

Institutional Impacts on the Development of an IT Industry: The Irish Experience

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ABSTRACT

Over the last twenty years, Ireland has become a hotbed of software activity. According to the Organization of Economic Cooperation and Development (OECD) Information Technology Outlook 2000, Ireland is the largest exporter of software goods in the world (IDA, 2002). In the past, smaller countries have suffered from economic disadvantage, but with the recent rapid development of IT sectors, a country that is both small geographically as well as demographically may achieve increased per capita levels of IT infrastructure built and used within that country (Dedrick *et al.*, 1995). With a population of fewer than 4 million and

producing software sales worth €10,150 billion, €8,500 billion of which is software exports, Ireland's software industry has experienced significant success in producing and exporting software (IDA, 2002). Ireland's emergence as an economic 'Celtic Tiger' has evolved as a result of Ireland's openness to the global market and to increased overseas investment. The authors propose a conceptual framework of factors that identify the key facets of national involvement that have impacted this software growth. This study investigates the extent to which institutional influences, such as government policies, have contributed to the evolution and growth of Ireland's software industry. In order to identify this governmental impact on the Irish software sector, the authors identify four small developed countries that have experienced significant IT industry growth. The varying levels of government intervention in these cases are considered, indicating the importance of national involvement in each of the four IT industries.

KEYWORDS

Ireland's software industry, external institutional influences and internal institutional influences.

INTRODUCTION

Since the industrialisation policy was introduced in 1968, Ireland has moved from an agrarian towards a technology-based industry. While some may argue this was fortuitous, it appears that the Irish government's efforts to industrialise the country has led to significant software developments. This rapid economic growth has enhanced employment levels and maintained low inflation rates (O'Riain, 1997). Currently, Ireland's software sector employs 30,000 people in both indigenous and multinational operations and the industry's employment rate has increased by twenty per cent over the last five years (National Informatics Directorate, 2002). But this economic boom did not happen overnight. According to Trauth (2000, p28), Ireland's development occurred in stages: the shift away from the protectionist policies of the 1950s, followed by recognition of the importance of information technology during the 1970s, and finally the realization of the information economy in the 1990s. Digital Equipment Corporation (DEC) was among the first multinational high tech companies to set up hardware operations in Ireland, doing so in Galway in 1971. While this government policy appeared to be the answer to Ireland's economic problems, O'Riain (1997, p12) conveys the reality:

“This policy's success is questionable as companies created mainly low-skilled jobs, developed few linkages to the local economy, and often left once their tax breaks ended”.

The emergence of the software industry in Ireland as a key component of the economic “Celtic Tiger” parallels the larger journey that Ireland took from an impoverished agrarian society to a significant post-industrial society in the second

half of the twentieth century. As documented by Trauth (2000, Chapter 2), this transformation occurred in phases as the economic development vision shifted from industrialization by invitation, to the recognition by the government of economic development through the IT industry, to the creation of a diversified IT sector.

After 1973, using Digital as an example, the Industrial Development Authority (IDA - a key government sponsored body) began to attract investment from foreign multinationals to Ireland. Analog Devices, Amdahl and Apple mark the first high profile technology based (hardware) multinationals to open operations in Ireland. These companies produced mostly hardware in the early stages of the high technology industry in the country but this was to change. As IBM took the steps in the early 1970s to unbundle software and hardware costs, it realized that revenue could be generated from software development, something that could be located overseas (Cochran, 2001). It is evident from Table 1 that the software industry is a major contributor to the Irish economy. It is important to identify the extent of institutional involvement in how government policy and strategy has shaped the growth of the sector and how it continues to do so for future industry development. Such an investigation will contribute to a better understanding of the institutional factors that have influenced the development of Ireland's software industry and can provide lessons for other countries/regions that wish to achieve a similar objective. Additionally, Ireland, itself, can also benefit from a better understanding of the uniquely Irish institutional factors that can be leveraged to ensure its continued success in this industry. This paper is structured as follows. First, we present a brief description of four country-level

mini cases considering the institutional impact on the development of their IT industries. This is followed by a consideration of the conceptual framework that was employed in this research. Finally, we discuss the research approach, the research findings and the implications of the research.

Table 1 Ireland's Software Industry

	Ireland
Demographics	
Population (million)	3.839
Country Size (Hectares) ⁴	7, 027,308
Language	English, Irish
Religion	93 % Roman Catholic (91% of these practicing), Majority of 9% Anglican
SW Revenue in 2000	
Euro (million)	10,150
Growth Rate	33%
SW Exports in 2000	
Euro (million)	8,500
Growth Rate	30%
Education and Training	
SW Graduates p.a.	5,877
SW Professionals per 1,000 people	6.71
Telecommunications	
	One of the most competitive telecommunications infrastructures in Europe. Investment of over \$5bn has resulted in state-of-the-art optical networks. (IDA, 2002)
Phone lines per 1,000 people	298
Level of Government Intervention	
	Started with Industrialization by Invitation. Highly involved industry promoter

FOUR SMALL DEVELOPED COUNTRIES: INSTITUTIONS

DETERMINING IT GROWTH WORLDWIDE

The four country-level, mini-cases considered in the following section detail the extent to which institutional influences have shaped the growth of IT sectors worldwide. The countries under consideration - Finland, Israel, New Zealand and Singapore - are distributed across the globe in Scandinavia, the Middle East, and the Pacific Rim. While their location, culture and IT focus differ significantly;

government intervention is identified as a key catalyst in the growth and development of their IT industries in each case.

