IRISH SOFTWARE LANDSCAPE STUDY

Interim Report, June 2014

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Irish Software Landscape Study

Executive Summary

Despite the growing importance of software in all aspects of modern life and the vibrant software industry in Ireland, there are many gaps in our knowledge about several aspects of the Irish software industry, for example, how much focus is on products versus services; how significant is the embedded software sector; what are the employment trends; what are the barriers faced by companies; what policies might be instituted to support the industry. Also, given the especially striking prominence of the indigenous software companies (almost 80% of all software companies in Ireland are indigenous), it is worth investigating the particular traits and challenges of this cohort.

This study of the Irish software industry was conducted by Lero - the Irish Software Engineering Research Centre, the Kemmy Business School at the University of Limerick, and the Centre for Science, Technology & Innovation Policy at the University of Cambridge. Among the key findings are the following:

- Growth in numbers involved in software development in past three years, especially in indigenous companies where survey respondents reported 39% growth, but also in foreign/multinationals (MNCs) where respondents reported 23% growth.
- Despite the growth potential, there is a risk that the extra employment will be created in offshore locations as the availability of skilled technical staff in Ireland is the key barrier to growth. Accessing personnel with appropriate sales and marketing expertise is also a major challenge.
- The dominant business model is a blended products and services model, with the latter very much complementing the product business, rather than the all too common problem in the past where services were a way of earning revenue but a distraction from the main product business.
- The US market is a key revenue market for both indigenous and foreign/MNCs.
- Gaining access to second-stage Venture Capital funding (the growth stage for companies) is a major challenge for many indigenous software companies.
- Investment in software companies could be more highly incentivised. The UK model appears to be worth studying in this regard. Also, innovative and radical personal taxation relief incentives, such as those available to the software industry in Eastern European countries are worthy of consideration here .

This is an interim report containing preliminary findings from an initial workshop, survey and preliminary interviews. We have prepared it primarily to help promote discussion and solicit feedback from the relevant agencies and stakeholders in the Irish software industry.

1. Introduction

When Netscape founder, Marc Andreessen, famously proclaimed in a 2011 *Wall Street Journal* editorial that "software is eating the world," he was referring to the disruptive nature of software in radically transforming many traditional industries. Given the importance of the software industry in Ireland, we need to ensure that we are in a position to fully leverage this transformation.

Ireland has an international reputation in key software-based sectors. The country is home to major global corporations as well as indigenous firms who have achieved significant success on world markets. On-going competitiveness will depend on how the software engineering community – business, academia, and supporting institutions – responds to the challenges posed by structural changes in the industry.

However, there are many gaps in our knowledge about the nature of the Irish software industry, for example, how much focus is on products versus services; how significant is the embedded software sector; what are the employment trends; what are the barriers faced by companies and what policies might be instituted to support the industry. Also, given the especially striking prominence of indigenous software companies (almost 80% of software companies in Ireland are indigenous, and about 25% of these are classified as High Potential Start-Ups)[1], it is worth investigating the particular traits and challenges of this cohort.

The Irish government recognises the continued importance of software to the Irish economy (see for example, the 2012, 2013 and 2014 Action Plans for Jobs). However, the complex, dynamic, and globally extended nature of software-based industries poses challenges for policy-makers in terms of identifying appropriate policy responses to emerging challenges and opportunities. This is made all the more difficult by conventional economic policy analysis which struggles to fully account for the value adding contribution of software within the economy.

This study of the Irish software industry is being conducted by Lero - the Irish Software Engineering Research Centre, the Kemmy Business School, University of Limerick, and the Centre for Science, Technology & Innovation Policy (CSTI), University of Cambridge, with the following aims:

- Analyse key trends and drivers influencing the competitiveness of current software-engineering based industrial activity in Ireland, as well as future growth opportunities.
- Investigate the extent to which software engineering underpins competitiveness across a range of sectors; and, in particular, identify where software supports high added-value activities.

[1] High Potential Start-Ups (HPSUs) are start-up businesses with the potential to develop an innovative product or service for sale on international markets and the potential to create 10 jobs and €1m in sales within 3 to 4 years of starting up (http://www.enterprise-ireland.com/en/funding-supports/Company/HPSU-Funding/)

- Identify those specific software engineering competencies required to respond to emerging high value opportunities, and address challenges to future competitiveness.
- Based on the above analyses, identify policy options for driving the software industry forward.

The study consists of a number of phases as illustrated in Fig. 1. We are currently undertaking interviews as part of Phase 3. We have prepared this interim report to provide initial feedback to agencies and other relevant stakeholders in the Irish software community, before moving on to the Phase 4 workshop.

