

**MAKING IT IN
IRELAND:
MANUFACTURING
2020**

Minister's Foreword

For too many years we became unduly distracted by selling property to each other rather than selling goods and services overseas. The dangers of such a reliance on one sector are obvious to all recent observers of the Irish economy. That is a mistake we cannot afford to make again.

That is why I am very pleased to welcome this report by Forfás that clearly sets out the potential for manufacturing in Ireland. The report has been informed by people who are directly involved in manufacturing and captures their belief in the importance of *the making of things* to Ireland's economic recovery. We are all aware of the constrained economic global and national environment that we are operating in.



Today, the manufacturing sector in Ireland employs 205,700 people directly and 400,000 people across all skills levels when indirect employment is taken into account. It is an integral part of Ireland's economic fabric, is a key driver of innovation, is a crucial player in Ireland's return to export-led growth and contributes to employment across all skills levels and in all regions throughout the country.

There is considerable promise for the sector in Ireland, with Forfás estimating the potential to create 43,000 direct new jobs by 2020. We know that this is not a given - and that an alternative scenario could see a continued loss in jobs in manufacturing.

However, it is clear that Ireland has a number of strengths on which to build. Ireland has strengths in a range of sectors including Food, Medical Devices, Pharma/BioPharma, ICT, Engineering and Green Technologies. Irish people are problem solvers, we are innovative, we are flexible and adaptable to change, and we can work in multi-disciplinary teams and with different cultures. These strengths have become even more important for Irish and foreign owned firms based here, and for the attraction of new investments in the context of the disruptive changes underway globally.

We *do* need to take action, and the Government is fully committed to addressing barriers to growth and working with the sector to realise its potential. This report sets out the actions needed to address what is in our control in terms of cost competitiveness and access to finance - building on the steps already taken by this Government to improve our international competitiveness and restore stability to the public finances and the banking sector. Addressing barriers, while necessary, will not be enough to position Ireland's existing and new firms to capture opportunities in an intensely competitive global environment. I have asked the enterprise agencies and others to drive the delivery of a *National Step Change Initiative*, aimed enabling companies to take one step up to drive enhanced productivity and competitiveness, to internationalise, to deepen engagement in innovation and to collaborate to compete.

Developing our people will be crucial to future success - and the complementary report *The Future Skills Needs of the Manufacturing Sector to 2020*, published by the Expert Group on Future Skills

Needs and Forfás, sets out a roadmap for action to provide the appropriate training and education for our people to ensure they can take up opportunities in the sector over coming years.

Enterprise and Government can work together to make the ambition set out in this report a reality. I established the industry-led Manufacturing Development Forum in 2012, and it will play a key role in ensuring the effective implementation of many of the actions in this report, and in championing the manufacturing sector in Ireland.

A handwritten signature in dark ink, reading "Richard Bruton". The signature is written in a cursive style with a large initial 'R' and 'B'.

Richard Bruton T.D.

Minister for Jobs, Enterprise and Innovation

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Executive Summary

Background

Manufacturing plays a crucial role in any economy. Manufacturing is a driver of innovation and technological advance, provides employment across a broad range of skills levels, and generates additional indirect jobs throughout the economy.

Some commentators have suggested that manufacturing is dying - particularly in developed economies. The reality is that manufacturing is *changing*. As it becomes more complex a very different set of capabilities will be required, capabilities that bring developed economies very much back into play for investment in manufacturing activities. This strategy looks at how manufacturing in Ireland can best compete over the period to 2020 in the context of the disruptive changes underway globally.

In Ireland the manufacturing sector has been overshadowed and its competitiveness impacted by growth in the domestic economy over the 2000s, a period when growth was driven by construction and consumption. Although manufacturing contributes significantly to Ireland's exports (at €78.5 billion in 2012)¹, a continued decline in employment over the past decade is a cause for concern, particularly in light of the high unemployment levels currently experienced in Ireland. Today there are 205,700² people directly employed in manufacturing.

There are strong industry views that more can be achieved with an increased policy focus on manufacturing. The Action Plan for Jobs 2012 (APJ 2012) sees manufacturing as essential for a return to more sustainable export-led growth. This strategy has been developed in response to the Action to:

Develop a long term vision for the manufacturing sector and put in place a strategic plan that will help to realise this vision³.

The APJ 2012 set out the overall ambition *to have 100,000 more people in work by 2016 and 2 million in work by 2020*. Within this ambitious context it is envisaged that 43,000 more people could be directly employed in manufacturing between 2011 and 2020⁴ - direct employment that can have wider positive employment impacts of a similar number of jobs throughout the economy.

This future is not a given. It is ambitious, yet it *is* achievable if the right actions are taken. Although we have no control over (and are dependent upon) a recovery in global market demand, Ireland's manufacturing sector can become better positioned to take advantage of opportunities as they arise.

A restoration in Ireland's competitiveness is crucial. It is absolutely critical that the existing barriers to growth - cost competitiveness and access to finance⁵ - are addressed as a matter of priority.