Finland

Remarkably, Finland and Ireland are the only two countries in Europe that boast positive trading balances for IT products and services (Watson, 2000, Lyytinen and Goodman, 1999). Traditionally seen as one of the poorer Nordic countries, Finland now has one of the highest per-capita consumptions of IT in the world (Dedrick *et al.*, 1995). Finland's government has played an active role in the evolution of the IT industry and its progression as an economic sector. For example, the Finnish government promotes IT positively; the Information Technology Advisory Board met from 1976 and until 1991, its objective was to advocate a "*national information society*" strategy (Watson, 2000). Additionally, the government contributed to the establishment of Technopolis, the world's most northern science park, home to the leading telecommunications and electronic firms in the industry including over 100 technology focused organisations (Edmondson, 1995). Considering government involvement in the education system, each year, Finnish universities produce approximately 600 IT graduates and while the polytechnics produce over 2000 computing and engineering graduates. The Finnish government recognises the demand for trained IT professionals, and IT-related courses have been expanded over the last few years to produce five times more IT than law graduates (ITAG, 1999).

Israel

The Israeli military developed a branch of the defence forces called the Science Corps in 1948. This division developed new arms, electronics and technology at a

rapid pace. Since then, Israel has established its high technology industry with a particular focus on software (Cohen, 2001). Between 1984 and 1992, Israel's software industry tripled its software sales, and increased its exports by 2700 per cent (Ariav and Goodman, 1996). By 1992, 150 indigenous software companies were set up, with sales of over \$600 million, employing approximately 5,500 of the 12,000 computer professionals in the country. Ariav and Goodman (1996) comment on Israel's positive attitude to IT adoption and development viewing it as the way "to maintain a qualitative edge in the light of numerical inferiority". In Israel, the IT sales industry accounts for \$4.15bn in revenue, amounting to 6 per cent of the country's GDP (Ein-Dor *et al.*, 1997). The Israeli government's policy in the IT industry has been remarkably inconsistent over the last number of years (Ein-Dor *et al.*, 1997). While Research and Development support has never faltered, the software industry has been placed into the forefront of government policy. The Israeli government realise the high value of software and intend to exploit its worth. While the IT industry continues to create revenue in the Israeli economy, the education bodies maintain a substantial level of IT related graduates. This strict regime means that Israel boasts the highest percentage of engineers in the world, with 27.4 scientists and engineers per 10,000 population (Ein-Dor *et al.*, 1997).

New Zealand

Historically New Zealand has been an agrarian economy, one that has grown since the development of refrigerated ships in the late 1880s. In the 1980s, New Zealand's government introduced a number of deregulated policies restructuring the economy into a more industry and technology based one (Watson, 2000).

Although New Zealand has achieved considerable success in the area of IT, it is evident that agriculture is still a major part of New Zealand's economy. With New Zealand's IT sales revenue amounting to just 4 per cent of GDP (significantly less than that of Finland), the country fears that they will lose out to more technically developed countries such as Ireland, Finland, Australia and the US, if a greater effort to adapt and develop a solid information based industry is not made (Watson, 2000). New Zealand's government show conservative support for their growing information sector, alternatively pursuing a non-interventionist policy with respect to all industry development. New Zealand takes a broad approach to government policy. The "Asia 2000 Strategy" aims to place New Zealand's exporters in the top position within the Asian market (Ein-Dor *et al.*, 1997; Myers, 1996). With the restraint shown in government support and finance, the adoption of IT in New Zealand may be severely curtailed.

Singapore

Singapore's IT industry has emerged as a significant force, providing low-cost assembly and manufacturing location for multinational operations. In recent years, Japanese multinationals have established considerable research and development centres in Singapore and indigenous IT companies concentrate their efforts on R&D to such an extent that two of them have almost an 80 per cent share of the world market for PC sound cards (Ein-Dor *et al.*, 1997 and Dedrick *et al.*, 1995). Singapore's IT sales make up 3.8 per cent of their GDP (Ein-Dor *et al.*, 1997). As a result, Singapore's higher-end IT production has continued to grow reaching \$10.9 billion in 1993 (Dedrick *et al.*, 1995). Singapore has enjoyed the powerful effects of government promotion of IT in both the public and private sectors since

1981. Singapore's government intervened to attract multinational companies to the country (much like Ireland's industrialisation by invitation (Trauth, 1999)) creating a climate for the development of a domestic IT industry and the extensive application of IT in all sectors. During the mid 1990s Singapore boasted the largest production of IT and the second largest investor in IT among all the small countries (Dedrick *et al.*, 1995). Table 2 illustrates the historical IT industry growth in these four countries. It identifies statistical data captured at varying cycles of IT development in the global economy. Evidently, Finland, New Zealand, Singapore and Israel have all enjoyed varying levels of IT growth and development in recent years, clearly, each of these countries have responded to different levels of government intervention.