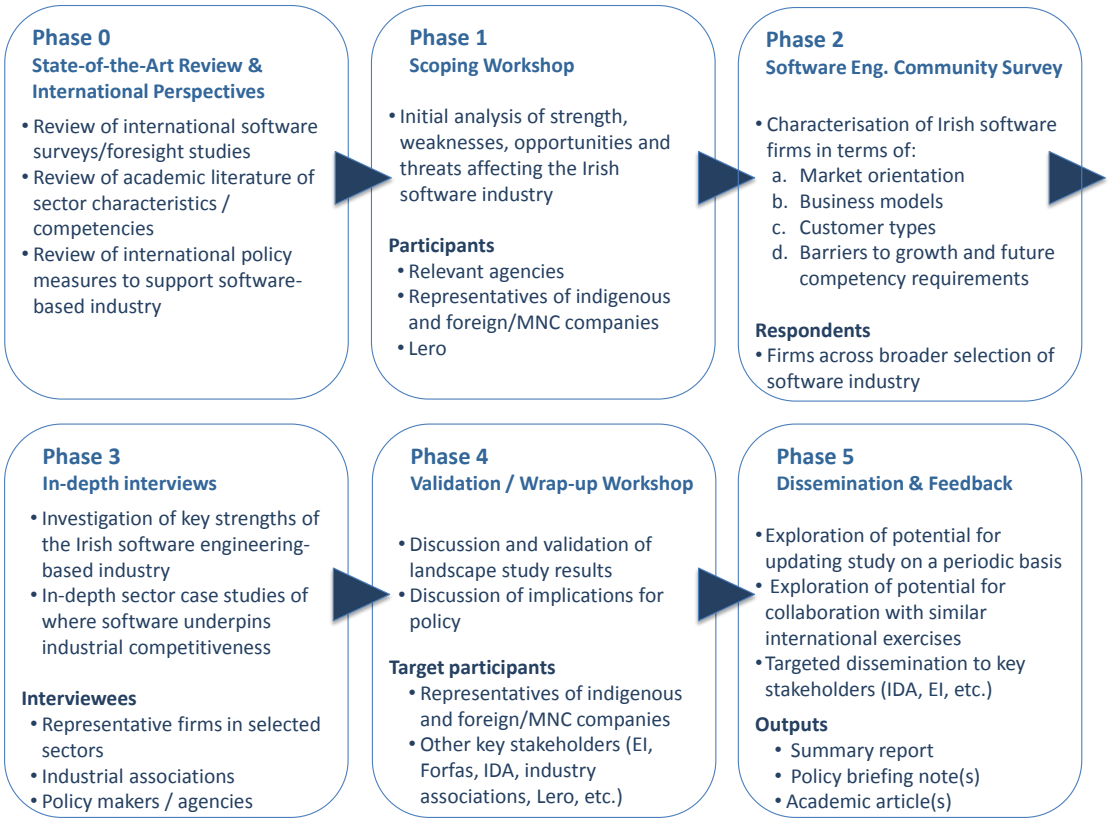

Fig 1 Irish Software Landscape Study Phases

2. Phase 0: State-of-the-Art Review and International Perspectives

2.1 International Perspectives

The software industry has received significant attention in important economies including Germany, Sweden, Finland and the US. These countries are starting to address issues affecting the competitiveness of their national software industries and have published a number of studies and strategy/policy documents that provide valuable reference information for Ireland, including sector studies and R&D prioritisation discussion papers.

Examples of recent national studies and strategy documents addressing the software industry include:

- *Strategic Vision and Business Drivers for 21st Century Cyber-Physical Systems*, a report of an executive roundtable sponsored by the National Institute of Standards and Technology (NIST, 2013).
- *The Networking and Information Technology Research and Development Program 2012 Strategic Plan*, a strategy document by the U.S. National Coordination Office (NCO) for Networking and Information Technology Research and Development (NITRD, 2012).
- *Future of Software Engineering Research*, a report by the U.S. National Coordination Office (NCO) for Networking and Information Technology Research and Development (NITRD, 2011).
- *ARTEMIS Strategic Research Agenda 2011*, a strategy document of the European Commission's Advanced Research & Technology for Embedded Intelligence in Systems (ARTEMIS, 2011)
- *ICT Strategy of the German Federal Government: Digital Germany 2015*, a national strategy set out by the German Federal Ministry of Economics and Technology (BMWi, 2010).
- *Economic and Social Impact of Software & Software-Based Services*, a report commissioned by the European Commission (PAC, 2010).
- German *National Roadmap for Embedded Systems*, a national roadmap developed with participation of industry and academia (SafeTRANS, 2009).
- *Playing to win in the new software market - software 2.0: winning for Europe*, report to the European Commission (Expert Group on a European Software Strategy, 2009).
- *ICT 2020 – Research for Innovations*, a report for the German High Tech Strategy, published by the German Federal Ministry of Education and Research (BMBF, 2007).

Additionally, national surveys have been recently carried out in countries such as Finland, Sweden and Germany in order to characterise their national software industry and uncover the main issues affecting their competitiveness. The design of the survey part of Phase 2 of this project has been informed by the results obtained in these country studies.

2.2 Emerging Trends & Drivers in the Software Industry

A review of academic and industrial literature reveals broad recognition of the changing context of the software industry globally and its ever growing pervasiveness in the life of consumers and the operations of businesses. Breakthroughs in software systems in the past have transformed our world and driven economic growth and job creation and there is therefore increased interest in understanding emerging trends and drivers shaping the future of the global and national software industries (see Table 1). A distinction can be made between:

- market trends opening new high value-add opportunities
- technical developments influencing the competitiveness of software-engineering based industrial activity
- emerging business models and organizational trends reshaping the way in which firms capture value

As a subset of these key emerging trends and drivers, it is striking to note that the role of software engineering in the sophistications and future competitiveness of industrial operations is highlighted repeatedly, not least in discussions around "digitalisation of manufacturing", "cyber physical systems", "internet of things" and "new industrial revolutions".

In Germany, for example, the initiative, '*Industrie 4.0*', promotes an "industrial revolution" based on cyber-physical system technologies which marry the digital virtual world with the real world (Acatech, 2013). The idea is to create intelligent networks connecting machines, work pieces and systems that control each other autonomously. For these networks to function, a reference architecture is required to bring the various elements of the network together, which will require advances in software applications used business management (business planning, inter-company logistics, etc.), production management (operational data, trend analysis, planning and optimisation functions, etc.), and process control and regulation (data acquisition through sensors, sequential control, continuous control, machine and process data, etc.).

In the US, the National Institute of Standards and Technology has recently sponsored studies that emphasise the potentially large economic impact of the development of cyber-physical systems in the future, as well as the critical role of software technology and service providers (NITRD, 2012). Similarly, software has been highlighted as one of the key enablers of "advanced manufacturing", which has been defined as the family of activities that depend on the "use and

coordination of information, automation, computation, software, sensing and networking" (PCAST, 201).

