening improvement over the years. The commitment and investment of the Malaysian government to higher education, for instance, has paid off handsomely in the form of a rapid increase in higher education enrolment. However, Malaysia is presented with a number of constraints in developing its HC. The ability of Malaysia to produce the critical mass of knowledge workers required for innovation is limited by the structural challenges in its education system, such as the relevance of higher education curriculum to economic development, the adequacy and quality of educators and other resources, and so forth. While its neighbouring country, Singapore, has been strengthening its ability to attract foreign talent in order to boost its innovation capacity, Malaysia has instead implemented a more reserved and protectionist approach which favours local recruits over foreign talents. As highlighted by Yahya and Kaur (2010) and Hassan (2008), not only does the country plan to reduce the total number of foreign workers by 200,000 in 2009, and an additional 300,000 by 2015, this reduction does not distinguish between professional foreign talent and foreign manual workers. At the same time, Malaysia is continuously losing its local talent to other countries which offer better compensations and living conditions. The ability of Malaysia to convert its "brain drain" to "brain gain", and to form a united and committed society living as "One Malaysia" is pertinent to increasing Malaysia's competitiveness and to moving the nation into the knowledge economy.

7 Conclusions & Proposals for Further Research

This final chapter presents our conclusions and thoughts on the implications of the study for national IC strategy, and ends with proposed areas for future research.

7.1 Conclusions

We began this paper by asking the question: "How are IC elements affecting and affected by each nation's unique context and use of ISM?" We have found that, firstly, certain IC elements have a higher level of influence on economic competitiveness, which indicates the possibility for strategic IC investment. Further, our study has shown that the focused factory ISM is the common starting point for Finland, Singapore and Malaysia, albeit with initial adoption due to economic factors rather than IC awareness. Subsequent ISM adoption is influenced by contextual conditions and the IC-ISM process is reiterative, leading the countries to possess unique IC profiles that in turn require unique policies for their future. Our study seems to indicate that the large-scale ecosystem ISM is at present the most advanced model for IC development, but also hints at our newly-coined "open breeding ground" as the next step in ISM development.

7.1.1 Implications for national IC strategy

This paper has delved deeply into the stories of Finland, Malaysia and Singapore to allow for a better understanding of the successes and pitfalls of national IC strategy. The following section presents some implications from the study that we believe should be considered when a country chooses to implement a national IC strategy.

7.1.1.1 Consider context

The country needs to evaluate and be aware of how its existing cultural and leisure capital, social capital, democratic capital, environment capital, technical capital and IC interact to provide it with its unique context. In other words, one country's successful IC strategy may not be a good fit for another country's adoption, as certain conditions that were necessary for success may be unique to the country's context and not easily duplicable. For instance, successfully implementing the large-scale ecosystem ISM requires that the country have low levels of corruption and a social welfare system, such as in Finland's case, to implement policies based on meritocracy, and provide tolerance for failure as a necessary part to

innovation. A united and committed society is also an important factor in driving nation-wide collaborative policies through, and this is made easier by Finland's homogenous society, which facilitates the sharing of same values and beliefs.

7.1.1.2 Consider the pros and cons of each ISM

While the three countries in our analysis began with the focused factory ISM, their next steps were entirely different and led to different results. Finland took the large-scale ecosystem ISM route, but consequently suffers from a "closed-ness" that is presented by a weak MC. Singapore, an example of the Hollyworld ISM at work, has strong HC, but relies on other IC such as PC to successfully extract the benefits from this strength. Accordingly, the country should consider how each ISM would amplify its strengths and possibly its shortcomings, and whether it should even adopt more than one ISM to further its national strategy.

7.1.1.3 Consider "unintended consequences"

While context can determine effectiveness of IC strategy implementation, the country should keep in mind that the national capitals that form its context are in turn likely to be affected by its IC strategy, for example, the possible adverse impact on Singapore's social fabric as a result of its foreign talent policies. As Forrester (1971), the founder of system dynamics theory, puts it, "the known and intended practices of the organisation are often fully sufficient to create the difficulty… the presumed solution makes the difficulty worse and thereby causing redoubling of the presumed solution so that matters become still worse." It is thus important to consider how one decision, made with the best of intentions to address one particular shortcoming, can have unintended consequences in affecting the larger system as a whole, and this dynamism must be recognised particularly in the complex field of IC.

7.1.1.4 Consider collaboration

This final point goes beyond the national perspective to take on the global perspective to consider the direction of national IC and the global economy. As Figure 6.1 shows, we raise the question of what the next driving force behind future economies will be, after innovation. One thought is a "mind-driven" economy, where economic prosperity depends on the ability to "think and use" knowledge, rather than the mere generation of new knowledge. If this is so, coupled with the increasing global citizenship of talent, nations may then need to move beyond the mindset of competition to one of collaboration, in order to fully harness the one asset that increases with use – knowledge. In fact, Amidon (2005) suggests that the core premise

underlying the future is collaboration; while competition is inevitable, the perspective organisations take will shift towards one of sharing and leveraging each other for mutual success, to create a common good which benefits all. In this sense, IC ranking becomes not about competition, but about benchmarking and learning from one another to move the world forward. Accordingly, whichever position a country finds itself in along the IC curve, it must recognise that it is part of and must find its part to play in a dynamic world system that will only continue to become increasingly interconnected by globalisation.

7.2 Proposed areas for future research

7.2.1 Evolving indicators for IC measurement

As described in Section 3.2, we used the transformed competitive IC data provided by Lin and Edvinsson (2010) in our research. Seven indicators were chosen to support the index for each of the four major IC elements, i.e. HC, MC, PC, and RC. While we recognised the importance of these indicators in contributing to the IC elements, the constantly evolving field of IC means that the timespan for the indicators to remain relevant in measuring IC is limited. We hence propose the following suggested updates to indicators for consideration in future IC measurement:

IC element	**Indicators for the future**
Human capital	• Passionate citizens • Quality of education (e.g. university rankings) • Quality of teachers (to supplement pupil-teacher ratios) • Usage of internet for education and business purposes
Market capital	• Collaboration between governments • Networking and knowledge migration • Knowledge currency
Process capital	• Mobility of citizens • Flow of information to and from overseas-based citizens • ICT platforms and infrastructure (e.g. availability of high-speed broadband and wireless internet hotspots)

Renewal capital	• Return on R&D investment in financial terms • Time from invention (thought) to innovation (application) • Entrepreneurship, "can do" mindset

7.2.2 IC & system dynamics

In the course of writing this paper, we have come to appreciate the dynamic nature of IC. While we have addressed our thoughts regarding the relations between IC and national capitals, we recognise the presence of dynamic relationships between the national IC indicators themselves. InCaS has in fact developed an IC system dynamics model for use by organisations (Edvinsson and Kivikas, 2007; InCaS Consortium, 2009), but to our knowledge, a similar model has not yet emerged for adoption at national level. For the purpose of aiding with our understanding we have conceptualised a preliminary system dynamics model for the national IC indicators in our study (Figure 7.1) and encourage interested students and researchers to consider this preliminary map, which captures the assumptions on which our mental models are based on, as a base for future research in better understanding the interdependences and relationships within the national IC context.