Table 2 Comparison of IT Industries in Four Small Developed Countries

	Finland	Israel	New Zealand	Singapore
Demographics				
Population (million)	5.0	4.9	3.4	2.8
Country Size (km ²)	338,145	21,950	267,800	621
Language	Finnish, English widely used	Hebrew, Arabic, English widely used	English, Maori	Chinese, Tamil, Malay, English
Religion	Lutheran 89% Greek Orthodox 1% None 9% Other 1%	Jewish 83% Islam 13% Other 4%	Anglican 22% Presbyt. 16% Catholic 15% Other 47%	Buddhism 29% Christian 19% Taoism 13% Islam 13%
IT Industry Development				
IT Sales/GDP	9%	6%	4.1%	3.8%
SW Exports				
Year	1998	1990	1998	1990
US\$ million	488	79	123	89
Growth Rate	-	39%	-	43%
Education and Training				
SW Graduates p.a.	2,000	4,700	-	4,000
SW Professionals per 1,000 people	6.94	7.54	7.21	4.11
Telecommunication				
Phone lines per 1,000 people	542	343	439	365
Level of Government Intervention	High level Intervention	Inconsistent (High-low)	Non- interventionist Policy	Industrialised by invitation

One major problem with analysis such as that presented in Table 2 is that the level of data in IT related areas is quite poor. The Organization of Economic Cooperation and Development (OECD) (1993) tell us that, “IT statistics remain a new and challenging area at work...available data is very scattered and generally inadequate”. It is the our intent to evaluate the extent to which Ireland’s software sector has developed through the impact of government policy, identifying the importance of this intervention and its significance in the future development of the sector.

RESEARCH FRAMEWORK

The conceptual model used in this study is derived from a variety of research sources, all of which are widely-cited in the literature. These include: (a) institutions influencing IT innovation (King *et al.*, 1994), (b) factors affecting it industry success (Ein-Dor *et al.*, 1997), (c) a strategy for software success in developing countries (Heeks, 1999) and (d) the influence-impact model of society-technology interaction (Trauth, 2000) (Table 3).

Table 3 Summary of Research Models

Model	Factors for IT Success	Institutions Influencing IT innovation	A Strategy for Software Success in Developing Countries	The influence-impact model of society-technology interaction	Institutional Factors impacting IT Industry Development
Author	Ein-Dor et al. (1997)	King et al. (1994)	Heeks (1999)	Trauth (2000)	Heavin, C. and Fitzgerald, B. (2003)
Key Factors	<ul style="list-style-type: none"> • Country size • Economic development • IT production development • IT industry success measures Exogenous Mediating Factors: <ul style="list-style-type: none"> • Geography • Raw Materials • National Culture Endogenous Mediating Factors: <ul style="list-style-type: none"> • Domestic IT use • Firm Strategies • Government IT policy • Government education policy 	<ul style="list-style-type: none"> • Government Authorities • International Agencies • Professional and Trade and industry associations • Research-oriented higher education institutions • Trend-setting corporations • Multi-national corporations • Financial Institutions • Labor organisations • Religious Institutions 	Enterprise Tactics National Strategy <ul style="list-style-type: none"> • Finance • Education and Training • Research and Development • Intellectual Property Rights • Infrastructure National Vision	<ul style="list-style-type: none"> • National Culture • National Economy • Societal Infrastructures • Public Policy 	External Institutional Influences: <ul style="list-style-type: none"> • Culture <ul style="list-style-type: none"> ◦ Language ◦ Literacy ◦ Religion ◦ Attitude to Education • Demographics <ul style="list-style-type: none"> ◦ Population ◦ Location ◦ Size ◦ Natural Resources Internal Institutional Influences: <ul style="list-style-type: none"> • Government Intervention • Government Bodies • Finance • Education

The resulting conceptual framework accounts for contextual influences that could contribute to the development of an IT industry (Figure 1). Ein-Dor *et al.* (1997) identifies two headings, endogenous and exogenous factors as contributors to IT development, factors that may and may not be controlled respectively. In this study, we adopt a similar approach splitting the key drivers into external and internal institutional influences.

External Institutional Influences

External institutional influences have been identified as contributors to the development of an IT industry. These factors include culture (such as languages spoken, workforce literacy, religion and attitude to education) and demographic¹ factors (such as population, geographic location, access to natural resources). While not extensively explored in this study, Ein-Dor *et al.* (1997) identifies these factors as indirectly affecting IT success, they offer an insight into the environment from which Ireland's software sector emerged.