Table 1. Emerging Trends & Drivers in the Software Industry

Key trends & drivers shaping the future of the global software industry	**Market Trends** • Increasing demand for personalised and connected products & solutions; device proliferation • IT consumerisation • Growing user demands in terms of functionality, reliability, and safety (including cyber-security) • Modular business structures (fragmentation of global value chains)	**Technology Trends** • Cloud Computing • Big data • Ubiquitous computing • Service-oriented architecture (SOA) • Semantic Web • Convergence of technical disciplines • Growing demand for security in critical production processes (safe & usable systems) • More software required in next-generation products & services	**Business Model Trends** • Converging business models (e.g. firms offering both commercial and open source software (OSS)) • Software as a service • Business model innovations, e.g. embedded software & service; advertising model • Cultural & organisational changes related to multidisciplinary collaboration

Software engineering underpinning competitiveness in other industries	**<u>Example applications where software is becoming increasingly critical</u>**
	• **Manufacturing:** process automation, simulation, and control; networks; new product design; rapid manufacturing; customised mass production processes; factory planning; product planning; hybrid machines
	• **Energy:** Smart grids; smart buildings
	• **Transportation:** intelligent mobility solutions; automated vehicles and traffic control; intelligent structures and signalling
	• **Health:** smart diagnosis, assistive systems
	• **Emergency response:** detection and surveillance systems, communications; emergency response systems
	
	<u>Indication of relevance</u>
	• IT-related development costs in a car have increased from around 15% in a combustion engine car to around 45% in a hybrid car
	• Number of lines of software in a typical mobile phone has increased fivefold from around 1 million in the early 2000's to around 5 million today; in a car, the number of lines has increased from 1million lines to 10-15 as many over the same period.
	• The share of cost for embedded systems development worldwide:
	  o Around 50% in the automotive industry
	  o Around 12% in the aerospace industry
	  o Around 50% in machines and equipment industry
	  o Around 45% in the medical industry		

Sources: NIST, 2013; Safetran, 2009; Expert Group on a European Software Strategy, 2009; METI, 2012.

3. Phase 1: Scoping Workshop

Following the preliminary state-of-the-art review of previous studies of the Irish software industry, in addition to reviews of contemporary studies of the software industry in counties such as Finland and Germany, phase 1 of the study involved a Scoping Workshop with key individuals from the Irish software industry, research bodies and relevant agencies. This 1-day workshop was held in July 2013. The workshop attendees are listed in Table 1.

Table 1 Workshop Attendees

Jennifer Condon	Enterprise Ireland
Dave Feenan	ISIN Head
Brian Fitzgerald	Lero
Karl Flannery	Storm Technologies
Maria Ginnity	Forfas
Michael Hughes	Enterprise Ireland
Bill Kearney	IBM
Helena Lenihan	Kemmy Business School
Carlos López-Gómez	CSTI, University of Cambridge
Margie McCarthy	Engineers Ireland DG
Maria Moloney	Escher Group
Tony O'Donnell	Engineers Ireland/SAP
Brendan O'Malley	Lero
Eoin O'Sullivan	CSTI, University of Cambridge
Tom Sullivan	Irish Computer Society

The workshop offered the opportunity for a pre-emptive consultation with stakeholders – industry, researchers, policy-makers. The goals of the workshop were to help ensure value & relevance of results, and also to increase awareness of the study which would help encourage participation. It allowed attendees to provide early feedback on plans for the study, and to offer suggestions on areas to consider, people/groups to interview.

The workshop comprised a number of brief presentations on themes related to the Irish software industry, including:

- Characterising the Irish software landscape – what we think we know
- International perspectives on the role of software in industrial competiveness
- Implications for policy: challenges of effective policy-making

A number of potential questions were discussed, including:

- What trends (market, business, technical) are most important for the Irish software sector?

- Are there particular sector characteristics that distinguish/dominate Irish software industry? Particular strengths? Gaps?
- Are there particular opportunities for Ireland in terms of software, for example:
    - Adding value (to particular products/services)?
    - Creating value (i.e. ability to make the product)?
    - Enabling local manufacturing (i.e. making product in Ireland)?
- What would an enabling environment for the software sector in Ireland look like?
- What are the 'big' policy issues (role for government) relating to the software sector in Ireland?

Attendees provided feedback from their perspectives and identified and elaborated on areas of interest. Based on the workshop discussions, a preliminary SWOT analysis was conducted, the results of which are presented in Table 2 below.

Table 2 Preliminary SWOT Analysis of the Irish Software Industry

Strengths	Weaknesses
• Well-established software industry both in terms of indigenous and FDI firms. • Policies supporting Irish firms in some areas recognised among the software community. • Existing software sector competencies (e.g. compliance and mobile payments). • Relative strengths/levels of activity in green technologies, energy and gesture recognition.	• Access to funding a key challenge to Irish start-ups. • Shortage of skills in Ireland, particularly felt by indigenous firms (as 'big names' tend to be more attractive to graduates). • Ireland has not been able to nurture global software giants. • Niche Irish firms usually bought in by larger corporations.
Opportunities	**Threats**
• 'Using Ireland as a test bed': Areas where Ireland has critical mass might be used as 'working labs' for driving the development of the software industry. • Irish firms are leaders in a number of industries, including food, pharma and agribusiness. Such firms might provide a platform for sector-specific software competence development. • Could Ireland build on current complementary/supporting activities/expertise? E.g. many social media user agreements are based in Ireland. Are there opportunities to capitalize on expertise in developing the emerging legal frameworks?	• There is a danger to start an 'arms race' whereby firms compete for top graduates, salaries are pushed up and, as a result, Ireland competitiveness is brought down. • Some innovations originated in Ireland might end up supporting more employment outside than within the country. • No clear understanding of who is writing software in Ireland and in which types of firms and sectors software competences are relevant.