¹ Annual Business Survey of Economic Impact, ABSEI 2012, Forfás (Agency supported firms) Exports have been relatively resilient throughout the recession

² Quarterly National Household Survey, QNHS Q3 2012, CSO

³ Under action 7.1.3 a specific step required that Enterprise Ireland identify barriers to start-ups undertaking manufacturing in Ireland and identify what actions are needed to address them: See Chapter 6

⁴ Based on an analysis of agency supported employment in manufacturing

⁵ Access to finance is more pertinent to Irish owned firms

However, addressing these barriers while necessary will not be sufficient. We need to achieve a transformative step change across the manufacturing sector in terms of productivity, innovation and competitiveness and in the supporting eco-system if this future is to become a reality.

Ireland has a number of strengths that provide a solid platform for growth and there is a future for manufacturing in Ireland.

Coordinated and concerted action by government, the enterprise development agencies and firms is necessary to make that genuine step change in order to realise opportunities to create jobs and sustainable growth. As many other developed economies are revisiting their manufacturing strategies, Ireland needs to be serious about establishing a differentiated and internationally recognised reputation for manufacturing.

Forfás has consulted extensively with industry, the enterprise development agencies, academia and key stakeholders in developing this strategy. The Manufacturing Development Forum (MDF) established in 2012 by the Department of Jobs, Enterprise and Innovation (DJEI) was a valuable source of insights throughout the process. The MDF will play a critical industry role in helping to promote manufacturing and to make the step change necessary to realise the potential of manufacturing here in Ireland.

A Definition for Manufacturing

The broad definition set out in *The Report of the High Level Group on Manufacturing (2008)* remains valid today. It defined manufacturing as: encompassing a broad range of activities from research and development through design, production, logistics and distribution to marketing and after sales services. The definition recognises that activities across the supply chain may be located in different countries and undertaken by different companies across the world, where it makes most strategic or economic sense. Within this context, this strategy emphasises the importance of retaining a focus on production - the making of things - at the core.

Manufacturing is Changing - Global Trends

By 2020 manufacturing will be different from what it is today. Changing consumer demands, the pace of advances in technologies, environmental concerns and intensified globalisation and competition are driving new models of manufacturing. European research has identified three types of factories at the forefront of these new models, each with different primary characteristics, namely: Smart, Virtual and Digital⁶. It is important to note that the term 'factory' should not be interpreted as being one physical plant in one location, but is more about the entire manufacturing activity, whether globally dispersed or not. It is also important to note that these are not mutually exclusive; rather, they are concepts for approaching the process of manufacturing as we progress to 2020. In broad terms, they are characterised as follows:

- **Smart Factories** offer agile manufacturing (flexibility and short-time cycles) and customisation involving process automation control, planning, simulation and optimisation technologies, robotics, and tools for sustainable manufacturing; Smart factories are underpinned with Lean and ICT systems, characterised as energy efficient, reliable, and cost-effective production operations.

⁶ http://ec.europa.eu/research/industrial_technologies/pdf/ppp-factories-of-the-future-strategic-multiannual-roadmap-info-day_en.pdf. These models have been described within the strategic research domain of ICT enabled intelligent manufacturing

- **Virtual Factories** are global networked operations built on pervasive ICT systems. Seamless integration of intelligence from all aspects of the business (regardless of where located and including external partners and suppliers) facilitate and drive decision-making. In simple terms, a complex global network of operations functions as one.
- **Digital Factories** offer greater simulation, modelling, evaluation and knowledge management and deliver enhanced Product Lifecycle Management (PLM) from the product concept level through to manufacturing, maintenance and disassembly/recycling; and facilitate better real-time decision making and quality control throughout the production process.

These models will be a global phenomenon: where advanced technologies are embraced; agile manufacturing is the norm; where simulation, modelling and analytics drive decision making; where sustainability is embedded throughout the operation; and where globally dispersed elements of the value chain operate seamlessly. In fact the *Factory of the Future* is already the 'now' in global companies such as Siemens, Intel and GE.

For many manufacturers in Ireland, however, these concepts seem like a far too distant (and unrealistic) future. But the fact is that Lean Principles, Sustainable Manufacturing and the pervasive use of ICTs cannot be ignored by *any* manufacturing firm in operation today - regardless of scale or ownership. These are the near term realities - and perhaps more pertinent to many of Ireland's manufacturing operations today. How they apply will be different according to individual firms' needs, strategies and contexts. For example, the smaller firm supplying to a larger player may need to adopt technologies, embrace sustainable manufacturing principles, and/or achieve certain standards if they are to remain a competitive supplier.

The changing nature of manufacturing has implications for all firms in terms of how they operate and in how they do business - in particular:

- *Customer responsiveness* is crucial - needing agility and flexibility on the 'factory floor', market led product development and customised solutions;
- Companies increasingly need to *collaborate to compete*; and
- *New ways of working* are needed that harness the full potential of each person in the workplace.

