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Drivers of Early Technology Sector Development in Ireland

Sarah Davis and Breda Kenny

Abstract

This paper explores the origins of the electronics and software sector, now called the Information Communications and Technology (ICT) Sector in the Republic of Ireland and its subsequent development from 1960 to 2010 inclusive. The research sought to identify key developments that influenced the emergence of the sector. For the purposes of this study, the ICT sector is defined as the foreign-owned and indigenous firms actively involved in the production, design and/or servicing of hardware and software electronic products within the Republic of Ireland. Empirical evidence in the form of 15 semi-structured interviews was analysed and validated by three respondents as well as one external ICT expert. Two key drivers found in the data were the development of a capable managerial cohort and a spin-off mechanism.

Key Words: ICT Industry Development, Ireland, Management Development, Spin-off Mechanism.

Introduction

This paper presents evidence of two drivers found in a study, which explored the origins of the Information and Communications Technology (ICT) sector in the Republic of Ireland and its subsequent development from 1960 to 2010 inclusive. The main aim of the research was to identify key developments that influenced the emergence of this important industrial sector. The electronic and software industry in Ireland, currently called the ICT sector, is defined as the foreign-owned and indigenous firms actively involved in the production and/or servicing of hardware and software electronic products within the Republic of Ireland. This broad definition is a modified version of the definition used by Collins and Grimes (2008). The requirement to explore the emergence and development of the sector from its beginnings in the early 1960s drove the decision to maintain a broad definition. Whereas many drivers were identified, this paper focuses on the two key drivers identified for the sector, namely, management development and a spin-off mechanism.

This paper is structured as follows: First, we review the literature on industry development, management development and spin-offs, followed by the methodological approach. Next, the findings that support a spin-off mechanism and management development as key drivers for the ICT industry development are presented. Finally, conclusions are drawn and some limitations of the research are outlined.

Industry Development as an Evolutionary Process

This section draws on theory from the strategy literature on industry development and management development. Every industry begins with an initial structure and is configured by *evolutionary processes* (De Wit and Meyer 2010). These evolutionary processes operate *even if there are no important distinct events to signal this* (Porter 1980 p. 140). Porter (1980) points to evolutionary processes as the forces that create the incentives or pressures for change. Evolutionary processes push industry from its initial structure towards one of many potential structures. Phaal et al. (2011) find that enablers and barriers to industrial development are contextual, industry-specific and depend on the phase of industrial emergence of the industry under review. They identify a co-evolutionary process between the demand side (market forces) and the supply side (technological forces) as a key driver. Changes within industry are usually due to interactions of many drivers and inhibitors, and industry dynamics itself, can act as a driver. Within the evolutionary process, management development is an important dynamic or evolutionary driver for industry development.

Talent Management

Most approaches to talent management are directed towards those managers who are seen as having the potential to be executive talent (Stahl *et al.* 2012). Globalisation has caused changes in the management of talent (Tarique and Schuler 2010). Where before, MNEs made an assumption that the techniques of the parent company could be adopted worldwide and staffed their key management positions with expatriate managers, a more recent trend is to manage talent on a global basis in a context which is more complex and multifaceted.

Where many context-dependent definitions exist, Blass (2007) defines talent management in terms of the extra management opportunities and processes that are provided to 'talented' people within an organisation which relates well to the McDonnell *et al.* (2010) definition of talent as a dynamic concept, which may change over time and with changing priorities within organisations. Key talent may also reside in technical employees who do not fulfil a senior management role (McDonnell et al. 2010).

In analysing over 414 structured questionnaires from multinationals (both indigenous and foreign owned), McDonnell et al. (2010) developed a framework of four Global Talent Management (GTM) approaches (global succession planning, global management development, global talent management and global talent development). Moreover, they identified five independent variables (sector, country of origin, employment size, level of standardisation of product/service, existence of a global HR policy body) which largely explain multinationals engagement in GTM. They concluded that MNEs were more likely to engage in management development if they employed more people and they identified a difference between high-tech manufacturing and traditional manufacturing, with high-tech manufacturing less likely to employ global management development, as they are likely to operate across different sectors and with non-standardised products.