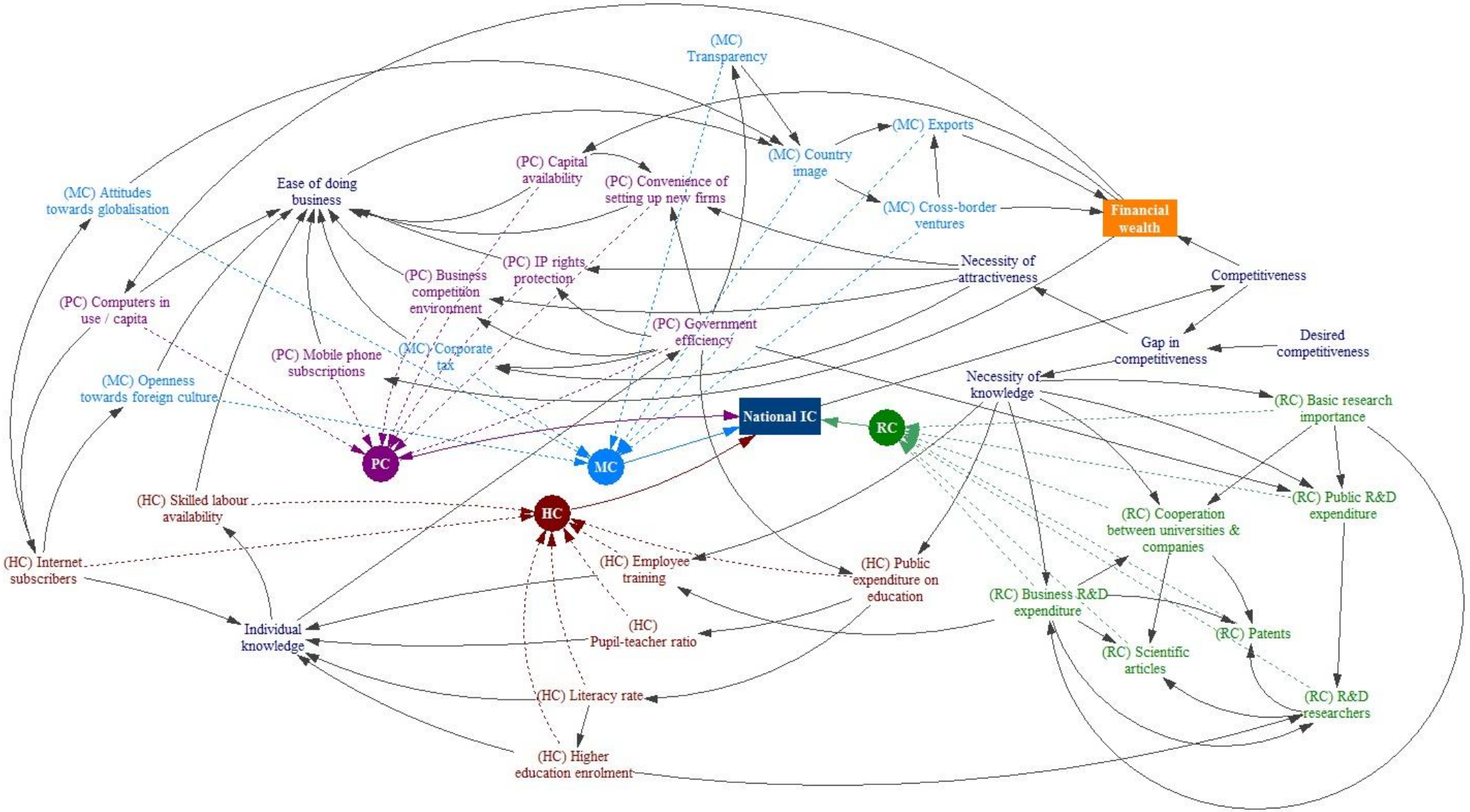


Figure 7.1: Preliminary map capturing dynamics between IC Indicators

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Appendices

Appendix A: List of Unique Selling Points (USPs)

- Historical events – fundamental to the culture and story of the city;
- Physical landmarks – buildings and architecture;
- Cultural institutions and sport teams, including events and exhibitions;
- Nature, environment and climate;
- Demographic structure;
- Traditions and civic culture, attitude, spirit and mindset;
- Knowledge centres – universities;
- Approach to the future – openness;
- Approach to "different" people - inclusiveness;
- Global connections – networks and diversity;
- Interactivity – between the city and corporate society;
- Speed of communication – feedback between leadership in the city, organisation and citizens;
- Adaptability – degree of innovation and development; and
- Attractiveness to people, companies and money (not least venture capital).