Standing still is not an option. We can already see a shift toward increasing complexity with the convergence of sectors and technologies requiring multidisciplinary skills; the need for adaptive, flexible production processes to cater to increased customisation; the shift toward nano-scale; increased collaboration and the sharing of resources and broader networks across companies and countries. These changes offer significant opportunities for the future of manufacturing globally - and for Ireland, although they involve disruptive changes to established business practices and to ways of working.

Manufacturing Matters: A Critical Component of Ireland's Economy

In Ireland, as with other developed economies, employment in manufacturing has been declining over the past decade. However, manufacturing remains a key contributor to Ireland's economy. In summary:

- There are approximately 205,700 people⁷ employed *directly* in manufacturing - and a similar number of people employed *because* of manufacturing - that is a total of over 400,000 people⁸;
- Manufacturing provides employment across a broad range of occupations, through from operatives, technicians and trades to engineering and technology professionals;
- Exports of agency assisted manufacturing companies were €78.5bn in 2012⁹ up from €54.8bn in 2000, and have proven to be relatively resilient through the recession - in fact, exports was the only component that contributed to GDP growth since 2009;
- Productivity in manufacturing has been increasing over recent years - annual average growth rates in per hour labour productivity across manufacturing sectors amounted to 5.6 per cent over the period 2007 to 2010¹⁰ - enhancing the competitiveness of Ireland's firms on international markets;
- As a sector, manufacturing is a key driver of RD&I. In Ireland manufacturing firms invested €718.5 million in R&D in 2011, which equated to 39 per cent of business expenditure on R&D (BERD);
- Manufacturing firms sourced €14 billion of materials and services from Irish based suppliers in 2011- although this has decreased from €17.5 billion in 2001. Manufacturing firms contributed €7.6 billion in payroll to the economy in 2011¹¹;
- Manufacturing is regionally dispersed, providing employment opportunities throughout Ireland; and
- Although Ireland is home to a number of large scale global players, almost 95 per cent of manufacturing firms employ less than 50 people¹².

While this paints a reasonably positive picture overall - much more needs to be done to enhance the capabilities of the sector to compete in international markets today and to respond to the disruptive change in evidence.

⁷ QNHS Q3 2012, CSO. See also Appendix III. Chapter 4 provides more detailed analysis of current status of manufacturing across a number of key indicators and trends

⁸ Based on multiplier used in Action Plan for Jobs 2012

⁹ ABSEI 2011, Forfás. Note that for Goods Exports and Imports CSO show a total of €92.6 billion in goods exports for 2011 (January 2012). Goods are categorised according to SITC codes (which are different categories to NACE codes) and include some non-manufactured products such as live animals, cereals and mineral ores. Manufacturing exports amount to €76 billion based on CIP 2010 data - agency supported firms contribute in the region of 95 per cent to manufacturing exports

¹⁰ Ireland's Productivity Performance, 1980-2011, National Competitiveness Council, April 2012. There are differences in terms of productivity performance by sector and by 'traditional' manufacturing and 'modern manufacturing'

¹¹ ABSEI 2012, Forfás (Agency supported firms)

¹² Business Demography 2010, CSO, 2012

Ireland's Distinctive Strengths*but*...

Ireland has a number of distinctive strengths - strengths that are needed in the new manufacturing era and that can make a difference to Ireland's reputation for manufacturing. However, these are strengths that need to be protected and further developed. Many of the strengths have a counter-point, so that although Ireland does have strengths - many come with a '*but*' and inform where Ireland needs to focus its efforts.

For example, although Ireland is well regarded as a 'good place to do business' with a generally positive pro-business environment and competitive tax regime, companies cite relative cost competitiveness and access to finance on reasonable terms as *the* key issues facing them today.

Ireland has strengths in manufacturing related sectors, and in particular has an internationally renowned track record in regulated sectors. However, there tends to be a negative perception and lack of understanding of what manufacturing is like today - of the increased sophistication and complexity, and of the broad range of career options it offers.

Ireland has a well-educated and highly skilled workforce. That said, a number of skills gaps have been identified, which although not necessarily involving large numbers, they are in critical roles that will become even more in demand as manufacturing continues to evolve, including, for example engineering, electronics, software, tool design, robotics and analytics¹³. Management capabilities and leadership skills need to be enhanced across a broader cohort of firms to drive international business growth for the innovative firm and to realise the step change needed to compete successfully in the new era of manufacturing. Ireland's capabilities in international sales, in understanding markets and cultures, in connecting to the customer and in developing stronger internal feed-back loops to inform new product and/or services development need to be enhanced. We need to continue to strengthen capabilities in innovation and to drive the adoption of technologies that are relevant to them across all manufacturing firms.

Internationally, Ireland has a reputation for people with a can do attitude, an ability to identify and to solve problems, and a high degree of flexibility in the workforce - attributes which can substantially differentiate Ireland's offering. On the other hand some firms cite a degree of inflexibility and embedded work practices that constrain the step change needed.