4. Phase 2: Survey

Following the Scoping Workshop, a survey was conducted in late 2013/early 2014. The survey was promoted by the Irish Software Association (ISA) and the Irish Software Innovation Network (ISIN) to their members, as well as to software companies on the Lero mailing list. There were 111 responses to the survey, of which 108 were deemed usable following checking for completeness. These form the basis of the survey analysis reported here.

4.1 Demographics

Some demographic information in relation to the survey respondents is presented in Table 3 below. As can be seen, about 63% of respondents represented Irish indigenous companies. Given that the proportion of indigenous software companies in the overall population of software companies in Ireland is estimated to be almost 80%, it would appear that that indigenous companies are somewhat under-represented in the sample. However, there are a couple of factors that might help explain this. Firstly, this survey was promoted through Lero. Since most of the companies that have collaborated with Lero to date have been foreign/MNCs, this may have had a biasing effect in increasing the responses from that cohort.

It is important to note that through the use of Lero's distribution channels, the sample has been able to include firms that are not traditionally classified as software firms but that have an interest in software and software-related innovation. Around 15% of the firms in the sample classified themselves as manufacturers of devices that contain software.

The two other demographic measures (*Years since establishment in Ireland* and *Number of staff involved in software development*) are skewed because of a small number of responses which reported very high values for these factors, thus, the median figures are reported in Table 3.

Table 3 Respondent Demographics

Factor	Indigenous	Foreign/MNC
% of respondents	63%	37%
Years since establishment in Ireland	Median: 7 (Min: 1; Max: 33)	Median: 17 (Min: 5; Max: 42)
Number of staff involved in software development	Median: 5 (Min: 1; Max: 600)	Median: 33 (Min: 1; Max: 800)

Given the high rate of establishment of indigenous software companies, the median of 7 years, clearly reflects a high rate of small-scale start-ups. In fact, 25% of indigenous companies were established within the past 3 years, whereas 25% of foreign/MNCs have been in Ireland for more than 15 years.

In terms of staff involved in software development, 50% of indigenous companies have 5 or fewer staff involved in software development, whereas only 13% of foreign/MNC companies have 5 or fewer staff involved in software development.

It is clear from the above that the indigenous and foreign/MNC sector are different in potentially significant ways. Thus, these two categories are distinguished in the analyses reported in the remaining sections.

It is also worth noting that the sample of respondent companies have a strong innovation focus – most, if not all, are members of the Irish Software Innovation Network and/or have close interactions with Lero or other leading software research institutes in Ireland.

4.2 Growth

We asked respondents about the numbers involved in software development, both now and 3 years ago. Within indigenous companies, the increase is striking with the numbers involved in software development reported as increasing by 39% over the past three years. This is very encouraging and reflects the positive trend of software start-ups. However, it is should be borne in mind that this is boosted considerably by the success of one respondent (Openet) who almost doubled the workforce involved in software development.

In the case of the foreign/MNC sector, the numbers involved in software development here have increased by 23% in the past three years. This is also encouraging and reflects the move higher up the value chain in terms of employment here.

It is interesting to compare the relative performance of Ireland v. India and Israel in employment growth over the period 2000-2008 (see Fig 2). The chart clearly shows the impressive growth in numbers in India (increasing over 700%) and also in Israel over the period (increasing by 50%), while the numbers employed remained flat in Ireland.

While the survey findings suggests that the flat trend in relation to employment from 2000-2008 has ceased and we are now on an upward employment growth curve, a number of caveats should be borne in mind. Firstly, companies who shut down (for example, indigenous start-ups who fail), or foreign/MNCs who leave the Irish market, are obviously not going to respond to a survey such as this. Likewise, those companies who are increasing the numbers employed in software are more likely to find this survey of interest and respond to it. Notwithstanding such caveats, the finding in relation to growth in the software

sector is welcome. It is also in keeping with the *Forfas EGFSN* 2013 report[2] which suggests growth of around 5% per annum for employment in the ICT sector more generally. Also, Enterprise Ireland figures for employment in the indigenous sector confirm employment growth of 17% since 2010[3].

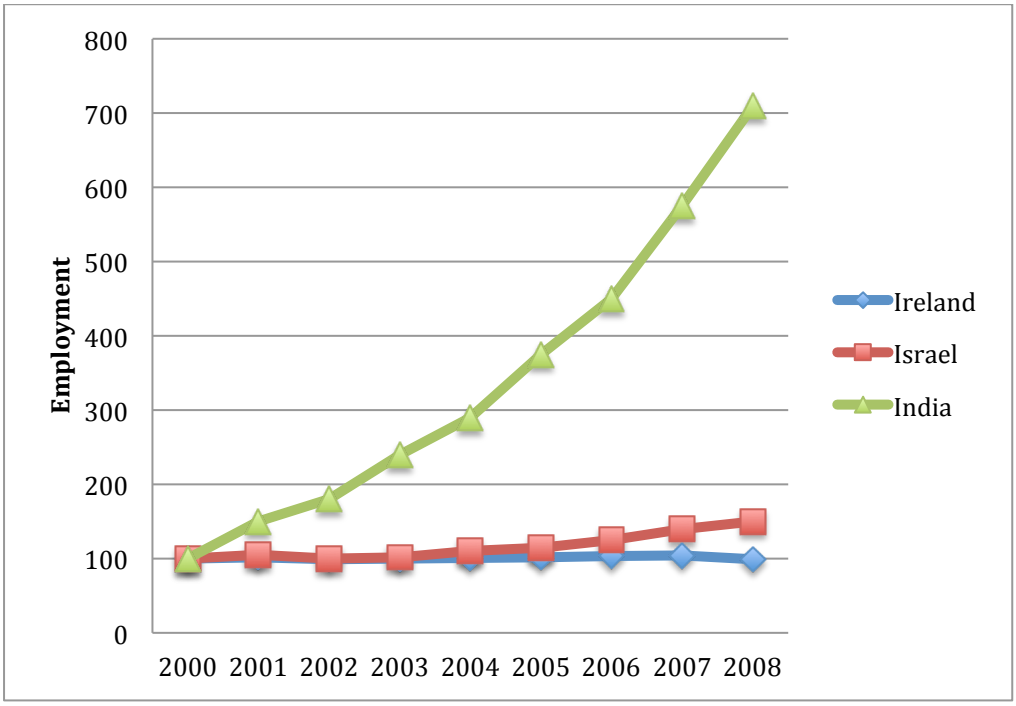

Fig 2 Employment Trends (2000-2008) in Ireland, Israel and India
(Source: Breznitz 2012)