Source: PricewaterhouseCoopers (2005)

Appendix B: Definitions of IC indicators

Indicators	*Definition*
Human Capital	
Skilled labour	Whether skilled labour is readily available
Employee training	Whether employee training is a high propriety in companies
Literacy rate	Adult (over 15 years) literacy rate as a percentage of population
Higher education enrolment	Percentage of population that has attained at least tertiary education
Pupil-teacher ratio	Ratio of teaching staff to students
Internet subscribers	Number of internet users per 1000 people
Public expenditure on education	Total public expenditure on education (percentage of GDP)
Market Capital	
Corporate tax encouragement	Whether corporate taxes encourage entrepreneurial activity
Cross-border venture	Whether international transactions can be freely negotiated with foreign partners
Openness to foreign culture	Whether the national culture is open to foreign ideas
Attitudes toward globalisation	Whether attitudes toward globalisation are generally positive in a given society
Transparency	Whether transparency of government policy is satisfactory
Country image	Whether the image abroad of a given country encourages business development
Exports of goods	Exports of goods (Percentage of GDP)
Process Capital	
Business competition environment	Whether competition legislation is efficient in preventing unfair competition
Government efficiency	Whether government bureaucracy hinders business activity
Intellectual property rights protection	Whether intellectual property rights are adequately enforced
Capital availability	Whether cost of capital encourages business development
Computers in use per capita	Number of computers per 1000 people
Convenience of establishing new firms	Whether creation of firms is supported by legislation
Mobile phone subscribers	Number of subscribers per 1000 inhabitants
Renewal Capital	
Business R&D spending	Business expenditure on R&D (per capita)
Basic research	Whether basic research enhances long-term economic development
R&D spending/GDP	Total expenditure on R&D (percentage of GDP)
R&D researchers	Total R&D personnel nationwide per capita (Full-time work equivalent per 1000 people)

Cooperation between universities and enterprises	Whether knowledge transfer is highly developed between universities and companies
Scientific articles	Scientific articles published by origin of author (per capita)
Patents per capita (USPTO + EPO)	USPTO and EPO total patents granted (per capita)
Financial Capital	
GDP per capita (PPP) (From IMF)	Gross domestic product based on purchasing-power-parity (PPP) per capita

Sources: Lin & Edvinsson (2008); Lin & Edvinsson (2010)

Appendix C: A Tale of Three Countries (unabridged)

C1. Finland

Historically part of Sweden, and later the Russian empire, Finland declared its independence in 1917. Finland was an agrarian country until the 1950s when it started transforming itself into an industrialised country. Initially, Finland's exports were dominated by forestry-related products. However, Finland considered diversity in exports as key in improving its economy, and thus invested heavily in higher education and R&D. Since 1980, R&D investments by the government and private sector have more than doubled to reach 3.5% of GDP by 2008. The steps taken by Finland have succeeded in converting its R&D investments and education into strengths in the form of high-tech industries and exports.

Transforming from its early days as a resource-driven economy, Finland has progressed to become a knowledge-driven one in the late 20th century (see Figure C.1 to chart Finland's progress over the years). This has boded well for Finland's economy, with Finland scoring a mean of 9.56 (out of 10) in FC for the period of analysis (1995 to 2008). The FC index for Finland has remained constant over the 14 years, with a minimum score of 9.47 and a maximum score of 9.64.

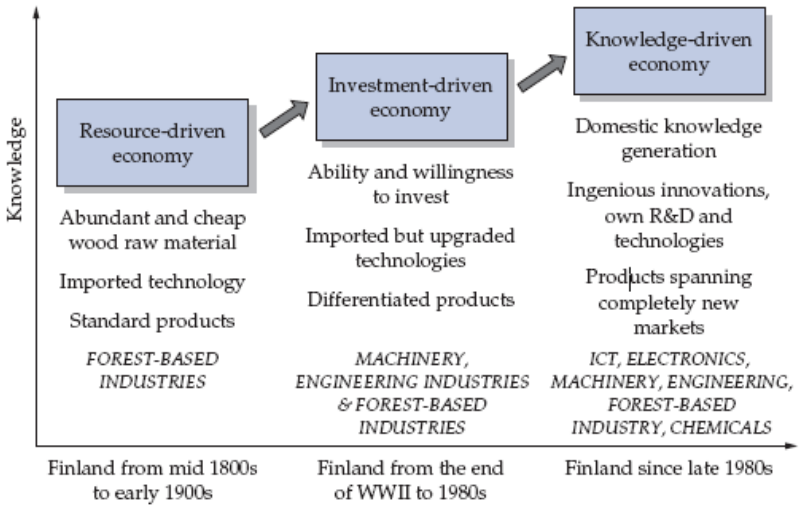

Figure C.1: Finland's stages of industrial and economic development (Carl, Jorma & Pekka, 2006. Adapted from Porter, 1990 and Hernesniemi and others, 1996)

Finland has become a success story in the international arena. It is highly regarded as a competitive economy and has been ranked number one in the World Economic Forum's (WEF) competitiveness index four times since the beginning of the 21st century. Finland consistently

comes in top in the OECD's Program for International Student Assessment (PISA) studies of learning skills and educational attainment. Additionally, Finland also ranked top in the 2009 Legatum Prosperity rating, which rates countries according to a variety of factors including wealth, economic growth, personal wellbeing, and quality of life.

In the world of innovation, Finland has become the forerunner in the field of ICT, primarily due to the success of Nokia. Finland realises that it is important to focus not only on learning from the past, but also on anticipating and preparing for the future. Accordingly, the Committee for the Future (CFF), one of the 15 special committees in Finland's Parliament, was established in 2000. CFF is an institutional innovation, the first of its kind in the world, which undertakes the responsibility to analyse Finland's future and the environment which determine its future, from a broad and longer-term perspective.

What then contributed to the success of Finland? According to the reports *5 Steps for Finland's Future* (Ståhle, 2007), and *Finland as a Knowledge Economy* (World Bank, 2005), one of the most important drivers of Finland's success is the Finns' "can-do" mindset, which was developed from Finland's unique historical and geographical context. Finland's geographical location, partly falling within the Arctic Circle, along with its harsh climate, has created a tough citizenry who must plan ahead to survive. During the cold war, despite its location in the intersection of the two confrontational worlds, Finland managed to make good use of this geographical constraint, by developing trading relationships with the Soviet Union and the Western world. In early 1990s, Finland experienced a severe economic crisis due to the disintegration of the Soviet system, but consequently managed to recover from the shock. These historical and geographical hurdles have developed the Finns' ability to rapidly adapt in order to overcome difficult situations.

Finland's second success factor is its self-reliance, which is a result of its culturally "island" posture. Being exposed and under pressure, much like an island, the nation is disciplined to consider ways to better mobilise human resources and more efficiently use external inputs, and this has consequently contributed to its rapid economic growth. In addition, due to its geographical isolation, Finnish people have the natural curiosity about the outside world and this has developed their openness towards external ideas and technologies. In fact, the Finns were among the first to introduce electricity and to use the telephone. Their curiosity and

openness in experimenting with telephone technologies have brought Finns to great heights in ICT innovation, especially in the 1990s.