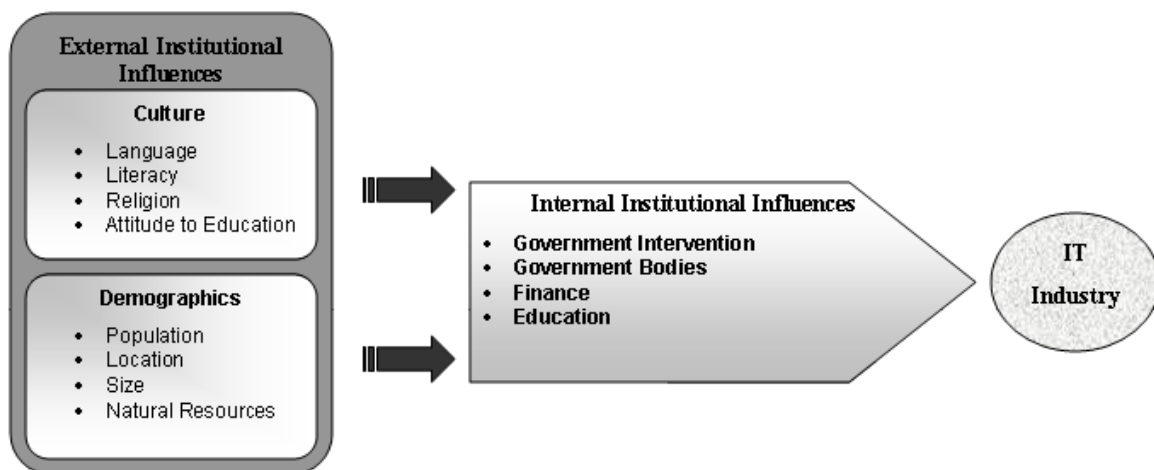


Figure 1 Institutional Factors impacting IT Industry Development

Demographics

¹ The term demographics has both a narrow definition as having to do with the statistics of population, and also a broad definition concerning the general condition of life in a community. In this instance, we use the broad sense of the word.

According to the latest estimates from the Central Statistics Office, Ireland's population is 3.8 million with 38 per cent of the population under the age of 25 years, giving Ireland one of the youngest populations in Europe (IDA, 2002). Given this population profile, Ireland may be classified as a small economy, similar to Finland, Israel, New Zealand and Singapore. Whereas small economies had been considered at a disadvantage, they now are perceived to have the ability to compete with their competitors in high technology sectors disregarding the capacity of their mass markets (Ein-Dor *et al.*, 1997). Two reasons are suggested as an explanation for this. The first is that a change in value creation has occurred. Value is no longer primarily created from industrial production. In the IT sector it is mainly created in analysis and problem solving tasks, identifying a customer's problem and offering solutions to those needs. Secondly, small countries no longer have to consider the issue of geographic location. Vast improvements in telecommunications mean that a manufacturer can carry out research and development in one country and production in another (Ein-Dor *et al.*, 1997). While Ireland's small size may have been problematic during its industrial era, it is not a disadvantage for an information economy. Ireland's location has also acted in its favour. Being close to the European market, a member of the European Union and maintaining links with the US market has enabled Ireland to create an international software market.

Over the last twenty years Ireland's young well-educated population has acted as a huge incentive for multinational organisations to set up operations here (Trauth 2000). In fact, Ireland has successfully educated more graduates than could be employed in the domestic sector. Given that almost all other countries

worldwide have experienced shortages of engineers and computer science graduates, the surplus in Ireland has provided a unique advantage for the software industry here. Finally, Ireland's limited supply of natural resources has acted as a motivating factor in the development of a software industry.

Culture

For the purpose of this study, culture has been identified as an external institutional influence that may not be changed, but it is fair to say that in the long term this may not be true. When considering Irish culture as it relates to the software sector, the language spoken, literacy levels, attitude to education and religion have been found to be important factors (Trauth, 2000). Undoubtedly, the fact that Ireland is an English-speaking country is a major benefit to the software industry, above all with regard to doing business in the lucrative US market. It also has been a highly influential factor in attracting many leading US multinational technology companies to set up in Ireland. The improved literacy skills since the availability of free secondary education in 1968 and the positive attitude to education in Ireland have brought many changes to the country's economic position.

There are different views regarding the external institutional influence of religion. According to Ein-Dor *et al.* (1997), religion does not directly affect the growth of an IT sector. Trauth (2000, p197), on the other hand, did see an influence of religion in Ireland. "Religion is woven into the fabric of Irish culture". This factor was not considered in our research.

Internal Institutional Influences

In contrast, the internal institutional influences, in particular, government policy, have been identified as having a significant impact on the development of the technology sector (Ein-Dor *et al.*, 1997, p85); it is this aspect of the model on which this research focuses. “Differences in the policies of governments seem to be major explanatory factors in differences in IT industry development”. Additionally, Weiss (1988:284) states that the responsibilities for industrial development should rest at a national level. Heeks’ (1999) model of IT industry success identifies -- national strategy -- as an essential component for the development of a software industry. King *et al.* (1994) suggest a framework emphasizing a number of institutional facets that impact IT innovation. The authors have drawn on these suggestions to develop a range of key institutional influences focusing on the emergence of Ireland’s software sector; they include finance, education, and training. The author recognises that each of these key aspects are directly related to and influenced by government policy and national strategy. Trauth’s (2000) study of Ireland’s Information Society considers the evolvement of Ireland as an agriculturally dependent country to a developing post-industrial economy and the changes that this emergence has brought about. Trauth primarily considers socio-cultural factors that have been influenced by Ireland’s shift from an agrarian to information-based economy. Trauth accounts for the extent of government involvement in shaping the transition to an information society considering the policy of industrialization by invitation in the 1960s up to the government’s intervention in shaping the growth of Ireland’s Software Industry during the 1990s. The author has gained insight into the cultural effect of the information economy on Irish society.