There is collaboration and networking in evidence particularly in the areas of RD&I and skills development (for example, through Skillnets) and within industry associations¹⁴, again demonstrating characteristics that will become increasingly crucial to success over the coming years. More could be achieved by firms collaborating to compete, or by strengthening the sub-supply connections between foreign subsidiaries based here and Irish firms.

Ireland's investment in R&D over the past decade is beginning to bear fruit with increasing international awareness of Ireland's excellence in certain fields of science and technology. However, there is a perception that investments have not been directed sufficiently toward engineering for manufacturing, and that previous strengths in areas such as polymers have been eroded. Smaller firms in particular face higher barriers to entry and difficulties in leveraging state funded R&D. The *Report of the Research Prioritisation Steering Group*¹⁵ recognises the needs of manufacturing activities and sectors.

¹³ See also Chapter 7 for further details as well as the complementary publication Future Skills Requirements of the Manufacturing Sector to 2020, EGFSN, Forfás, 2013

¹⁴ Business Networks on the Island of Ireland, Intertrade Ireland, 2010

¹⁵ Published by Forfás and the Department of Jobs Enterprise and Innovation in 2011

As we paint the picture of Ireland's future in manufacturing, the imperative to cultivate our strengths and to address constraints is reinforced. The extent of the change is such that a business as usual approach would see Ireland's manufacturing capabilities falling behind by 2020 as the rest of the world moves on.

Painting a Picture of Ireland's Future in Manufacturing

We set out an ambitious, yet realistic vision for manufacturing in Ireland for 2020. By 2020 Ireland will become internationally renowned as:

A place that excels in manufacturing - and where manufacturing adds value

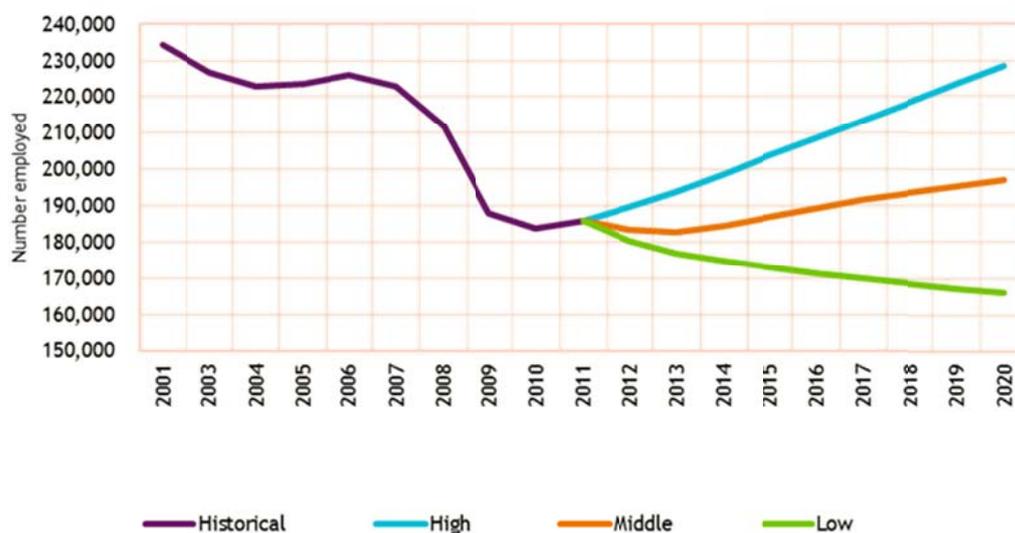
- A place where manufacturing is focused on the **customer** - *Agile, responsive and collaborative*
- A place where **people** make the difference - *Multi-disciplinary and highly skilled with a distinctive capability in simplifying the complex*
- A place that **innovates** in product development and manufacturing processes - *embracing leading edge technologies*
- A place where **quality** is embedded *across business operations, demonstrated by differentiation and a track record in highly regulated sectors*

It is estimated that up to 43,000 more people could be working directly in manufacturing by 2020 (under a *Competitive Manufacturing Scenario*)¹⁶. This number could be doubled if indirect jobs are taken into account. Achieving this job creation assumes that the necessary step change is achieved and that Ireland's relative competitiveness is improved.

We cannot be complacent. In a 'do nothing' scenario as many as 20,000 more manufacturing jobs could be lost by 2020. [Appendix II sets out the underpinning assumptions].