Both indigenous and foreign/MNCs identified growth as a primary goal. For the indigenous sector, 69% agreed that growth, especially in international markets, was their key goal. For the foreign/MNCs, a slightly lower figure of 59% rated growth as the most important objective.

We also investigated the factors perceived as limiting growth. For indigenous companies, the top three factors were rated as follows:

<u>Indigenous Companies: Top 3 factors limiting growth:</u>

1. Lack of availability of able technical employees
2. Lack of availability of able sales and marketing employees
3. Lack of funding from VC and public sources

In the case of the foreign/MNCs, the top three limiting factors differed slightly, although the availability of able technical employees was still the top factor, but

[2] Addressing Future Demand for High-Level ICT Skills, *Forfas Expert Group on Future Skills Needs* Report, Nov 2013.
[3] Personal communication from Michael Hughes, Enterprise Ireland.

not rated with the same significance as the indigenous companies. This reflects the greater difficulty that indigenous companies face in recruiting able technical staff, a point discussed further in the interview phase. The second ranked factor for foreign/MNCs, that of competition from low cost countries, reflects the fact that the software industry is truly a global one, and Ireland cannot afford to be complacent.

Foreign/MNCs: Top 3 factors limiting growth:

1. Lack of availability of able technical employees
2. Competition from low cost countries
3. Lack of availability of able sales and marketing employees

However, it is clear that for both indigenous and foreign/MNCs, the shortage of human capital, both those with technical expertise and also more broad sales and marketing expertise, represents the most significant barrier overall.

4.3 Products v Services

Respondents indicated the make-up of their portfolio in terms of a product v. services v. embedded software dimension. The findings are illustrated in Table 4.

Table 4 Products v. Services Focus

Product v. Service Focus	Indig.	Foreign /MNC
Providing both products and services	36%	59%
Providing just a software product	28%	15%
Providing software services	19%	8%
Software embedded in a device	13%	18%

Clearly, the product & services model is favoured by both sectors, especially in the case of foreign/MNCs. In the past, agencies in Ireland have tended to recommend a software product strategy, as a key differentiator from India and Eastern Europe where the software services model is more common (Breznitz 2012). There have been good reasons for this, as a product focus can scale to market more quickly and can be very profitable. Also, the services model tends to be more dependent on the amount of human capital resources available, in which countries such as India have a considerable advantage over Ireland due to the larger number of personnel available. In the past, Irish software companies were often forced to follow a services approach, as the revenue from products was often not sufficient for survival. These services typically took the form of consultancy. However, it was a distraction, as it took resources away from the key goal of developing and improving the software product core business.

Clearly, a combined product and services model is now favoured as the most popular model in a large number of companies. This issue was explored in more detail in the interview phase of the research, reported in section 4 below.

In terms of the products being produced, these included telecoms software, analytics, web and cloud products. In terms of services, these included bespoke development, systems integration and consultancy/training/support. Embedded software typically arose in medical devices or the electronics sectors.

4.4 Markets

In terms of the markets where revenue is generated, the importance of the US market is striking. It is the main market for the foreign/MNC sector and the second most important market for indigenous sector. While this somewhat reflects the prominence of US companies in the foreign/MNC sector here, the significance of the US market does not appear as strongly in the software sector in other European countries.

There were also interesting differences between the sectors. For the indigenous sector, the Irish market was the most significant, followed by the US and UK. For the foreign/MNC sector, the US market was the most significant, followed by the Asian and EU markets. This reflects the prominence of US companies in the foreign/MNC sector here.

Table 5 Revenue Markets

Market	Indigenous Avg % revenue	Foreign/MNC Avg % revenue
Ireland	37	10
US	23	39
UK	19	12
EU	14	15
Asia	5	18
Other	2	6

4.5 Customers

The main customers of the respondent companies represent a strikingly diverse range of sectors. These include service sectors as well as physical product manufacturers, with significant activities in ICT hardware, electronics and medical devices, but also in emerging sectors such as green technologies and traditionally less software-intensive sectors, such as food and agribusiness.

A significant number of firms produce what appears to be sector-specific bespoke software. The extent to which such software is high value-adding (based

on a combination of sophisticated technical knowledge and competencies together with sector-specific insights) merits further analysis during the interview phase of this study.

Although the survey is dominated by software product and/or service firms, the number of respondents who produce embedded software for devices or production technologies is still worth noting. Such software can be high value-adding; and trends suggest embedded software will become ever more prevalent in products and manufacturing systems.

4.6 Policy

Of the firms that responded to this question (Is your company seeking *external funding* during 2013 or 2014?), there were also significant differences between the indigenous and foreign/MNC sectors: 54% of indigenous companies said they were going to seek external funding during 2013 or 2014, but only 11% of foreign/MNCs suggested they would do so.

Of those firms that were seeking funding, most suggested they would be applying for VC funding, with very few applying for bank funding (the latter is not surprising given that software firms tend to be viewed as too risky for banks, primarily due to their lack of personal assets).