RESEARCH METHODOLOGY

The aim of this study is to identify the extent to which the Irish government contributed to the development of the software sector. Given the qualitative, exploratory nature of this research, a country-level case study of Ireland's Software Industry was employed as the most fitting research approach. This strategy reflects Trauth's (2001) study of Ireland's information society, where she pursued policy analysis using an interpretive approach to qualitative research methods in theory development. This marks a transition from the typical statistical positivist type IS industry research studies to an increasingly qualitative approach to research at this level of analysis.

Fifteen key interviewees were carefully and painstakingly selected based upon their level of involvement with the software industry. The interviewees were chosen through the use of positional and reputational selection methods (Knoke, 1994). A number of advantages have been identified in the use of elite interviews for qualitative research, "Valuable information can be gained from these respondents because of the positions they hold in social, political, financial or administrative realms" (Marshall and Rossman, 1989). In order to investigate Ireland's software industry it was necessary to identify a sample of prospective interviewees who would be able to offer insight into the history of the industry, the public policies that have effected its development and future plans that may be undertaken.

In order to investigate the role that these internal institutional factors have played in the emergence of Ireland's software industry, a two-phased study of the

Irish software industry was conducted. Initial data collection and analysis focused on document analysis of government documents, research papers and reports by the National Software Directorate and the Industrial Development Authority (IDA). This was used to inform the development of an interview guide (Appendix 1) that was developed in conjunction with the conceptual framework presented in Figure 1.

As already mentioned, interviewees were selected based on their level of involvement with the software industry. The fifteen interviewees chosen for this study were drawn from academe, industry and the government and are among those key players involved in the birth and growth of Ireland's software sector. Each interview was taped and lasted approximately one hour in duration. Five of the interviewees represent academe, four represent government and six represent the software industry. The industry based respondents were selected based on their positions as CEOs in Irish software organisations while the academic and government representatives were chosen based on their positions in educational institutions or key government bodies and also on their reputation as "movers and shakers" in the system (Knoke, 1994). In total, these interviewees offered insights into the history of the industry, the public policies that have affected its development, and future plans that may be undertaken. The interviewees have been represented in this study with the use of aliases to protect their privacy and opinions.

With regard to this study, we have benefited by the use of coding techniques drawn from the conceptual framework. This model (Figure 1) identifies the external and internal institutional influences impacting the growth of

a software industry. We derived eight code labels from the framework and assigned them to chunks of categories of data derived from the interview tapes. Throughout the coding analysis stage we made a number of changes to the list of codes; the coding stage was an iterative process through which patterns emerged from the interviews (Miles and Huberman, 1994). Initially, first-level coding was carried out as a data reduction technique summarizing large segments of data and finally pattern coding was employed as a way of identifying core themes across the interviews (Miles and Huberman, 1994).

ANALYSIS AND DISCUSSION OF EVIDENCE

Institutional factors are “ubiquitous and essential components” that lead to the understanding and explanation of IT innovations (King *et al.*, 1994). It is necessary to evaluate the institutional impact on the growth of Ireland’s software industry considering the fifteen interviewees’ opinions and insights into government strategy, industry financing, support from government sponsored bodies and educational change as contributors to the growth of Ireland’s software sector.

Government Intervention – Deliberate or Accidental

There are conflicting views concerning the direct institutional involvement in the development of Ireland’s software industry. While the government undertook the policy of industrialization by invitation at the close of the 1950s, there is no clear evidence to support the deliberate strategy of intent for the cultivation of a software industry. From the interviews, the authors uncovered a wide spectrum of opinion with regard to government strategy for the development of a software

industry in Ireland. There are champions for the government's efforts and others who felt that the government's strategic attempt to develop a software industry occurred by chance. One academic in the IS field states that, the government's steps in the late 60s and 70s were not deliberate.

"The government didn't see software as a strategic area, not in any targeted fashion".

He strongly commends the individuals at that time studying maths, physics and engineering. He believes it was those people who carved a software industry for themselves, these people had the foresight and ability to make something of software. As one academic with considerable industry experience put it: *"Software grew from the grassroots up"*. It has been suggested the government's policies were not deliberate in the early days but the government saw the general need to improve the economic situation in Ireland, this included changing the education system. At the time, literacy rates were extremely low and many failed to complete second level education. One interviewee from the National Informatics Directorate agrees with this view, he believes the development of the industry had no clear strategy but there were individuals who wanted to take a risk on technology.

"It was really down to individuals with ideas and the nerve to pursue the idea and no amount of intervention or government agencies can produce that". (Sean, National Informatics Directorate)

While the extent of the foresight for the software industry wasn't there, there was a growing confidence that there was a future in IT.

"It was always believed that computers had a great future, people didn't exactly see where the future lay". (John, former Computer Science Lecturer)

National Strategy

In contrast, a number of interviewees support the government's deliberate strategy towards developing a software sector. Paul (Software CEO) is a champion of the institution's efforts. In his opinion, the evolution of the software industry featured in government strategy at an early stage. One Israeli IS academic interviewed supports the government's industrialization by invitation policy as Ireland's "special factor" contributing to the development of the software industry. Software industry growth may stem from a factor that is unpredictable, earmarking this unknown factor as the source of technological development in other countries. He identifies Nokia's significant growth in Finland as a "special factor", while Israel's defence forces have driven the Israeli IT industry through R&D development. Trauth (2000) recognizes the "visible hand" that has guided Ireland's economic progression.