Thirdly, Finland possesses a high quality education system. As mentioned before, Finland has constantly ranked top in the OECD's PISA. This success may be attributed to Finland's continuous efforts in fostering excellence in science education and in implementing the LUMA program. LUMA, where LU stands for *luonnontieteet (*or natural science), and the MA stands for *matematiikkaa (*or mathematics), was implemented since 1996 to raise interest in science and mathematics.

The forth success factor is the highly communal nature of Finnish Society. Being one of the world's smallest and most homogeneous societies, Finland possesses a strong national culture. Like other Nordic countries, Finland also possesses a strong spirit of cohesiveness, high moral values and emphasis on equality. These traits may have resulted partially from Finland's geographical isolation, homogeneous gene pool, and strengthened by its unique Finnish language. As a result of this cohesiveness and nationalism, it has been easy for Finland to address political, economical, societal and other issues as they arise.

Despite its success today, there are concerns with regards to the ability of Finland to remain competitive and sustain its pace of innovation. These concerns revolve around the following areas:

- The ability to bring true globalisation to Finland;
- Finland's ageing population, where in 2030 almost every fourth person will be 65 or older;
- A low ICT usage level, contrasting to its leading position ICT production; and
- The country's dependence on Nokia for its economic and innovation success.

C2. Singapore

Lee Kuan Yew, Singapore's famous Minister Mentor, noted in a speech in April 2009 that Singapore has had its independence "thrust upon her. A small country must seek a maximum number of friends, while maintaining the freedom to be itself as a sovereign and independent nation." This well summarises the steps that the young and tiny nation took on its tough but resilient journey into becoming one of the most competitive world economies today. When

Singapore became its own sovereign state on 9 August 1965, it faced the same problems that many third-world countries face today - high unemployment levels, lack of sanitation and supply of potable water, and ethnic conflicts. The Singaporean response? To take the bull by the horns, and aggressively pursue globalisation even before it became fashionable to do so, through encouraging open trade and FDI, and adopting a pro-business and export-oriented approach. It responded to the challenges of a lack of natural resources (having to even import water) and a small domestic market by building a skilled and comparatively low-cost labour force, attracting MNCs, and providing struggling industries with a jumpstart through the use of GLCs. As a result, within a span of 40 years, it has emerged as a knowledge-driven economy that focuses on generating a high rate of innovation, adaptation, and commercialisation of new technologies, which thus results in the production of innovative products and services at the global technology frontier (Asia Development Bank, 2004). This has translated into economic success – in our study, Singapore's FC is upward trending with a mean of 9.85, highest among the three countries of analysis, and has the eighth highest GDP per capita (PPP) in the world (CIA, 2010c). This is further backed up with success in economic competitiveness, with Singapore increasing in ranking from fifth (2008-2009) to third (2009-2010) on the Global Competitiveness Index.

Why has Singapore succeeded where so many of its neighbours and other countries with richer natural resources have failed?

Some have attributed it to the unusual effectiveness and decisiveness of the Singapore government, which has won worldwide kudos over the years. Institute of Management Development's World Competitiveness Yearbook has ranked Singapore first in government efficiency for three years running (2007 to 2009). The government's effectiveness, however, may be due to the social contract articulated between the ruling People's Action Party (PAP) run government and the people of Singapore, in that, for working hard, giving up some individual rights and accepting government control, the government would in turn take steps to ensure prosperity and a better quality of life for the nation's citizens. This collectivism mindset may be hard to duplicate in Western and other non-Confusionist societies which value the individual over the community.

The autocratic hand of the PAP also proved key in supporting its strategy of encouraging foreign investment, by boosting investor confidence in the stability of the nation's polices and

in the commitment to protecting foreign investors. For instance, in its early years of independence, Singapore amended its laws to ensure the preservation of foreign investors' property, and cracked down on corruption and labour unrest to promote a safe and stable environment for business. This may go against the grain of popular belief in the superiority of democracy over autocracy, with Singapore being an obvious exception to the rule.

In addition, Singapore has placed continued and heavy emphasis on the management and development of its only but most valuable resource well – its people. When Singapore declared its independence, education was harnessed as a social engineering tool to convert the resource-poor island into a regional economic power. The government adopted a tripartite system of academic, technical and vocational schools to support the country's basic economic policies. For instance, in order to increase the supply of workers having the relevant industrial skills to operate machines, technical education was introduced in the 1960s, whereby technical subjects were compulsory for all male lower secondary students. To lower the number of school dropouts, streaming was introduced in 1978 to accommodate and support the different levels of learning ability among children. This resulted in a higher number of students proceeding on to further education, which consequently produced the right workers for Singapore's manufacturing industry then. Further, in support of its main educational objective at the time of ingraining national identity and patriotism among the younger generation in order to achieve a "multiracial, multicultural and multilingual society", in 1966 the government adopted the bilingual policy, making English the nation's first language and mother tongue the second. This has resulted in one of Singapore's most competitive strengths – a workforce well-versed and fluent in the global working language of English. This compliments Singapore's strategy of attracting and retaining the best foreign talent. The language barrier is not only thus lowered, but Singapore has also made efforts to ensure that Singapore is an attractive place to live and work. The strategy of convincing talented individuals to take ownership in Singapore is based on the realisation that in the long run, these skilled and highly motivated people are the ones who improve economic efficiency and hence produce economic growth. As such, Singapore has been relatively successful in retaining not only its own best and brightest, but also in attracting similar talent from around the world, who are drawn by an easy transition to Singapore living and opportunities to make a decent living without being heavily taxed (Economist, 2000: 86-89). In fact, in Mercer's most recent Worldwide Quality of Living survey, Singapore, ranked 26th, is the top-scoring Asian

city, and is ranked first worldwide in terms of city infrastructure, which is noted by Mercer as having a significant effect on the quality of living experienced by expatriates[7].