When asked about the type of *public sector funding* firms planned on applying for, it is worth noting that only 35% suggested they would be applying for any type of public sector funding, and of those, most would be applying for RD&I funding (followed by funding for internationalization e.g. trade fairs).

With regards to the *specific programme interventions* offered by the Irish development agencies:

In the case of indigenous firms, just 37% were either satisfied or completely satisfied with public sector funding for RD&I (only 6% rated these as completely satisfying their needs). Also 39% of indigenous respondent firms were satisfied or completely satisfied with public sector funding for Leadership for Growth/Management Development.

For the foreign/MNC firms, 56% were either satisfied or completely satisfied with public sector funding for RD&I (although only 5% rated these as completely satisfying their needs). Also 28% of foreign/MNC respondent firms were satisfied with public sector funding for Leadership for Growth/Management Development. However, none were completely satisfied.

From a policy perspective in particular, it should be borne in mind that the findings here relate only to the Irish software sector. These results (and indeed, this holds for many of the results throughout this interim report) would prove more insightful if benchmarked against other sectors both in Ireland and further

afield, however, this is an avenue for further investigation and beyond the remit of the current study.

4.7 Technical Competencies

Many of the technology domains and technical competencies highlighted by respondents (as critical to their future competitiveness) reflect the growing complexity and distributed nature of software and software-embedded systems, as well the systems nature of the innovation process itself. As already mentioned, the sample of respondent companies have a strong innovation focus.

Top 3 platform/technology domains for future competitiveness:

1. Cloud computing
2. Data analytics
3. Cyber-security technologies

Top 3 techniques

1. Agile/Lean/Kanban
2. Continuous deployment/integration
3. Software performance testing

5. Phase 3: In-Depth Interviews

The survey allowed respondents to indicate if they would be willing to participate in follow-up interviews. These were drawn upon, and supplemented with key individuals from the indigenous and foreign/MNC sectors, and also policy representatives from the relevant agencies, to conduct a number in-depth interviews which sought to elaborate the survey findings.

5.1 Product-Services Model

An interesting finding from the survey was that almost half of all companies overall were following a product and services[4] business model, with a greater occurrence among foreign/MNCs than indigenous (59% v. 36% respectively). As already mentioned, Irish agencies have traditionally tended to recommend a software product strategy for Irish companies, as this can scale more readily without depending on the availability of additional human capital which tended to be the case with service related business. It was therefore a key differentiator from countries such as India who have a greater advantage in terms of the amount of ICT human capital available. However, this traditional distinction between products and services no longer applies in a straightforward and simple manner. A significant portion of revenue, up to 30% according to a number of interviewees, can be earned through product services support. This new strategy could be labelled the **product-services** model. If there is a good product-market fit in the first place, then there is likely to be an opportunity for services revenue also for the product. This is even more likely to be the case in cloud environments where no physical product is actually shipped.

The nature of the current software development environment also influences a product-services model. As one interviewee explained, "there are very few green fields now, it is mostly brown fields". The point he was making is that in 'brown field' situations, the existing configuration needs to be catered for. There may be data migration activities, links to front-end databases, upgrades, conversion from on-premise solutions to cloud solutions. In cloud solutions, product-based services are necessary, and there may be links to billing systems. All the above could provide service-based business opportunities.

There are many useful advantages to the product-services focus. Provision of services helps the reputation of the product in the market. Also, it ensures that the product company is engaging more closely with the customer-base which is very useful in itself in the long run.

However, a significant implication of the services approach is that a different skill-set is actually needed to promote and provide services than that needed to

[4] Note 'services' in this context should not be interpreted as in the sense of cloud-based software-as-a-service (SaaS) which is still product-oriented. Rather, services in this context represents activities such as bespoke development, systems integration and consultancy/training/support.

provide a product. The revenue model for services is vastly different, as it is typically lower than the revenue generated for the actual products in actual volume, which may cause it to be viewed as less valuable, but it can still be a significant part of the business revenue model. The services focus therefore requires a senior management position if the company is to deliver successfully on this strategy.

Face-to-face interviews with policy-makers also confirmed this ever-increasing trend towards a product-services type model. Traditionally, there was a tendency to focus more on products given that it was inherently more scalable. Interestingly, according to one policy-maker, there were a lot of companies in the past that did both products and services, however, traditionally, many services were given away by firms for free, as they did not associate much value with them.

5.2 Importance of Software Engineering to Ireland's Industrial Competitiveness

One particular area of focus of this landscape study has been the role of software engineering in supporting high value-adding industrial activities in Ireland, including the investigation of 'hidden' software activities taking place in firms that are not conventionally classified as software firms, for example, telecommunications, medical devices.

The increased interest in mobility and wearable computing is fuelling international demand for software across industry sectors, as are the large-scale embedding of sensors in products, production processes, and smart buildings and such infrastructure. Given that technology adoption cycle continues to get shorter (market penetration for tablets was quicker than that of smart-phones, and the penetration of wearable computers is likely to be even quicker), this increasing trend towards embedded software is likely to grow in importance.

The survey found that 15% of respondents described themselves as manufacturers of devices with embedded software, with a slightly greater preponderance in the foreign/MNC sector (18% v. 13% for indigenous companies). The main sectors represented by the surveyed firms included medical devices, electronics (excluding telecoms) and ICT (hardware, including telecoms).

In follow-up interviews, representatives of the Irish medical device community highlighted the growing importance of software to the future of the medical devices sector, but emphasised the particular importance to high potential areas like diagnostics and connected health. With a strong multinational presence in the country (20 of the top 30 medical devices companies globally have operations in Ireland), opportunities could arise in areas where Ireland has growing complementary strengths, including embedded software, sensors, middleware, data mining. Similarly, there could be high value opportunities in software-enabled domains such as remote diagnostics and eHealthcare services.