¹⁶ The Competitive Scenario reflects the targets in the Government's Action Plan for Jobs 2012 for the period to 2016, and continues these projections for the period 2017-2020. The Scenarios are based on an analysis of Forfás employment survey data, and therefore do not include the non-agency manufacturing firms (currently employ circa 19,700

Figure 1 Manufacturing Employment Scenarios to 2020



Source: Analysis based on Forfás Annual Employment Survey Manufacturing Employment Data

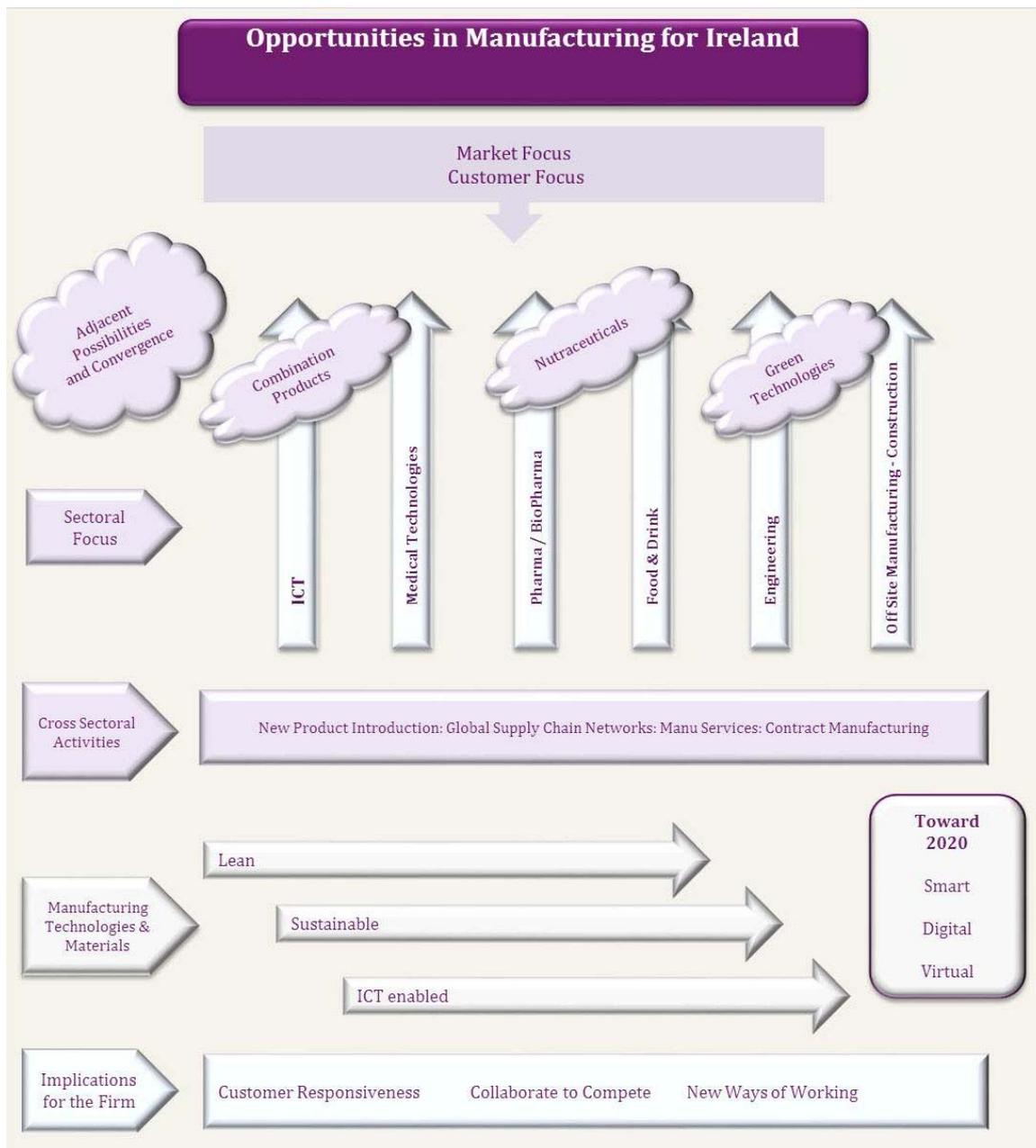
Areas of Opportunity

A number of opportunity areas have been identified - building on Ireland's existing sectoral strengths and capabilities in the context of the disruptive changes set out above. Lean Principles, adoption of ICTs, and the sustainable agenda are pervasive, as are the likely changes to ways of doing business and ways of working.

Ireland needs to continue to keep abreast of change and to refresh its proposition to attract investment - from new and existing foreign firms and from start-ups and existing Irish firms across a range of manufacturing and related activities.

The areas of opportunity are set out as follows:

1. Focus on Sectors : Maintaining what we have; and Building on Strengths
2. Functions & Activities : Adapting and Responding to Globalisation
3. Developing and Adopting New Technologies and Materials
4. Focus on indigenous potential - Manufacturing Start-ups and Scaling.



A Focus on Sectors

Global drivers of change impact upon market growth and present opportunities for Ireland’s manufacturing firms. Aging populations, environmental concerns, increased affluence in emerging markets, increasing digitisation and changing consumption behaviours are driving growth in markets such as healthcare, wellness, food, green technologies (including energy, water etc.) as well as for more customised products and services in markets such as ICTs, consumer products and automotive. Building on our strengths, we look specifically at opportunities in Food, Pharma/Biopharma, Medical Technologies, ICT and Engineering as well as the potential for Offsite Manufacturing (OSM) in construction, areas that deliver to global market demands. We also consider ‘new’ areas arising from convergence and adjacent possibilities.