In spite of its economic success, there is a concern that the strong, autocratic style of government leadership that has brought Singapore through its tumultuous years may in fact be a hindrance to having a people willing and able to think for themselves and a society able to support failure, necessary prerequisites for successful innovation. In fact, despite numerous government efforts to encourage innovation, Singapore has encountered difficulties in establishing a durable base of entrepreneurial activity. Many attribute this failure to government policies, which often are portrayed as discouraging creativity and perpetuating risk-adverse attitudes among its people. The challenge of building an entrepreneurial people to keep up and excel in an increasingly innovation-driven world economy is further perpetuated by challenges arising from Singapore's own success and which the next generation will have to face, as Senior Minister Goh Chok Tong noted in his National Day speech in 2009 (AsiaOne, 2009a). Among the ten challenges mentioned by Senior Minister Goh, four relate to Singapore's people, its most precious resource:

1) *Helping to keep workers employed till age 75, in the face of an ageing population*
   Within the past 50 years, the life expectancy of Singaporeans has increased from 60 to 80 years, and accordingly the age for retirement has been raised from 55 to 62. With continued health care advancement, life span is expected to further increase to 90 years, resulting in Singaporeans needing to work till the age of 75 in order to accumulate enough savings "for a cosy retirement of 15 years", Mr Goh said. He added that the challenge would thus be to motivate and train older people to continue working in the light of this new reality.
2) *Getting young people to marry and have children*
   Economic prosperity, along with increased opportunities for education and career growth, has led to fewer women getting married, while those who do get married are giving birth to fewer babies. This serves to further decline birth rates in Singapore, from 5.8 in the 1960s to an all-time low of 1.23 in 2009, far fewer than the 2.1 birth rate required for the population to replace itself (BBC News, 2004; Tay, 2010).

[7] In the same worldwide Quality of Living survey, Helsinki, Finland is ranked 30th, while Malaysia is not ranked (Mercer, 2009).

3) *Supporting an ageing population*

Increasing life spans and decreasing birth rates together create the challenge of supporting the increasing number of old people by their working young adult children. As of 2009, 9% of the population comprise of those aged above 65. In 20 years, this is estimated to double to 20%.

4) *Preventing a brain drain*

A large number of students study overseas instead of locally, and more and more of them are choosing to stay abroad and work instead of returning home. They cite reasons such as a lack of job opportunities, a stressful environment and overly fast-paced living, and a lack of appreciation of their talent by local firms (AsiaOne, 2009b). While Singapore's competitiveness and drive has served it well on the global front, the price may be paid in the form of a "brain drain". Singapore will thus need to find ways to encourage these students to return home and contribute through a sense of bond and belonging, as noted by Mr Goh.

C3. Malaysia

Malaysia was formed in 1963 from Sarawak and Sabah in East Malaysia, the Federation of Malaya (which achieved its independence in 1957), and Singapore (which consequently separated from Malaysia and became its own sovereign state in 1965). With land area of 329,748 square kilometres, Malaysia is blessed with abundance of resources, such as fertile lands for agriculture, rich mineral deposits for tin mining and petroleum and natural gas exploration, rainforests for timber; and beautiful landscapes, seascapes and rich cultures for tourism.

Since its independence, the population in Malaysia has grown rapidly, from 7.4 million in 1957 to 27.7 million in 2008 due to natural growth and the influx of immigrants. Malaysians live in a multi-racial society comprising of many ethnic groups, such as Malays, Chinese, Indians and non-Malay indigenous groups. Different ethnic groups in Malaysia possess their own values, beliefs, religions, cultures and practices. Despite these differences, ethnic groups in Malaysia today live in a harmonious society where the values of respect and tolerance are upheld.

Starting as a low income agrarian country since its independence, Malaysia has transformed itself from a factor-driven economy into an investment-driven one. In the 1960s and 1970s,

low cost labour and natural resources were the dominant bases of competitive advantage and exports in Malaysia. The poverty rate in Malaysia in 1970 was as high as 49.3%, with income disparities present between urban and rural areas, as well as between races. Following a time of ethnic unrest in 1969, several initiatives were undertaken to protect the rights of indigenous groups and to correct the income disparity between races. These initiatives, amongst others, include the amendment to the Malaysia Constitution and introduction of the New Economic Policy (NEP) to protect the rights of "bumiputeras" (or indigenous group).

At the same time, in the 1970s, Malaysia steadily transformed itself into an investment-driven economy and established itself as a manufacturing base for leading MNCs. Efficient infrastructure, investment incentives and other business-enabling environmental factors were developed to attract FDI. Manufactured goods, particularly electrical and electronic products, replaced agricultural products as the main contributor to exports. As more jobs were created and income per capita increased, the poverty rate decreased, from 49.3% in 1970 to 8.7% in 1995. Subsequently, from 1995 to 2008 (the period of our study), Malaysia scored a mean of 8.66 in FC, with a slight upward trend from 8.63 in 1995 to 8.77 in 2008.

Over recent decades, the competitive advantage that Malaysia previously had in mass and low cost production and other efficiency factors has eroded with the boom of China, Vietnam and other neighbouring developing nations. Malaysia has hence realised that in the long run, the country would not be able to maintain its competitive advantage and achieve further economic progress by solely functioning as a "factory". It thus has no other option but to transform itself into an innovation-driven economy by enhancing its ability to produce innovative products and services and to move up the value chain into new areas of competitive advantage.

In 1991, the Malaysian government declared its ambition to mould Malaysia to an industrialised and fully developed nation by 2020, as envisioned by its fourth Prime Minister, Dr. Mahathir, via Wawasan 2020 (or Vision 2020). Nine strategic aims addressing social, economy and science and technology challenges were outlined. One of the strategic aims of Vision 2020 is to establish a scientific and progressive society, "a society that is innovative and forward-looking, one that is not only a consumer of technology but also a contributor to the scientific and technological civilisation of the future". With Vision 2020 to guide the development of the nation, focused initiatives to develop the country towards an innovation-driven economy have been launched, two of which are described in detail in Section 4.2.3.