However, there are challenges to capturing those opportunities. As outlined in the *EGFSN Manufacturing 2020* report and confirmed in interviews, many medical device firms continue to find it challenging to recruit software engineers, especially with the skills to carry out software quality validation (in particular, quality validation of software systems supporting the highly regulated manufacturing environment); firmware development; and software skills to manage manufacturing/automation systems/equipment.

5.3 Markets

A striking finding from the survey was that of the importance of the US market. This is interesting and reinforces the 'Ireland is closer to Boston than Berlin' adage. The US market emphasis does not appear as important in other European software industry surveys. Discussing the issue with interviewees, a number of explanatory factors were suggested. Firstly, a large number of major US multinational companies (MNCs) are located in Ireland and this will inevitably increase the focus on the US market. However, a number of successful indigenous companies have focused directly on the US market. Among the reasons suggested were that the US market is the largest and also that it is one which is very willing to embrace new products. Also, venture capital companies who can provide later rounds of funding are typically US-based. Hence, Irish companies readily seek to establish themselves in the US market. More on the venture capital issue later.

Interviews with policy-makers also echoed much of the above. They highlighted the aspiration of many software entrepreneurs to be connected to what they regard as the "*tech-savvy*" market in Silicon Valley. As one interviewee explained, "*Everyone wants to be part of Silicon Valley*". *According to another, "Silicon Valley is seen as the happening place, particularly for internet-based technologies".* It was also suggested that for many software firms, the US market is easier to conquer than the UK one. In the words of one policy-maker, "*if you have a niche product, in some ways the US is easier to crack than the UK*" and added that "*product-market fit is the single biggest issue all firms are facing*".

5.4 Incubator and Venture Capital Support

It is relatively easy for a start-up company to find office-space in the many incubation centres that have been provided throughout Ireland. Also, some seed funding is available through government and bank funds. However, one criticism suggested by one interviewee was that seed funding VCs operate in a very risk averse mode, more like Series A VC funders elsewhere. He cited the example of receiving a term sheet from a New York-based VC and immediately being offered terms by an Irish VC, and in fact being offered more funding than he was seeking.

Paradoxically, one interviewee suggested that what is needed is a way to allow start-up companies who are non-viable to fail faster. The individuals involved

could learn from failure and find positions in new companies, thus making these new ventures more likely to succeed.

While adequate seed funding may be available, subsequent larger tranches of Series A funding are not readily available. Rather than just supporting companies at the start-up incubation phase, there is a need for greater support for those companies who have successfully identified the product-market fit, so as to try ensure they can be successful. The attrition rate from these companies will be lower than in the incubation phase. According to one policy-maker "the second phase VC (the growth stage for a company) is where the challenge is".

Also, there is a tendency to view all ICT investment as homogeneous, rather than recognising the very many different specialisms that arise in the field. This is an area in which tax incentives could be provided. During the recent recession, the Irish ability to invest in property, with eventual negative consequences, might have been better served if incentives were available to invest in Irish software companies. This is discussed further in section 4.6 below.

5.5 Barriers to Growth

Interestingly, two of the top 3 barriers to growth reported in the survey were the shortage of able technical staff (No. 1 barrier for both indigenous and foreign/MNC respondents) and the shortage of able sales and marketing employees. The shortage of technical staff has been widely acknowledged and there have been successes in reducing the numbers of technical positions that are being filled by inward immigration (down from 55% to about 40% in 2014). However, more needs to be done to address the needs of industry here.

The shortage of sales and marketing expertise is also quite revealing. This is also a serious limiting factor. Given the importance of foreign markets for Irish software companies, there is a need for expertise related to these overseas markets. This reflects the need for complementary skills among the management team of companies, rather than being overly focused on strong technical skills.

One of the policy-maker interviewees highlighted that it's not simply sales and marketing skills that are required but specifically, skills as they relate to the new and emerging business models of the software industry (more on this in section 4.6 on policy supports below). Another policy-maker spoke of software companies looking in particular for employees with project management experience which are typically in scarce supply. The point was made that the latter is not just an Irish issue, given the global shortage that exists with respect to IT capabilities and skills more generally.

5.6 Policy Supports

For the policy-makers interviewed, the key challenges for any start-up company tend to emanate from three main sources:

- Identifying the appropriate product-market fit;

- Getting an initial reference site (getting into overseas markets, e.g., the BRIC[5] economies, and developing a path-finder with firms is one of the key success metrics adopted by Enterprise Ireland HPSUs, for example);
- Proving the business model.

These key challenges are issues that the policy environment tries to support. In relation to the business model, policy-makers see this as an area in which there has been significant change. Ten years ago, it was about 'business-to-business' (B2B) solutions. The last number of years, on the other hand, has witnessed the emergence of a number of companies in the 'business to consumer' (B2C) space, with many financial services companies, for example, now operating in the 'peer-to-peer' space. In summary, the new business model tends to generate revenue on a consumables basis. This raises challenges with respect to capital investment and getting a return on investment.

Given the dominance of indigenous companies in Ireland, there is a significant focus by policy-makers on HPSUs. Indeed, according to one policy-maker "*the HPSU is where innovation is captured in the sector*". Growing HPSUs to scale is one of the key challenges that concerns policy-makers. On the other hand, when companies are really successful, then they become a target for takeovers.

As already mentioned, investment in software companies could be much more highly incentivised. Much more is needed than what has been provided through the BES (Business Expansion Scheme) and its replacement in 2011, the EIIS (Employment & Investment Incentive Scheme). These schemes largely resulted in property investment which led to well documented problems for the country. Also, employee share option schemes (ESOF), which can help lower costs by providing employees with equity stakes, do not work well in Ireland.