Sectors - Maintaining and Reenergising What We Have

Concerns have been raised by firms that in the eagerness to identify 'new' sectors and areas of opportunity, the focus may be taken off reinforcing and sustaining the not insignificant 205,700 currently being directly employed in manufacturing. In order to reach the potential jobs envisaged in the *Competitive Scenario*, it is crucial that a focus is maintained on sustaining the jobs already in existence in manufacturing.

There will always be a constant churn in employment as firms re-structure globalised operations and adapt to economic circumstance. Steps can be taken by firms, and by the Government to support firms, to reposition themselves - to invest in identifying new market opportunities, enhancing productivity and in building innovative capacity so that they remain competitive and relevant to their existing and potential customers. For multinational subsidiaries based in Ireland, their positioning within corporate global strategies is crucial, as is their ability to extend their current mandates.

It is important to acknowledge that a continued increase in productivity is likely to result in a period of low job growth in the short term, particularly as international markets continue to experience and forecast relatively low growth over the coming years. This period of restructuring is necessary. It will see firms in a considerably stronger position to take advantage of growth opportunities as they arise leading to sustainable employment.

Many existing firms in Ireland have already invested in the necessary changes. Many others may not have accepted that there are things within their own control.

The enterprise development agencies provide business development and advisory services and supports to assist firms in transformational change, development and sustainable growth.

It is about building on these supports to facilitate a step change across the broad cohort of manufacturing firms in Ireland, to encourage increased cross-sectoral and cross ownership peer learning and to enable access to the most appropriate intervention depending on the specific needs of a company¹⁷. An overarching priority in this regard is leadership and management capability. Firms need also to commit the time and resources required to realise change, and to engage openly and inclusively with the workforce (indeed for some, it is about acknowledging that change is needed in the first instance).

Ireland's GDP growth is based on aggregated output - by taking one step up, each individual firm can play its role in contributing to Ireland's recovery and future.

Sectors - Building on Strengths

The fact is that none of the sectors in which manufacturing firms operate is static. Even those that may be categorised as mature or traditional sectors are evolving in response to (sector specific) global drivers of change. New sub-sectors emerge and new opportunities arise at the blurring of the edges of well-established sectors. New methods, technologies and materials can have a disruptive impact on more traditional sectors.

A brief synopsis for each sector, placing the emphasis on what is changing is outlined below followed by an overview of opportunities arising from convergence.

¹⁷ Some foreign owned companies cite an interest in the Leadership for Growth, International Trade Missions and Lean programmes provided by Enterprise Ireland for its client base

Food

Harvest 2020 sets out to achieve the potential to increase exports by 42 per cent by 2020 in response to increasing global demands and opportunities in developing economies¹⁸. An update on its implementation was published in September 2012 which includes key actions to be delivered upon in 2013¹⁹.

Ireland benefits from its green image and reputation for quality which is hugely important given the increased focus on traceability (from fork to farm), food security, standards and quality production systems. Brand recognition is vital to build consumer trust and confidence and international reputation.

The food sector operates to tight margins in circumstances where the multiples have considerable purchasing power. In the first instance, it is important that companies continue to embrace both Lean and sustainable principles across their entire business operations - investing in capital equipment and automation, ICTs (technology deepening) and re-skilling of their workforce. In addition, more companies need to build capabilities and to add value through the development and introduction of new products and services. Companies also need to build capabilities in international selling including developing an understanding of different cultures, market tastes and global supply networks.

Food companies cite challenges in terms of access to finance, including onerous conditions imposed by banks and limitations under State Aid Guidelines, as a key issue. According to the industry, issues relating to access to finance²⁰, as well as relative cost competitiveness, constrain the potential growth of the sector in Ireland.

Pharma/Bio-pharma

The most fundamental change facing this sector is the shift toward personalised healthcare²¹ with targeted therapeutic interventions leading toward growth in innovative delivery mechanisms, companion diagnostics, niche busters²² and an increase in biologics. The shift toward biologics and niche busters is seeing consolidation in the market, increased complexity in manufacturing processes, new materials and packaging and the need for firms to have cold chain logistics management capabilities to ensure that the manufacturer's FDA approved storage conditions are carefully observed along the distribution chain.

For Pharma companies globally, the expiry of patents is of key concern, as are issues relating to over-capacity, significant R&D costs and low product pipe-lines.

Across the sector, the level of sophistication in manufacturing is increasing, requiring multi-disciplinary capabilities, new processes and analytical methods, shorter product runs and multi-product 'flexible' factories, as companies improve their abilities to adjust to ever-changing market demands.