Appendix D: Finland, Singapore and Malaysia's scores based on the NICM model

Country	*Category*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*Mean*
Finland	**IC**	**7.04**	**7.66**	**7.51**	**7.96**	**7.99**	**8.00**	**8.13**	**8.20**	**7.94**	**7.97**	**8.02**	**7.54**	**7.50**	**7.89**	**7.81**
	ICexFC	**6.44**	**7.21**	**7.02**	**7.57**	**7.60**	**7.61**	**7.76**	**7.85**	**7.53**	**7.56**	**7.63**	**7.02**	**6.97**	**7.45**	**7.37**
	FC	9.48	9.47	9.49	9.52	9.54	9.56	9.57	9.58	9.59	9.59	9.59	9.62	9.64	9.64	9.56
	RC	5.22	6.62	6.21	7.03	7.12	7.50	7.84	8.06	7.80	7.91	8.11	7.88	7.64	8.03	7.35
	PC	6.86	7.79	7.61	8.12	8.28	8.22	8.17	8.44	7.92	7.81	7.92	6.93	6.87	7.39	7.74
	MC	6.15	6.81	6.63	6.86	7.04	7.03	7.03	7.02	6.51	6.64	6.56	5.76	5.91	6.63	6.61
	HC	7.51	7.62	7.63	8.27	7.95	7.71	8.01	7.90	7.88	7.89	7.91	7.52	7.46	7.76	7.79
Malaysia	**IC**	**5.32**	**5.33**	**5.20**	**5.29**	**5.36**	**5.09**	**5.50**	**5.84**	**5.98**	**5.61**	**5.88**	**5.88**	**5.75**	**5.78**	**5.56**
	ICexFC	**4.49**	**4.49**	**4.33**	**4.47**	**4.56**	**4.21**	**4.73**	**5.14**	**5.32**	**4.85**	**5.17**	**5.17**	**5.00**	**5.03**	**4.78**
	FC	8.63	8.67	8.68	8.57	8.59	8.62	8.59	8.62	8.65	8.68	8.69	8.72	8.75	8.77	8.66
	RC	2.10	1.94	1.83	1.83	1.78	1.59	1.90	1.99	2.19	1.94	2.18	2.27	2.16	2.53	2.02
	PC	5.17	4.81	4.69	4.49	4.85	4.57	5.34	5.56	5.45	4.78	5.50	5.62	5.23	5.17	5.09
	MC	6.64	7.00	6.56	6.12	6.62	5.73	6.57	6.85	7.09	6.50	6.63	6.67	6.32	5.69	6.50
	HC	4.05	4.23	4.24	5.43	4.98	4.96	5.12	6.17	6.53	6.17	6.39	6.13	6.28	6.72	5.53
Singapore	**IC**	**6.66**	**6.74**	**6.76**	**7.03**	**7.16**	**7.21**	**7.51**	**7.49**	**7.59**	**7.53**	**7.63**	**7.83**	**7.91**	**7.60**	**7.33**
	ICexFC	**5.88**	**5.98**	**6.01**	**6.35**	**6.50**	**6.56**	**6.95**	**6.91**	**7.02**	**6.94**	**7.05**	**7.30**	**7.39**	**7.01**	**6.70**
	FC	9.81	9.80	9.80	9.74	9.79	9.84	9.77	9.80	9.84	9.89	9.93	9.96	9.97	9.96	9.85
	RC	3.39	3.81	3.97	4.32	4.62	4.22	4.73	4.88	5.16	5.12	5.31	5.74	5.97	5.59	4.77
	PC	6.70	6.57	6.69	6.89	7.23	7.22	7.56	7.58	7.46	7.36	7.57	7.87	7.73	7.16	7.26
	MC	8.55	8.47	8.28	8.48	8.54	8.24	8.30	8.10	8.57	8.31	8.31	8.52	8.73	8.05	8.39
	HC	4.86	5.05	5.08	5.71	5.61	6.56	7.20	7.10	6.90	6.97	7.02	7.08	7.14	7.23	6.39

Source: Lin & Edvinsson (2010)

Appendix E: Results from correlation analysis between FC & IC elements

Finland	**HC**	**MC**	**PC**	**RC**
Sustaining effect	(0.45)	(0.56)	(0.57)	0.81
Boosting effect	0.14	0.33	0.18	0.21
Linear growth potential	0.42	0.60	0.69	0.63
Exponential growth potential	0.10	0.36	0.46	0.37

Malaysia	**HC**	**MC**	**PC**	**RC**
Sustaining effect	0.56	(0.18)	0.38	0.79
Boosting effect	(0.22)	0.22	(0.06)	(0.29)
Linear growth potential	0.24	(0.07)	0.05	(0.11)
Exponential growth potential	(0.66)	0.08	(0.09)	(0.19)

Singapore	**HC**	**MC**	**PC**	**RC**
Sustaining effect	0.59	0.10	0.52	0.85
Boosting effect	(0.47)	(0.09)	(0.28)	(0.30)
Linear growth potential	0.52	(0.38)	(0.13)	0.03
Exponential growth potential	(0.45)	(0.17)	0.32	(0.64)

Appendix F: What's next for the three countries (unabridged)

F1. Finland

Finland has achieved great success in rapidly transforming from a resource-based economy to knowledge-driven economy. Operating in the large-scale ecosystem ISM environment, Finland has its IC elements relatively evenly distributed, with the highest HC, PC and RC scores among the three countries of our study. Finland has been successful in coordinating and linking elements pertinent to innovation together, which include:

- Government and authorities which shape the fundamental social and economic conditions to foster innovation;
- Universities, research institutes and business enterprises which produce new information, knowledge and knowhow; and
- Business enterprises, citizens and authorities as users of innovation products.

In terms of HC, the focus of education has been providing equal opportunity to ensure that poorly-performed students are not left behind. However, Finland's Education Minister, Henna Virkkunen, has recently mentioned that increased attention will be given to the brightest pupils to support them in their gifted areas (Burridge, 2010). Due to its ageing population, Finland acknowledged that its innovation capability is not sustainable if it sees "creativity = youth" and investing solely to promote innovation amongst the "youth". Finland, via the CFF, is looking into ways to mobilise the experience, expertise and creativity of the elderly, including the possibility of closing the gap via immigration, though the positive effects of immigration on creativity may require time for their fulfilment. One other key factor to fostering innovation is improving the entrepreneurial spirit of Finland's citizens and communities, as innovation and entrepreneurship are closely related (CFF, 2005).

Finland has achieved high PC scores, mainly due to its early start and leadership role in ICT, especially in the production of mobile communication. However, mobile communication technology has not resulted in breakthroughs for Finland in other ICT areas such as wireless broadband and internet services and applications. Recognising the importance of the role of ICT in offsetting shrinking labour forces when baby boomers retire, Finland has started to focus on increasing ICT usage and offering higher broadband speeds, rather than simply increasing the reach of broadband to its citizens. According to Europe's Digital

Competitiveness Report 2009, Finland strives to achieve 1 Mbps as a universal service obligation by 2010 and 100 Mbps throughout the country by 2015. Moving forward, Finland will participate actively in the European Commission's digital agenda for Europe which is targeted to "create world beating infrastructure and unlock the potential of the internet as a driver of growth and the basis for open innovation, creativity and participation" (Commission of the European Communities, 2009).