Countries in Eastern Europe, such as Romania and Moldova, have eliminated income tax for employees in the software sector. This has the effect of retaining human capital within the country who might otherwise emigrate. These initiatives appear to be quite successful. Such imaginative policies are worthy of active consideration in Ireland.

At the more macro-level, an issue that could become highly problematic is the manner in which the UK has significantly improved conditions in this area. This is already resulting in Irish companies choosing to open as start-ups in Northern Ireland or the UK. Given that we have a land border with the UK, it is critical that we do not allow the disparity between supports for software start-ups here and in the UK to become a major factor in companies choosing where to establish their base.

Interviews with policy-makers also highlighted the need to incentivise people to start-up and expand their companies and also for investors to invest in such companies. As one policy-maker stated "the fiscal environment is the single

[5] Brazil, Russia, India, China.

biggest issue. Tax breaks are needed for the entrepreneurs and likewise for the private investors to invest".

The survey found that a relatively low number (35%) of companies were applying for public sector funding. One of the policy-makers suggested that this might be due to the lack of awareness by companies of the public sector funding available. There may also be a challenge (due to issues of cash flow and timing for example) for some firms in terms of applying for public sector funding in the first instance. The point being made is that companies have to more than match the funding they apply for from agencies. For example, the grant may be worth 30% but the company has to provide 70% which can be problematic. As the policy-maker outlined "*the company has to spend before it gets*". Finally, the policy-maker questioned whether the finding had something to do with the public sector funding environment and specifically whether "the funding environment is suitable for an iterative R&D process which occurs in the software sector?"
Policy-makers were questioned as to what an enabling environment for the software sector in Ireland might look like. They highlighted the importance of the following issues:

- significance of getting a correct fiscal environment where entrepreneurs and investors are incentivised;
- availability of finance (in particular, there should be more focus on second-round VC funding);
- broadband infrastructure;
- the match and availability of skill set (human capital) and the importance of peer networks which may be facilitated by technology (there may be potential for new policy instruments/interventions in this regard).

One policy-maker also highlighted the need to ascertain the extent to which national state investment in R&D is being realised. The point being made was that the state is putting lots of funding into structures such as Technology Transfer Offices in the third-level institutions, but there still tends to be pure science which remains disconnected from companies.

With respect to policy supports in general, policy-makers also made the point that if companies can be more specific about their needs (and articulation of same), then policy-makers could better respond in terms of helping to address such needs. Generic calls from companies relating to skills gaps for example, are according to one interviewee "of little use…there needs to be a move away from the generic towards the specific". This interviewee suggested that "*industry also has a role to play in terms of helping policy-makers*". Finally, one policy-maker emphasised that a key policy challenge is to understand where exactly the state should best intervene in relation to those companies that 'develop' technologies versus those that 'use' technologies (aggregator-type companies).

5.7 Clustering

Another issue discussed with interviewees was the failure to develop a symbiotic cluster between the indigenous and the foreign/MNC sector in the software domain. This has occurred to a much greater extent in the medical technology sector where MNC companies both purchase from indigenous companies and also help grow the market for these companies. Currently, the Irish medial technology cluster is recognised as the third largest globally. However, this scenario has not been replicated in the software sector in Ireland.

One interviewee suggested that in sectors such as the medical device and agri-business sectors, indigenous companies tend to grow, whereas software companies tend to sell rather than growing in size.

Given that both indigenous and the foreign/MNC sectors are healthy, and the natural willingness among Irish companies to collaborate, this represents an opportunity. Agencies could consider joint go-to-market schemes which would involve partnerships between indigenous and the foreign/MNC sector. Indigenous companies tend to be extremely good in niche areas and this can be leveraged effectively in partnerships with MNCs who have broader expertise or can provide platforms. Also, new emerging areas of interest such as cloud, smart grids, or security and privacy represent areas in which potential MNC and indigenous collaborations could be fruitful in creating a value-add proposition for both parties.

6. Conclusions

The overarching message emanating the study is that of a vibrant software industry with tremendous potential. The growth in employment in the sector, which is increasingly evidenced in several sources, is strongly confirmed by our survey respondents, with the caveats mentioned above in relation to our sample. However, overall, this is excellent news.

The differences between the indigenous sector and the foreign/MNC sector are quite significant on almost all the areas we investigated. This suggests that policies and supports need to be nuanced for each category. A major opportunity arises in the potential to create a synergistic cluster between these two cohorts.

The traditional product v. service model appears to have been well and truly replaced. By far the most popular model is a blended product and services one, with the services business very much complementing the product business. Also, the embedded software model is growing in significance, particularly for the foreign/MNC sector.

The shortage of suitably qualified Irish candidates has forced companies down the route of inward immigration – currently somewhere between 40% and 55% of jobs are filled in this manner. Global software development has in the past proved problematic for companies which has somewhat limited the attractiveness of this option. However, as communications technologies improve and companies get more competent in this area, there is a real danger that the potential growth in employment in this domain will be satisfied by overseas recruitment. It would be a real missed opportunity if the success of the Irish software industry had more employment significance for Eastern Europe than for Ireland.

As with other sectors in Ireland, there is the concern by policy-makers regarding the impact of particular sectors on job creation (as articulated in documents such as Government's Action Plans for Jobs 2012; 2013; 2014).
The point emerged during policy interviews that software firms don't necessarily focus on jobs growth. Indeed, for many software firms, although they may have their core employment in Ireland, they also like to grow jobs in other countries (e.g. Eastern Europe) so as to give themselves a blended cost base. The point was made by one policy-maker that "alignment of our jobs agenda is not necessarily aligned with that of software firms". For software firms, there tends to be more of a focus on other growth measures such as revenue growth, export growth and growth of margin (the latter is where investors tend to focus). However, the same policy-maker highlighted that productivity growth and margin growth are two of the big challenges currently facing the software industry in Ireland.

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