McDonnell *et al.* (2010) also explored a number of talent development mechanisms, such as short or long-term international assignments, formal global management training, assessment of performance against global management competencies and qualifications. They concluded that existence of a global HR policy body within the MNE had a positive influence on a greater use of management development mechanisms. Of the MNEs that were surveyed, 90% of them still used the traditional mechanism of sending employees on qualification programmes and the least commonly used mechanism was overseas assignments. Their study showed more than 80% of the MNEs were using a multimethod approach to talent development. There was no significant difference between the indigenous MNEs and the foreign-owned MNEs (McDonnell *et al.* 2010).

While McDonnell *et al.* studied multinational practices within the Republic of Ireland between 2006 and 2007, as we are exploring retrospective drivers for the ICT sector in Ireland, it is useful to review the beginnings of this sector and the original spin-off mechanism at the often designated source of origin, Silicon Valley.

A Spin-off Mechanism

Adams (2011) delves into the story of the early scaling up of ICT industry development in Silicon Valley in the USA. During the period between 1940 and 1965, a mix of both large and small high-tech firms had been a key feature of the Silicon Valley area. The large enterprises were primarily branches of multi-locational firms. Hence, distant organisations played critical roles through their subsidiary branch plants located in the Valley. *Incumbent firms are natural training grounds for the next generation of entrepreneurs in an industry* (Klepper 2011 p. 145). These training grounds developed some entrepreneurial employees who then went on to set up their own firms as spin-off companies. Fairchild Semiconductor was, either directly or indirectly, responsible for 82% of the spin-offs that entered Silicon Valley (Klepper 2011). Often, these entrepreneurial employees located their new spin-off companies in close proximity to the seed company.

Moore and Davis (2004) relate the spin-off companies to the creation of, and the increase in, the numbers of technologist managers in the early days of development in Silicon Valley. This involved a three-phase process consisting of (1) the learning of both people management and firm management; (2) the structuring of a technology business (i.e. the moving from a one-off design in the laboratory to mass production processes); and (3) guiding the innovation process within the technology firm. While this echoes the management development perspective, already described, a spin-off mechanism provides an alternative perspective on the evolutionary processes involved in industry development and focuses attention on business development as well as human capital development.

New firms in an industry can be categorised as diversifiers, spin-offs and their parents, or other start-ups. A *spin-off* mechanism is posed by Klepper (2011 p. 143) to explain the evolution of four industry clusters. The four clusters were the automobile industry in Detroit, the tire industry in Ohio, the cotton garment industry in Bangladesh and the semiconductor industry in Silicon Valley. There were common features of these extreme clusters (Klepper, 2011). In each cluster studied, more than a hundred firms entered in a 30-year period.

Each cluster started with a single seed company and followed similar evolutionary paths. Klepper (2011) traced the background of the new firms by establishing who had founded them and their previous work history.

Industries do not develop in isolation and elements in the general economic environment may contribute to the creation of spin-offs. *Caiazza et al.* (2014 p. 103) define spin-off companies as *new companies created with human resources as well as core technology previously used in other organisations (mother-firms)*. These mother-firms can be either industrial firms or public research institutions. In either case, spinning-off is an entrepreneurial activity. In the case of public research institutions, the factors that affect spin-off creation can be of the macro, of the meso, or of the micro order (*Caiazza et al.*, 2014). At the macro level, government policy and entrepreneurship supports push the economy; at the meso level, structures promote and support new economic activities from collaborative research with institutions; at the micro level, the focus of single researchers on the possibility to commercialise research or the development of an entrepreneurial mind-set at the individual level.

This research seeks to understand if a spin-off mechanism was operating in the evolution of the early ICT sector in Ireland and highlights the variety of factors that may influence such dynamic and complex sectors, leading, at best, to contextual findings. The next section reviews the methodology and then the empirical data collected which supports the evolutionary forces of management development and a spin-off mechanism are reviewed in the findings and conclusion sections.

Methodology

A critical realist (CR) philosophical approach (Sayer 1992, Bhaskar 1997, Danermark et al. 2001) is chosen to deal with the time-frame and the subject area breadth. CR allowed the viewing of the Irish ICT sector as an open system (Danermark *et al.* 2002, p.199) thus allowing the complex and dynamic and interactive nature of the government policy and the ICT sector to be explored.