Capturing future opportunities for Ireland depends on the ability to respond to these challenges. Companies need to prepare for more complex new product introductions through process

¹⁸ Harvest 2020, Department of Agriculture, Fisheries and Food, 2010

¹⁹ Food Harvest 2020, Milestones for Success, Department of Agriculture, Fisheries and Food, 2012. The implementation of Harvest 2020 is being led by the Food Harvest 2020 High Level Implementation Committee

²⁰ Chapter 7 discusses the funding environment (which is relevant to all manufacturing firms) in more detail

²¹ Tailored to the needs of the patient, enabling the delivery of the appropriate treatment, in the appropriate way at the appropriate time

²² Targeted to specific patient cohorts and/or rare diseases

development, innovation, operational excellence and productivity enhancements (e.g. Lean, Six Sigma). A continued focus on developing skills and capabilities²³ is required as is an enhanced focus on smart materials and packaging and traceability. It is crucial that the recommendations of the *Report of the Research Prioritisation Steering Group* are implemented to strengthen the industry relevance of State funded research particularly in areas of manufacturing technologies.

The shifting nature of the sector will also have implications for: sub-supply (e.g. in a move towards the 'plastic' factory and single use systems) which should be of interest to indigenous companies; for water quality and supply; and for increased energy demands.

ICT Hardware

The ICT sector has a well-developed global supply chain model, comprising a number of very large players as well as smaller, agile, technology intensive and innovative firms. The sector is one in which the pace of change is exceptional, where products become commoditised at an early stage in their life-cycle, where mass customisation and manu-services models are well embedded. The R&D life cycle is relatively short, iterative and highly competitive and a close connection with the customer is an essential part of the process. The phenomenal increase in Big Data and mobility pose real challenges for the sector and Cloud Computing has been identified as the industry's solution to manage these challenges.

Despite a considerable reduction in terms of employment of those involved in ICT hardware manufacturing²⁴, Ireland remains host to a number of global players and a range of Irish owned electronics firms.

For Ireland growth opportunities in the ICT/electronics manufacturing sector are in R&D and/or Intellectual Property (IP) intensive low or medium volume manufacturing activities: pilot production and prototyping; 'intelligent' devices and systems integration serving the manufacturing and other sectors aimed at increasing energy efficiencies; advanced Integrated Circuit (IC) design and fabless manufacture (e.g. System on a Chip, Lab on a Chip)²⁵; and in furthering the applied research agenda in manufacturing process developments, analytics and optimisation of the supply chain.

As well as being a sector in its own right, ICTs have a pervasive impact across all businesses, and ICT adoption is becoming a necessity for *all* manufacturing firms. The greater use of ICTs in production processes facilitates greater quality management and control, enhanced efficiencies, optimisation of energy and waste reduction through real time analytics, modelling and simulation. ICTs are an enabler in terms of building customer and supplier relations, optimising business processes, access to markets, logistics and supply chain management and engaging in open innovation etc.

Medical Technologies

The Medical Technologies sector is a well-functioning eco-system in Ireland and continues to demonstrate strong growth potential. High value opportunities (e.g. combination products, technologies for independent living) are being driven globally by advances in science and

²³ Including Quality by Design, Process Analytical Technology, information based analytics and Quality Risk Management, RFID, Materials Technologies, IP creation, protection and exploitation

²⁴ Prior to the Internet/digital era, software replication was classified as manufacturing. Much of the decline in hardware employment post 2000 resulted from global decisions to relocate manufacturing activities to lower cost economies in response to the commoditisation of electronics products

²⁵ Irish owned companies include Magnetic Solutions, Powervation and Redmere. Foreign owned IC design companies include Analog Devices and Xilinx

technology and convergence, particularly with pharma and ICT. Companies are challenged with demonstrating increased product efficacy and achieving high quality standards while facing downward price pressures from procurers.

To realise opportunities and future investment by foreign and Irish firms, Ireland needs to prepare for more complex production by embedding operational excellence across the entire business and by embedding real time analytics capabilities. Firms need to enhance capabilities in product and engineering design, as well as in innovation in product, process, materials and packaging. Contract manufacturing operations (CMOs) need also to further develop capabilities to offer leading edge technologies, the 'flexible factory' and to engage as strategic partners. Sub-suppliers need to keep abreast of the changing dynamics, technologies and materials relevant to the medical devices sector and to innovate to provide relevant solutions.

Engineering

There are a number of innovative engineering companies based in Ireland. The Engineering sector encompasses those that are engaged in sub-supply (e.g. plastics, components) and those involved in own branded products either Irish or foreign owned, serving a range of markets including medical devices, plant and machinery, agricultural equipment, automotive, aeronautics and other industrial products.