"Ireland has achieved this economic transition by employing a comprehensive industrial policy framework to guide societal, industry and government behaviour."(Trauth, 2000)

Motivation for Industrial Development

The interviewees commend the government's actions in developing a potentially flourishing industry during the early eighties. Through their policy of industrialization by invitation the government offered a fifteen-year full tax exemption for companies that chose to locate in Ireland. This altered in 1981, when the government offered a corporate tax rate of 10 per cent and additional grants to export focused companies until 2010. In the same year the International Services Program was established marking a shift from the old Industrial Development Authority, whose focus was predominantly manufacturing – plant

and machinery, capital investment to a new program focusing at service industries such as software.

“This shifted the emphasis for supporting capital investment to supporting investment in people”.
(Sean, National Informatics Directorate)

The Industrial Development Authority (IDA) introduced the employment grant during the early eighties; this meant that a company employing a certain number of people would receive a lump sum per employee. This motivator acted as yet another incentive to multinational investment in Ireland. The fact that the Irish wage rate was among the lowest in Europe acted as a driver for foreign investment. When the global economy experienced an economic downturn during the eighties, Paul (Software CEO), remarks how the Irish economy was no different. He states that the IDA was extremely proactive in their thinking and commends them on attracting a number of electronics based companies to the country. These companies were primarily American who had advanced in the utility of PC based applications, creating additional knowledge within the industry by bringing computers to the factory floor. These companies extended the software industry early on by using desktop applications in day to day running of the manufacturing plant, although they were not inherently software companies.

“All of a sudden we had the applications that were readily understood, the desktop was no longer a mystery and you had a growing demand of industrialization in Ireland”. (Paul, Software CEO)

Accordingly, the market opened to companies that could provide more specialized computer application services.

State Sponsored Bodies

The Irish government unlike most other countries has provided a significant support structure for the software industry. The authors contemplate the objectives of these groups and how they have contributed to the establishment of the software sector. The National Software Directorate (NSD) was set up in 1991 and was renamed the National Informatics Directorate (NID) in 2001. It was established to provide coordinating services to the industry. The National Software Directorate is responsible for the software Programmes for Advanced Technology (PAT). According to the National Software Directorate (1992), the aim of the software PAT was to align the industry with education, create niches in the software market and to create revenue from relevant research in the area of software technology. Additionally, the Centre for Software Engineering was set up in 1991 as a support service for the software development community within Ireland. The aim of the centre is to help companies in Ireland to improve its quality and productivity and to implement software engineering best practice by offering advice on company strategy and providing training. The Strategic Business Group (SBG) has been set up within the IDA; part of their objective is to consider developing a new niche software position for Ireland. One government-based interviewee who works for the unit identified the fact that Ireland can no longer plug the young educated population as our main edge for competitive advantage. Countries such as India and Israel boast of the same young educated graduates and this factor no longer gives Ireland the edge that has been enjoyed up to now.

Industry Financing

One of the most limiting and contentious factors with regard to the development of an indigenous software company in Ireland is that of funding. While many have developed solid business plans and quality products, the availability of venture capital has been problematic from the early days of the industry.

*“The lack of available finance is proving to be a real barrier to growth and is the single greatest problem facing high-tech industries today.”
(National Software Directorate, 1992)*

The National Software Directorate established a state sponsored venture capital fund in 1996 called the ICC Venture Capital Fund. It comprised 50 per cent state money, which was European funded money and the other half was investments acquired from a number of private sources. One software entrepreneur interviewed commented on the government’s conservative view of venture capital. Government sponsored investment was not aligned with the same view of risk as the NSD had hoped. While the National Software Directorate was extremely confident in the future of software, the state venture capital bodies such as ICC were conservative in their financial support for software producing companies. The fund has grown considerably; ironically when this fund became operational in 1996 other venture capital funds appeared. The mystery surrounding the industry disappeared and investors were more confident backing software knowing that the government was investing heavily in it. Entrepreneurial culture began to change; entrepreneurs were no longer “hustlers”, people setting up small firms gained confidence in a new and exciting industry. Venture capital is no longer the issue it was, especially for a software company that is already up and running and seeking to expand their operation. In 1999, indigenous venture capital was 90 per cent of internal investment and external investment almost

negligible, while in 2001 indigenous investment had dropped to 30 per cent and external investment has significantly improved to 70 per cent. Undoubtedly, the availability of venture capital for software funding has acted as a significant enabler for the industry. While investment is increasingly obtainable, without a solid business plan and a quality product with a potential market, investment remains difficult to acquire.