The unit of analysis is a social construct, an open system, consisting of the industry sector. It contains, embedded within it, other entities such as the ICT enterprises, institutions, and individual actors. In CR, entities will usually be structured. For example the ICT sector, as defined, can be seen as an entity in its own right, consisting of a series of other entities such as firms, associations, networks, people, processes, resources etc. all of which can have an effect on one another. Some of these structures are nested. Each firm, for example, can have its own structure; can be a member of a network and a constituent of the ICT sector as a whole. Each entity has its own causal powers and liabilities. According to Ryan *et al.* (2012 p. 300), *Critical realism is well suited to addressing the central questions of structural change and transformation in industrial relationships and networks*. There is a match between the evolutionary processes (Porter 1980, De Wit and Meyer 2010) and the CR view of underlying structures and driving mechanisms (Bhaskar 1997).

A semi-structured research interview plan addressed relevant areas of government policy, technical education and industry development and this plan formed the basis for conducting interviews with all respondents. Empirical evidence in the form of fifteen semi-structured

interviews (Davis 2015) was gathered. Interviews times were typically between 45 minutes and 2 hours. Kvale and Brinkmann (2009 p. 2) call it an interview, where knowledge is constructed in the inter-action between interviewer and the interviewee.

A non-pre-specified within-case sampling (Miles and Huberman 1994) or selection process was used to identify key *experienced and knowledgeable experts* (Lincoln and Guba 1985). Only persons with ten or more years of ICT managerial experience with working knowledge of the contexts (Maykut and Morehouse 1994 p. 57) were interviewed. The sampling spectrum covered three representatives of the industrial development agencies, four educational influencers (people actively involved in technical educational) and eight people with relevant ICT industrial experience. Some of the respondents had relevant ICT industrial experience and academic experience. Under the banner of industrial experience, hardware and software development, as well as indigenous industry and MNCs (multinational corporations) were represented by the selection of experts with relevant experience. Table 1 summarises the respondent/interviewee selection, their areas of expertise and the enterprises or organisations where they worked. The final column in Table 1 provides an indication of when the respondent first joined the workforce, an indication of the range of their historical perspective of the ICT sector development.

Table 1: List of interviews

Interview Number	Area of Expertise (Company history)	Gender	Year range Start of work/ career
Interview 1	Government Policy Enterprise Ireland, ICT sector	Male	1980-1984
Interview 2	Government Policy IDA, ICT sector	Male	1990-1994
Interview 3	Education and Electronics Industry Institute of Technology, Farran Technologies, Apple	Female	1980-1984
Interview 4	Government Policy Local Enterprise Office	Female	1980-1984
Interview 5	Electronics Industry DEC, Logitech, Computer Products	Male	1980-1984
Interview 6	Education and Industry University, Bourns, Electronics, EMC	Male	1985-1989
Interview 7	Electronics Industry Krupps, Wang, EMC, Incubator advisor	Male	1965-1969
Interview 8	Education and Electronics Industry University, a university spin out company,	Male	1990-1994
Interview 9	Software Industry Serial Entrepreneur	Male	1985-1989
Interview 10	ICT Industry DEC, Microsoft	Male	1970-1974
Interview 11	Electronics Industry Northstar, Apple	Female	1985-1989
Interview 12	Education and Indigenous Electronics Industry Institute of Technology, Telectron, 2 IDA green field start-up companies	Male	1965-1969
Interview 13	Electronics Industry GE Subsidiary ECCO, Apple, mentor/advisor to high tech start-ups	Male	1960-1964
Interview 14	Electronics Industry ESB, GE subsidiaries Ecco & EI, CEO of large Irish owned electronic Company.	Male	1970-1974
Interview 15	Telecommunications Industry Amdahl, Telecom Éireann, Engineers' Ireland	Male	1980-1984

Yin (1989) points out the suitability of a single longitudinal case study to identify trends over an extended period. Documents and Journals in the *Engineers Ireland* library and archival documents in The National Archives of Ireland in Dublin, corroborated and augmented the evidence from the fifteen semi-structured interviews. In order to validate this research, 3 respondents and 1 knowledgeable ICT expert who had not taken part in the research, reviewed the findings and conclusions. All four concurred that the findings depicted the industry as they knew it and found it a good representation of the industry development.