Finland recognises that its future is to be founded on innovation and competence, where its growth in productivity is based on new innovations and renewing practices. In line with this belief, Finland invests heavily in its R&D, with an aim to raise the GDP share of R&D to four per cent by 2010 (HighTech Finland, 2010). The R&D investment as a percentage of GDP in Finland is ranked third in the world, after Israel and Sweden. Additionally, Finland continuously evolves in anticipating of future needs. The creation of CFF, Aalto University and a network of Strategic Centres for Science, Technology and Innovation are examples of Finland's continuous renewal efforts.

Finland, being part of the global economy, faces challenges, as well as opportunities for renewal, from changes in the global value network. These changes occur in world economy, population development, environmental issues, safety and security issues, and cultures and values development globally. Accordingly, Finland's *Strategic Centres for Science, Technology and Innovation* was launched in 2006 to anticipate the needs of society and businesses in time spans of five to ten years. These centres function as a new kind of organised cooperation between businesses, universities, research institutes and financing organisations. Example of such cooperation and interactions include the following:

- The VTT Technical Research Centre of Finland (VTT), in its October 2009 newsletter, shared an interesting interactive media research initiative, done jointly by IBM Research, Nokia Research Centre and VTT, in creating a new level of meeting experience which enables people in multiple locations to interact and collaborate with avatars and objects in a single, virtual meeting!
- Due to the changes in innovation environments, demand and user-driven innovation has increased its importance. Accordingly, Helsinki has started to develop its city centre as meeting place and its university campuses as user-driven innovation environments (HighTech Finland, 2010).

Despite its high score in HC, PC and RC, Finland faces a low MC, particularly in the export dimension. The low score calls for increase of Finland's ability to bring true globalisation to the country. Finland operates in a large-scale ecosystem innovation system, where an ecosystem refers to a self-sustaining system, capable of maintaining itself with nothing requires from outside except for energy or light. However, in order to stay at forefront of innovation, Finland needs to explore the advantages of innovation activity in a world without borders, and perhaps move from a large-scale ecosystem to an innovation breeding ground, through leveraging on existing network benefits while attracting the right talent and investment for renewal and then exporting innovation internationally. As reported by the Academy of Finland, an area which needs to be addressed is the low level of international involvement in Finnish research system, where only 3% of researchers in Finland are foreigners, as compared to 10% or more in Sweden, the Netherlands, and other Western European counterparts. Moving forward, Finland will need to develop its capabilities in providing competitive solutions to its international clients, and foster interaction between Finland and the global society.

F2. Singapore

The 2009-2010 Global Innovation Index report, which was compiled jointly by INSEAD and the Confederation of Indian Industry and ranked Singapore seventh in the world, noted that the engineering, efficiency-driven model that has made Singapore today's success story needs now to be augmented with a more creative, innovative bottoms-up model, in the face of an increasingly knowledge-driven global economy. Given recognition to this new competitive playing field, the Singapore government launched the "Remaking Singapore" initiative in 2002 to develop Singapore into a global hub for creativity, innovation, and design. Achieving these new capabilities would require a social science, human-centred, bottoms-up model, which may be a challenge given Singapore's hierarchical and Confucian culture and traditionally top-down approach to implementing government policy. The government is in turn attempting to turn this around by revamping the education system to promote creativity among the younger generation (though this may in itself be paradoxical, since creativity is not a subject matter that can be taught!). This may be in awareness of the need for its people to not just be knowledgeable (well-educated), but knowledge-able (able to apply knowledge and create new knowledge through innovation) in order to boost its Human Capacity (where it is ranked 48th by the 2009-2010 Global Innovation Index report).

As a follow up to the "Remaking Singapore" initiative, the Economic Strategies Committee (ESC) was set up in 2009 to develop strategies for Singapore's future, positioning it as global city in a new world environment with many opportunities at hand. In its January 2010 report, the ESC recognises Singapore's main challenge of slowly expanding workforce, which is a combined result of an ageing population, low birth rates, migration of young talent overseas, and a required limit on Singapore's dependency on foreign workers. Singapore will thus need to grow based on skills, innovation and productivity; in other words, the focus should be shifted to quality rather than quantity. The ESC then puts forth three priorities which it recommends government officials focus on in the coming decade – boost skills in every job; deepen capabilities among Singapore companies to seize opportunities in Asia; and make Singapore a distinctive global city. Within the three priorities are seven strategies which cover one or more aspects of IC (Figure F.1):

Figure F.1 Singapore's strategies for the next decade (ESC, 2010)

1) *Growing through skills and innovation (RC, HC)*

   The ESC recommends increasing productivity growth from the current 1% yearly to 2 to 3% per year, which would in turn allow GDP to grow by 3 to 5% per year over the next ten years. This is to be achieved not only through increased efficiency, but also by encouraging enterprise innovation (RC), upgrading workforce skills (HC), and managing the nation's dependency on foreign workers while retaining skilled foreign talent (HC).

2) *Anchor Singapore as a Global-Asia hub (MC)*

   The ESC proposes to achieve this by leveraging on Singapore's geographical and cultural connectivity to Asia and to the rest of the world. Singapore's market neutrality can also provide international businesses with a strategic base to manage and integrate their pan-Asian operations, without the in-market challenges and constraints that plague other economies (MC). The strategy also aims to grow opportunities in ASEAN, by collaborating with regional partners to fulfil the vision of a single market under the ASEAN Economic Community by 2015 (MC).

3) *Build a vibrant and diverse corporate ecosystem (PC)*

The ESC recognises that Singapore's key strength can be a diverse corporate landscape, which comprises a mix of both large and small companies, as well as local, Asian and global firms. This landscape can then create multiplier effects through solid partnerships and networks between diverse companies and the resulting synergies can enable local companies to better capture emerging opportunities, particularly in Asia (PC). The ESC recommends achieving this by ensuring that MNCs, a major source of new technologies and key to Singapore's connectivity to developed country markets, remain as key players in the Singapore economy, while growing a deeper base of globally-competitive Singapore enterprises through steps such as facilitating cross-border financing capacities and empowering local trade organisations to drive growth and internationalisation.