Educating an Information Society

Ireland's education system has acted as a pivotal contributor to the development of the software sector; it has emerged as an undisputable factor contributing to the growth of the industry. Since secondary education was made freely available under state legislation in 1967, a culture has developed in Ireland where the expected standard and quality of graduates each year remains increasingly high. One academic respondent earmarks the availability of free secondary education as a turning point in the industry's development. In agreement, Sean (National Informatics Directorate) comments that the education system has played a definite role in the development of the software industry. While the education system was not set up with the development of a software industry in mind, there was definitely a bias toward the more technical areas from the outset. Early on, it may not have been a deliberate strategy on the government's behalf; the institutions have supported the technical courses and pushed the government in the direction of technology. Trauth (2000) considers Ireland's move in education. "In the 1970s and 1980s, two new universities were established and the traditional universities were adapted to incorporate business and IT skills in their curricula". The University of Limerick was established in 1971 and Dublin City University was

set up in 1980. In addition, the Regional Technical Colleges (later renamed Institutes of Technology) were opened placing yet another focused step towards technology.

The government's "visible hand" of influence since the 1960s has acted as a major contributor in developing the software sector. While, government involvement in the software industry may have been more accidental than deliberate during the early days of industrial development in Ireland, the foresight of the government's industrial policy of industrialisation by invitation is commendable in its efforts. Figure 2 identifies both the external and internal institutional influences on the growth of Ireland's software sector.

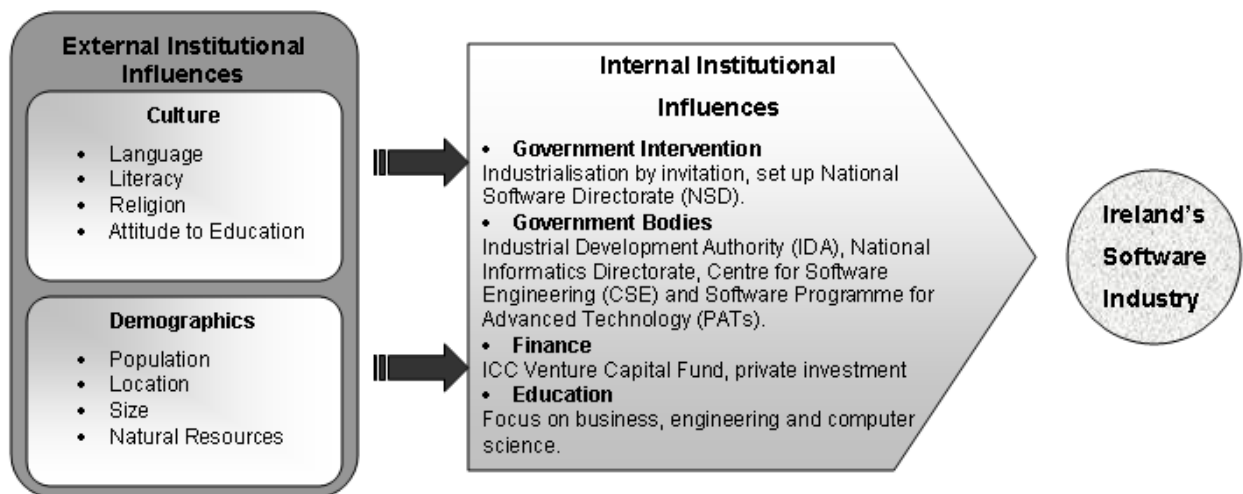


Figure 2 Institutional Factors impacting Ireland's Software Sector

External institutional influences such as culture and demographics while not considered in great detail in this study, act as direct influences on the development of the software sector have acted as key industry drivers. The slow cultural change since the 1980s has transformed Ireland's attitude to entrepreneurship, risk taking and investment. Although there have been dramatic highs and lows in the industry, in particular the adverse affect of the 'Dot Com' turnaround, a new

founded entrepreneurial ethos is derived from Irish Software houses being quoted on the Nasdaq. Companies such as Iona Technologies, Baltimore and SmartForce have given others the confidence to develop software and test the market. As it has a population under 10 million, Ireland is considered a small country. While population size has been problematic during the heavy industrialization period it is not a disadvantage in the age of the Information Economy. Ireland's location has also acted in its favour, being close to the European market, a member of the European Union and maintaining links with the US market has enabled Ireland to create an international software market. Finally, the internal institutional input since the early nineties has shaped the way forward for the industry.

After carefully analysing the interview content, the interviewees and their respective backgrounds, we attempted to generalize the key findings, grouping the respondents by their backgrounds, Table 4 summarises the respondent views considered in this research.

Table 4 Summary of Interview Responses

	Internal Institutional Factors
Academic	Evolved- <ul style="list-style-type: none"> • Government prodded by academia initially. • Adopted deliberate strategy in 1990s.
Government	Proactive- <ul style="list-style-type: none"> • Government's deliberate strategy and foresight in developing Ireland's Software Industry.
Industry	Supporting Role- <ul style="list-style-type: none"> • Primarily Financial

With the provision of finance and extensive support from the National Informatics Directorate, Enterprise Ireland and the Centre for Software Engineering the industry has enjoyed the expertise, opportunities and strategies derived from this software think tank. The development of the sector has been tangible, according to the National Informatics Directorate (2002), the Irish software industry generated

revenue of €2,198 billion in 1991 this has increased exponentially to €10,150 billion in 2000.