Findings and Discussion

Many drivers for the ICT sector were identified during the research. Five categories of driver were identified, namely, global, national, industry-level, firm-level and individual drivers. This paper focuses on two key industry drivers, management development and a spin-off mechanism. First, we review the empirical support for the development of a managerial cohort and then we consider the support for the spin-off mechanism.

In the early 1960s, there was a lack of a developed base in electronics, which was borne out by the experience of 5 of the respondents. The Committee of Industrial Organisation (1963), which was tasked with reviewing the state of industrial development in Ireland, examined only twelve companies in their “Wireless, Television and Telecommunications” Report. These companies were mostly manufacturing radios and televisions for the home market and had no design or development functions. By the late 1960s, with the IDA policy of attracting overseas investment, new options were appearing for engineering graduates in Ireland. The first electronic subsidiary of GE in Ireland was EI. This was GE’s first overseas subsidiary and it was set up in Ireland in 1963. GE’s second subsidiary, in Dundalk, called Ecco, opened in 1966. *I finished up here [university] in ‘68 and I was just lucky that General Electric and Westinghouse came recruiting in the college that year (Interview 7)*. This respondent and others described the electronics industry at the time as an ‘exciting’ option compared to the semi-state bodies and existing industry options.

The ICT sector developed and changed over the five decades. Initially, the subsidiary work was, typically, in manufacturing of components that were end-of-life in the USA and *normally you would only get the assembly of these products for GE (Interview 14)*. Cheap labour and preferential tax were driving forces for overseas investment. *The way it kicked off here was around the Shannon Free Zones and that kind of idea and manufacturing tax (Interview 3)*. One respondent referred to GE as the first wave of development and identified the arrival of Digital Equipment Corporation or DEC and computer manufacture as the start of the second wave (Interview 7).

The data showed the respect and admiration of the respondents for the training and development that they received from company training, on-the job training and mentoring by individuals. In GE subsidiary, Ecco, Respondent 13 stated, *I got a lot of development from Jim (Interview 13)*. He was involved in setting up the first training programme and grant application in Ecco. This training programme was prompted by the fact that the company was looking to grow by 300 people in that year. In addition, *I invented all kinds of training. That we would send everyone to the IMI and we would rotate people and send them to the States (Interview 13)*. This course has been attributed with producing some of the cohort of

managerial experience that spun-off into other companies (McCambridge 2001). In fact, this respondent had worked with and could name more than fifty former Ecco employees who subsequently became CEOs or leaders of other technical companies.

Respondent 11 referenced the environmental learning benefit of working in a small set up. It [Northstar in the 1980s] *was an extremely good learning environment because it encapsulated an entire electronics company on a small premises with a few people* (interview 11). This all-around view then supported further career advancement for this respondent. The work place as a learning environment was referenced by two others as follows: *And I learned more in my four years at Apple than I have in any four years since* (Interview 3) and *There were great lessons in Apple* (Interview 13).

Management Development

Initially, management personnel came from corporate headquarters to run the Irish subsidiaries (Tarique and Schuler, 2010). *The plant manager [in DEC] when I was there [1970s] was American. Most of the senior management were American* (Interview 10) and *they [GE] originally came in with all American Managers* (Interview 13). These subsidiaries offered a new opportunity for training and development. *GE offered me a job in the States on their Manufacturing Management Programme* (Interview 5). This changes with time to a situation where it is mostly Irish management as illustrated by the comment: *It's over to the Irish management to make the European thing run* (Interview 2).

In the early electronic companies, training was about development of the engineering manager and this is described well by Respondent 14. *I had made the transition from being engineer to being supervisor with engineering responsibility. That set me up then for an Operations job, which I got. And then my boss said to me 'You are going nowhere unless you spend some time in marketing' and later when choosing between job options this respondent was advised you want two years under your belt as operations manager and then you've done your marketing. You are dead-on then. You'll pick up an MD job no problem.* In the second wave, Digital Equipment Corporation (DEC) had the advantage of training managers in the American way of doing business with monthly and quarterly reports and with the rhythms and demands of US-style business (Interview 5). These habits, training and knowledge were then transferred to other companies when DEC closed down, illustrating the interlinking of management development and spin-off mechanisms.