4) *Make innovation pervasive, and strengthen commercialisation of R&D (RC, HC)*

The aim of this strategy is to establish Singapore as Asia's Innovation Capital – a centre for enterprise and innovation, and a location of choice for commercialisation, even for ideas not invented locally (RC). Steps to achieve this strategy include increasing national R&D expenditure to 3.5% of GDP by 2015, through increased private sector R&D expenditure (RC); strengthening the emphasis on innovation and the commercialisation of R&D by supplying customised platforms to help integrate the capabilities of companies, research institutions and public sector agencies to produce innovative solutions (RC); and intensify efforts via the education system to ingrain an innovative mindset among the younger generation of Singaporeans (HC).

5) *Become a smart energy economy (MC)*

The ESC recommends the resilient, sustainable, and innovative use of energy in Singapore, not just because of the nation's inherent resource constraints, but also to contribute to the reduction carbon emissions as a responsible member of the global community. While this strategy is not strictly under our definition of IC (and is perhaps more applicable to PricewaterhouseCoopers (2005)'s category of environmental capital), it may indirectly influence the image of Singapore abroad, and in turn attract environmentally-conscious businesses to its shores (MC).

6) *Enhance land productivity to secure future growth (PC)*

Given Singapore's scarce land resources, this strategy recommends accelerating the shift towards higher value-added and more land-efficient activities, finding ways to use land more flexibility, introducing new business locations to support a range of enterprise needs,

and investing ahead to create new land and space, such as underground development. This can have a direct impact on the ease in which businesses are set up (PC), particularly since Singapore is ranked 16th in terms of ease of property registration in World Bank's *Doing Business 2010* report.

7) *Build a distinctive global city and an endearing home (HC, MC, PC)*

In a bid to be less clinically business-like and more culturally dynamic, the ESC recommends looking towards the softer side to growth, by emulating cities such as New York and London in becoming a "leading cultural capital" and a "distinctive global city". The ESC provides the rationale that people are attracted to such cultural centres "not because of the specific economic activities they conduct but because people want to be there… Being a global city and a meeting point in Asia for enterprise, talent, cultures and ideas will be a source of competitiveness and growth in its own right" (Kolesnikov-Jessop, 2010). Accordingly, the ESC suggests achieving this by attracting and nurturing diverse pools of talent and making Singapore a hub in Asia for thought and practice leadership (HC), developing Singapore into a leading cultural capital by investing more in supporting the arts and making Singapore more competitive as an art trading hub (MC), and providing the best quality of life in Asia (PC).

F3. Malaysia

Malaysia has successfully transformed itself from a factor-based economy into investment-driven one. The poverty rate of the country has declined dramatically while its GDP per capita has steadily increased from US$1,812 in 1980 to US$4,358 in 1995 (the first year of our study) and to US$8,118 in 2008 (the last year of our study). Among the four IC elements, MC had the highest mean score and this could be explained by the nation's production-based economy, where social intelligence and good relationships with its international clients are emphasised in order to attract FDI.

In recent years, Malaysia has seen continuous emphasis by policy makers on the importance of innovation and the nurturing of a "first class mentality". However, the question as to whether Malaysia can successfully transform itself into an innovation-driven economy remains. This leap is pertinent to sustain and generate further growth in Malaysia's economy, especially when the competitive advantages it enjoyed in the past are fading fast. This decreasing competitiveness and attractiveness of Malaysia in the eyes of foreign investors may indeed be indicated by the decreasing trends of its MC indicators and its stagnant PC.

Malaysia is a relative newcomer to innovation, as compared to other developed nations such as Finland and Singapore. Being focused on national innovation initiatives such as ICT and biotechnology, Malaysia operates under the focused factory ISM and applies the "cluster" concept in gathering ICT and biotechnology companies, with their supporting industries and other institutions within close proximity to enable knowledge exchange and timely support. The first significant national innovation initiative, the MSC, was a good starting point for other innovation initiatives due to the increased role of ICT globally. The second national innovation initiative, BioMalaysia, has rightly capitalised on the resources uniquely available to Malaysia, such as its rich biodiversity and availability of palm oil for biofuel. However, current and future national innovation initiatives can only be successful if the required physical infrastructure and the IC elements are in place.

While all four IC elements in Malaysia are lower than Finland and Singapore, its HC has shown an encouraging improvement over the years. The commitment and investment of the Malaysian government to higher education, for instance, have paid off handsomely via a rapid increase in higher education enrolment. However, the ability of Malaysia in producing the critical mass of knowledge workers required to increase its competitiveness and move the nation into the knowledge economy is limited by the following challenges it faces:

- Increasing the relevance of curricular in higher education to the economic development;
- Increasing the adequacy and quality of educators and other resources;
- Achieving world-class status for its universities; and
- Turning its "brain drain" into "brain gain".

Beyond absolute scores, it is worrying to note that both its MC and PC have also been downward trending. Close attention is thus needed to address Malaysia's lacklustre performance particularly in the aspects of transparency, ease of cross-border ventures, government efficiency and convenience of establishing new firms. Despite the launch of the two national innovation initiatives, only a slight improvement is observed for RC for the 14-year span of our study. The numbers of R&D researchers, articles and patents remain low. In addition, the research and innovation system is disjointed, research funding is insufficient and university-industry linkage has remained weak (World Bank, 2007).

Appendix G: List of common abbreviations used

A*Star	Agency for Science, Technology and Research
CFF	Committee for the Future
CIA	Central Intelligence Agency
E&E	Electronics and Electrical
EPO	European Patent Office
ESC	Economic Strategies Committee
FC	Financial Capital
FDI	Foreign Direct Investment
GCR	Global Competitiveness Report
GDP	Gross Domestic Product
GLC	Government-Linked Corporation
GNP	Gross National Product
HC	Human Capital
IC	Intellectual Capital
ICexFC	Intellectual Capital score excluding Financial Capital
ICT	Information and Communication Technology
IMD	International Institute for Management Development
IP	Intellectual Property
ISM	Innovation System Model
IT	Information Technology
MC	Market Capital
MDC	Multimedia Development Corporation
MM	Minister Mentor
MMU	Multimedia University
MSC	Multimedia Super Corridor
NBP	National Biotechnology Policy
NICM Model	National Intellectual Capital Measurement Model
OECD	Organisation for Economic Co-operation and Development
PC	Process Capital
PISA	Program for International Student Assessment
PPP	Purchasing Power Parity
R&D	Research & Development
RC	Renewal Capital
SME	Small-to-Medium Enterprise
USP	Unique Selling / Strategic Point
USPTO	United States Patent and Trademark Office
VTT	VTT Technical Research Centre of Finland
WEF	World Economic Forum