CONCLUSIONS

Evidently, the national factor has been identified as playing an influential role in the development of Ireland's Software Industry. The importance of the government's involvement in the development of the industry is clearly supported by Weiss (1988:284) who comments that the responsibilities for industrial development should rest at a national level. In addition, Ein-Dor *et al.* (1997) back this view noting that the high level of government intervention in the case of Singapore has contributed to the development of their IT industry. While on the other hand, New Zealand's lack of governmental direction for the technology sector has meant that the development of its technology sector has been less rapid. Finally, Trauth (2000) comments that the conscious role played by the Irish government in the development of the software industry has resulted in the successful transition of Ireland as an agricultural state to a technology driven Information Society. Despite global economic shifts, new software companies are being formed, the industry is becoming increasingly niche focused and despite the difficult environment substantial venture capital funds are available to established software companies, €500 million was raised in 2002 and early 2003 (HotOrigin, 2003). While this study uncovers varying views with regard to the institutional impact on the software industry, we acknowledge that the future of Ireland's software sector is grounded in significant institutional support.

“The overall lesson is one of hope. Given sufficient vision, direction and determination, a small country with limited industrial experience can establish itself as a significant player in a high-tech

field within a relatively short period. This lesson is surely one worth learning by policy makers in all the aspiring countries of the world.” (Ryan, 1997)

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Heavin C and Fitzgerald, B. (2004) Institutional Impacts on the Development of an IT Industry: The Irish Experience, *Journal of Global IT Management*, Vol . 7. No. 4. pp. 380-397.

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APPENDIX 1

Interview Guide - Introduction

During the 1960s, it was widely believed that companies would not generate revenue manufacturing off-the-shelf software to be sold independently of hardware. Although it is unclear as to whether the software industry was born with IBM's unbundling

announcement in 1967, it is evident that IBM's move to sell software separately from hardware packages boosted industry confidence and their sale of software packages legitimized the concept of paying for software as an industry. By the early 1970s, markets began to realize the value of the software industry and it was later in that decade when the market began to experience almost exponential growth.

The Irish Software Industry

Since the 1960s, Ireland's economy has rapidly moved from being purely agricultural based to an economy heavily concerned with the information sector. The Irish Software Industry has grown considerably over the last few years, making Ireland the second largest exporter of software in the world valued at euro 5.71 billion. The industry employs approximately 20,000 workers and many of the world's largest software producers have developed Irish operations including Microsoft, Lotus, SAP, Logica, Oracle and Sun Microsystems.

A number of key events lead to the establishment of an Irish Software Industry. The government's policy of industrialization-by-invitation in the early 1960s attracted a number of high-technology multinational organizations to Ireland and commenced the effort to establish Ireland as an information society. In 1967, secondary education was declared free and compulsory up to the age of fifteen. Investment was increased in both secondary schools and the area of technical education; this initialized the emphasis on the quality of education in Ireland. Following this, considerable investment was ploughed into the development of the telecommunications industry. By 1980, the Irish telephone service provided one of the highest percentages of digital exchange in Europe. The sale of software in Ireland was finally being recognized as an "industry". A campaign by the industry's trade association (now known as the Irish Software Association) led to government recognition of the industry in 1989 and the setting up of the National Software Directorate in 1991. The work of the National Software Directorate led to the introduction of a state-sponsored venture capital fund in 1996, a major reason for the accelerated growth of the industry in the late 90s. The Irish Software Industry is the result of many contributing factors some of which were deliberate strategies supported by the government and others, which happened by accident. The aim of the researcher is to identify these factors deliberate and otherwise and explore their effect on the development of the industry since its establishment in the early 1960s.

Software – A Global Context

The lack of literature relating to the area of the Irish Software Industry has forced the research into a wider realm of exploration. In order to gain a sense of what has occurred in the Irish Software Industry to date, it has been necessary to examine software industries worldwide in order to carry out a comparative analysis between the factors that concerned other countries and those that may have concerned Ireland. Over recent years a number of countries have been cited as IT/software success stories. These stories include Finland, New Zealand, India, Singapore, the United States and Ireland. It has been necessary to examine the factors that have encouraged software success in a number of these countries in an attempt to develop a comparative analysis between the software industry in these countries and that of Ireland. The literature provides varying frameworks depicting worldwide IT development and software growth. Using these models, the researcher has developed a framework focusing on those factors that influenced the emergence of Ireland's Software Industry. Using the framework the researcher intends to explore the following factors and their relevance to the emergence of the industry.

Interview Questions

National

1. How has Ireland provided a climate for the development of a software industry?
2. Do you feel the government has acted as a major catalyst in the development of this sector?
3. In your opinion, has there been a major event/turning point, which has shaped the growth of the Irish software industry?
4. Has the education system acted as a major contributor to the development of the software industry in this country?

Enterprise

1. Do you feel that Irish entrepreneurs “have got it right” in relation to the development of the Irish software industry?
2. How does software enterprise/national strategy in Ireland differ to strategies pursued by other countries? What in your opinion are the strengths and weaknesses of these strategies?

Individual

1. Do you think that Irish social/culture issues have contributed in any way to the growth of the countries software industry? If so, to what extent?

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2. Are there other factors not included in the model that you feel may be a key issue in this area of research?
3. What do you foresee as the future of Ireland's software industry?