There was a divide between the engineer who remained as an engineer throughout his working life in industry and those who were promoted through the management route. In line with McDonnell et al. (2010), two respondents commented on the differences between the engineer and the technical manager and Respondent 13 commented, *there is the divide between the professional engineer and the manager and I probably went the manager route.* Good technical companies ensured that there was a promotion path for both of these types of talent. Two respondents stated that this was the case at EMC *You could follow both paths* (Interview 6).

DEC was widely known as an open company, which encouraged development of their employees (Interview 10). Similarly, with the successful company EMC, two respondents

indicated how progressive their training policy was and the commitment to training continued even when the company was going through difficulties in 2001 and 2002. *They never cut back on their training and development budget. They always invested in people (Interview 6). Furthermore, two leadership development courses were mandatory for us all at director level at EMC* and this respondent reported that training in EMC was updated to match ongoing requirements, thus supporting the dynamic notion of talent as proposed by McDonnell et al. (2010).

From a low base, the sector exhibited the first two phases of Moore and Davis (2004) development process, namely, development of management of large manufacturing organisations and in the structuring of technological companies. As a successful example, EMC had developed to phase 3, i.e. guiding an innovation process, by developing a *really multifunctional campus* (Interview 6). This reflects the multimethod approach to talent management referenced by McDonnell et al. (2010). However, this respondent attributed success to the roots in manufacturing where *one of the unique things about EMC at the time ... it was manufacturing the full product range for worldwide and that this is what allowed it to become that centre of excellence.*

In general, the management development process was an effective legacy for the future developing industry. Key companies invested in management development and provided good training to talented employees. These companies were then the source of management for further incoming investing companies and, in some cases, for starting up Irish technology companies. The case presented here differs from Davis and Moore Silicon Valley phase 2, in that, typically, in the Irish case, the manufacturing came first and then the design or development of products was added later (Interview 11). This respondent related the example of the GE subsidiary EI in 1974, where for the first time design responsibility for one product was added to the Irish subsidiary's mission.

The next section explores a recurrent theme in the data collected of prior experience leading to spin-off effects as the learning and development from the past is inherited and develops the new generation of companies and entrepreneurs.

Evidence of Spin-off Companies

References to the formation of spin-off companies, both from indigenous companies and from the foreign-owned multinationals, were found in 10 of the 15 interviews. 'Seeding' was a term that was used by some of the respondents to denote experience or training in one company or environment that then led to subsequent development of other new companies and skills. As seeding, typically, refers to funds that venture capitalists invest in start-up companies, the term spin-off has been used hereafter to avoid confusion. This spin-off process was notable for being continuous and ongoing throughout the fifty years from 1960 to 2010.

Many individuals were mentioned as key figures in the development of the industry through the process of spin-off. One such individual (mentioned in 2 Interviews), who in GE subsidiary Ecco, *was one of the top management team... and later went on to become the manager of EI and later again then, managed Digital and ended up managing Intel.* This was reflected by Respondent 6 who worked in EMC around the year 2000 and found *the training under*

American companies like that is fantastic. It really develops leaders in people (Interview 6). The continuous support and development of the indigenous industry then led to a more positive business environment. From an entrepreneur's perspective, *as it is today... If you want to start your own business – this [Ireland] is the place to start* (Interview 9). From this software entrepreneur's point of view, development for the indigenous software industry began around the time of the dot.com era: *the incubation centres, the accelerated programmes like the Enterprise Development Programmes*. That was one thing that was necessary to help people realise and give them a support structure to start a business (Interview 9). This lends support to the complex nature of industrial development where evolutionary drivers exist in government policy, educational support, and the industry itself, reflecting *Caiazza et al. (2014)* macro, meso and micro factors that drive spin-off development. The following statements from the semi-structured interviews, illustrate the spin-off mechanism as an evolutionary force that operated throughout the five decades under review. Initially, *Ecco was a gem really and it was a source of a lot of us guys who came up* (Interview 6)

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The following statements from the semi-structured interviews, illustrate the spin-off mechanism as an evolutionary force that operated throughout the five decades under review. Initially, *Ecco was a gem really and it was a source of a lot of us guys who came up* (Interview 6) and the next generation of management came from General Electric *because General Electric had a fantastic management training programme... and maybe, even in the 1970s, when you looked around Irish industry, the number of General Managers that had come from either EI or Ecco... it was very significant. The next wave was DEC* (Interview 7) and *Wang came in and so I applied there and I was taken on as part of the start-up crew for Wang, which was fantastic... the general manager was from DEC* (Interview 7). Similarly, the Amdahl organisation was compared with DEC as a source of spin-off companies and management talent. EMC was the source of the entrepreneurs who founded VMWare by following the management experience trail through Bourne's Electronics, EMC and then to VMware (Interview 6). Similarly, three interviews referenced the closure of Motorola as a spin-off source company. It was the source of a high-tech start up with *five of the best people* (Interview 13). An example of the spin-off process was described as follows in one interview: *Motorola in Cork, right, look at Alcatel, even go further back to the earlier times when Wang were. [here] and Northstar and look at the people that came out of those companies and where they went. And all these people and the skills that were created. And what happened was what happened with DEC in Galway when they shut down. Galway now has a very strong industry coming out of the back of that* (Interview 9).

Where the above describe the spin-off mechanism from the multinational presence in Ireland, there was also support for the spin-off mechanism operating within indigenous industry and with some migration of management talent between the multinationals and Irish companies. Indigenous company, Telectron was identified as a source of spin-offs by one respondent who named two talented individuals, *one who left then afterwards [Telectron] and formed a company called Aisling. They made emulators and another who went on to become Engineering Manager in Analog Devices in Limerick* (Interview 12) and again this respondent emphasised the importance of allowing talent a dual path towards career progression. A software manufacturing company called SMC was another 'mother company' *where companies such as Client Solutions, PFH, Pepco, WASP ... came from SMC* (Interview 9) and within this interview, Baltimore Technologies as attributed as a spin-off source company or 'mother company' where the number of *people that came from that company to form their own and absolute leaders of industry today.*

Development of essential management capabilities and talents, alongside a spin-off mechanism are clearly, when taken in context, important drivers for ICT development from the sector's emergence in Ireland in the early 1960s and throughout the subsequent decades.

Conclusions

The ICT industrial sector demonstrated a general trend of national development (Porter 1991) by upgrading from provision of factors, such as provision of low-cost labour, graduating to investment-based growth and, with further evolution, leading to innovation-led development. The development of the industry began with the promotion of Ireland as a low-cost manufacturing electronics location which corresponds to factor-based development, as illustrated by the early work in the two GE subsidiaries; it moved to more advanced technological foreign direct investments including software and services (such as DEC, Apple, Microsoft, EMC) and these moves were reflected in the data collected.

The sector subsequently moved to encourage venture capital investment and entrepreneurship as the successful indigenous software base developed. More recently, industrial policy has sought to drive innovation to further national economic development. The data generally support this evolutionary path, where, on an industry level, the semi-state bodies played a key role in sector development in the 1960s, where the dominant industry players were in radio and television receiver manufacturing. This is in stark contrast to the 2000s, where indigenous firms emerged and prospered from MNCs' outsourcing strategies while campus-based incubators expanded and supported both spin-in and spin-off technology entrepreneurship activity.

In Ireland, there has been much debate over the years about the role of foreign direct investment and its effect on development of an innovative or entrepreneurial culture. Early criticisms of foreign direct investment centred on the types of skills developed and the lack of self-determination and control by management of the subsidiary. However, a spin-off mechanism combined with the development of a capable managerial cohort, as part of the evolutionary processes, may offer insight into ICT industrial development in Ireland. This may reconcile the entrepreneurial nature (Caiazza *et al.* 2014) of both the foreign-owned multinational and indigenous industry within the ICT sector development within Ireland.

Management development and training were instrumental in bringing managerial talent to the fore, in particular for those who were capable of successfully starting-up the next generation of spin-off companies leading to a successful evolutionary process when viewed over five decades. However, McDonnell et al. (2010) warn that high-technology companies are now less likely to engage in global talent management than were the previous companies engaged in traditional manufacturing, because they have operations across different sectors and because of their non-standardised products. This has implications for future management development in this country.

A limitation of this paper is that the findings here focus on two effects from a much larger study and cannot, in isolation, be representative of the industry as a whole and counter arguments would warrant a complete paper in their own right.

The types of company and company culture within the industry were seen as drivers. 'Open' and 'developmental' were frequently used words to describe companies which supported management development. Management development and a spin-off mechanism were both needed to produce the evolutionary processes of successful ICT development. In the complex and multifaceted talent management requirements for global talent development, further examination of what can be concluded from the historical context of successful development is warranted, particularly, with the emphasis on modern talent management in the more complex global environment. This paper views management development as the legacy, with the spin-off companies as the inheritors, in an on-going, dynamic, evolutionary process of ICT sector development which served Ireland well from 1960 to 2010.

References

- Adams, S. B. (2011) 'Growing where you are planted: Exogenous firms and the seeding of Silicon Valley', *Research Policy*, 40(3), 368-379.
- Bhaskar, R. (1997) *A Realist Theory of Science.*, London: Verso
- Blass, E. (2007) 'Talent Management: Maximising talent for future performance', *London, UK: Chartered Management Institute.*
- Caiazza, R., Audretsch, D., Volpe, T. and Debra Singer, J. (2014) 'Policy and institutions facilitating entrepreneurial spin-offs: USA, Asia and Europe', *Journal of Entrepreneurship and Public Policy*, 3(2), 186-196.
- Collins, P. and Grimes, S. (2008) 'Ireland's Foreign-Owned Technology Sector: Evolving Towards Sustainability?', *Growth and Change*, 39(3), 436-463.
- Committee of Industrial Organisation (1963) Report on the Wireless, Television and Telecommunications Industry, Dublin.
- Danermark, B., Ekstrom, M. and Jakobsen, L. (2001) *Explaining society: an introduction to critical realism in the social sciences*, Routledge.
- Davis, S. (2015) *A study of the electronics and software sector in Ireland from 1960 - 2010* [Research], unpublished thesis (Master of Business), Cork Institute of Technology.
- De Wit, B. and Meyer, R. (2010) *Strategy: Process, content, context*, Cengage Learning EMEA.
- Klepper, S. (2011) 'Nano-economics, spinoffs, and the wealth of regions', *Small Business Economics*, 37(2), 141.
- Kvale, S. and Brinkmann, S. (2009) 'Learning the craft of qualitative research interviewing', *Thousands Oaks: Sage Publications.*
- Lincoln, Y. S. and Guba, E. G. (1985) *Naturalistic inquiry*, Sage.
- Maykut, P. S. and Morehouse, R. (1994) *Beginning qualitative research: A philosophic and practical guide*, Psychology Press.
- McCambridge, Á. (2001) *ECCO- A Job or a Way of Life?* , Tallaght, Dublin: Snap Printing.
- McDonnell, A., Lamare, R., Gunnigle, P. and Lavelle, J. (2010) 'Developing tomorrow's leaders—Evidence of global talent management in multinational enterprises', *Journal of world business*, 45(2), 150-160.
- Miles, M. B. and Huberman, A. M. (1994) *Qualitative data analysis: An expanded sourcebook*, sage.
- Moore, G. and Davis, K. (2004) 'Learning the silicon valley way', *Building high-tech clusters: Silicon Valley and beyond*, 7-39.

- Phaal, R., O'Sullivan, E., Routley, M., Ford, S. and Probert, D. (2011) 'A framework for mapping industrial emergence', *Technological Forecasting and Social Change*, 78(2), 217-230.
- Porter, M. E. (1980) 'Competitive strategy: Techniques for analyzing industries and competition', *New York*, 300.
- Porter, M. E. (1991) 'Towards a dynamic theory of strategy', *Strategic management journal*, 12(S2), 95-117.
- Ryan, A., Tähtinen, J., Vanharanta, M. and Mainela, T. (2012) 'Putting critical realism to work in the study of business relationship processes', *Industrial Marketing Management*, 41(2), 300-311.
- Sayer, R. A. (1992) *Method in Social Science: A Realist Approach.*, London; New York:: Routledge.
- Stahl, G., Björkman, I., Farndale, E., Morris, S. S., Paauwe, J., Stiles, P., Trevor, J. and Wright, P. (2012) 'Six principles of effective global talent management', *Sloan Management Review*, 53(2), 25-42.
- Tarique, I. and Schuler, R. S. (2010) 'Global talent management: Literature review, integrative framework, and suggestions for further research', *Journal of world business*, 45(2), 122-133.
- Yin, R. K. (1989) 'Case study research: Design and methods, Newbury Park', *Cal.:* Sage.

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