In general, however, a step change in capability is required across the engineering company base (both indigenous and foreign owned). This requires aggressive marketing by the enterprise development agencies of RD&I programmes to increase the uptake by foreign owned firms of existing programmes²⁶, and to encourage indigenous firms to develop their own IP and products for export markets. It also requires optimising sub-supply opportunities between foreign and indigenous firms; building connections with State funded materials research to address the future needs of other sectors such as Biopharma (the 'plastics factory'), Medical Technologies (nano-scale) Construction (smart buildings); assisting Irish owned firms to reorient their strategies toward growth market opportunities and foreign owned firms to review their strategic positioning within their global corporations; and building sales capabilities in the context of a more sophisticated solutions based proposition.

Engineering is a problem solving discipline, a crucial building block to Ireland's manufacturing future across all sectors and this capability needs to be nurtured and complemented with flexibility in the workplace.

Off-site Manufacturing - Construction

In 2009, Enterprise Ireland identified factory based construction or off-site manufacturing (OSM) as one of the areas offering potential although the construction industry has suffered a significant decline over the period since then²⁷. Interest in OSM is gaining traction internationally as difficult economic conditions in the construction industry have increased the appeal of Lean methods and practices. The influence of the green agenda, technological advancements, developments in quality materials, the rising use of Building Information Modelling (BIM) and sophisticated manufacturing facilities now offer significant productivity gains on projects not possible before²⁸.

²⁶ Foreign owned engineering firms have the lowest take up of the IDA Ireland R&D programme relative to other manufacturing sectors (Chapter 4)

²⁷ Forfás has developed a strategy for the construction sector that is scheduled for publication early 2013

²⁸ Construction Research & Analytics, Industry Insights and Alliances, McGraw, Hill 2011

Although today there are a relatively small number of Irish based firms currently engaged in OSM, it is an area that offers potential as the construction sector seeks to recover. OSM can help to transform construction into a highly productive, technologically rich sector - delivering a competitive offering to both domestic and overseas markets. The potential for exporting modular and pre-fabricated buildings or elements of buildings may be somewhat reliant on a cost to value consideration, given the relatively high transport costs and home based competition in markets such as UK, Germany and Belgium. Factors such as availability of natural resources (aggregates), the economic realisation of new developments in materials over the coming years (e.g. composites, smart materials, graphene) and investments in R&D will all play a role.

Adjacent Possibilities and Convergence

Adjacent Possibilities is based on the premise that enterprises and economies find it easier to master new products that are similar to ones they already make - utilising accumulated productive knowledge²⁹. An example might be the application of the knowledge, expertise and competences of glass extrusion to photonics or of the textiles sector to the development of composites (where Ireland is already seeing connections being made). Convergence is primarily enabled by advances in technologies, and results in the emergence of 'new' sectors and products such as nutraceuticals and combination products - areas in which Ireland has considerable opportunity based on existing sectoral strengths.

Whatever terminology used, 'new' sectors and areas of opportunity arise from the blurring of existing sectors and/or application of core competences from one to another. From Ireland's manufacturing perspective the areas of Combination Healthcare Products, Functional Foods and Nutraceuticals, and Clean Technologies present more immediate opportunities.

Ireland can realise potential from emerging or nascent areas of opportunity by maintaining a watching brief on what is happening at the edges of known sectors and by stimulating cross-sectoral knowledge sharing in the first instance. A systematic approach needs to be taken as opportunities become apparent to garner insights into changes that may be needed to support its growth - including skills, regulations and standards, planning regulations and the IP environment - so that a more proactive (and anticipatory) approach is taken to enterprise strategy development.

Functions and Activities - Adapting and Responding to Globalisation

Looking horizontally, across manufacturing sectors, there are a number of areas of interest from Ireland's perspective. These will resonate differently for individual firms, depending to some extent on ownership and/or scale or reach of internationalised activities. In addition to the areas set out below, IDA Ireland will continue its efforts to attract a broad range of headquarter activities from manufacturing firms (engaging with both its existing client base for mandate extension and potential new names). Activities include customer support centres, sales lead generation, RD&I functions, shared services, IP management etc.

Manu-services

Manu-services require a much closer connection to the customer than is necessary when delivering a (mass produced) product at a certain price point. A manu-services model can have a transformative impact on what might otherwise be a relatively low value and/or commoditised product.

²⁹ Factories of the Future Public Private Partnerships - Strategic Multi-Annual Roadmap, prepared by the Ad-hoc Industrial Advisory Group, Directorate-General for Research, Industrial Technologies, European Commission, EUR24282EN, 2010

Sometimes referred to as servicisation, this concept relates to where added value is provided by the manufacturing firm through a mixture of software, products and services to the extent that the traditional distinction between manufacturing and services has become increasingly blurred.

For the manufacturing firm, a manu-services approach requires changes in the way it does business. It involves a business model that is somewhat different from the more direct 'price for product' model. It will generally require a different sales approach, different revenue models, new forms of innovation, longer term management of customer relationships, and/or collaboration with partners that offer complementary services. For Ireland's manufacturing companies with existing product offers, the opportunity is to develop additional revenue streams from associated services. The immediate need is to: raise awareness amongst manufacturing firms that can assess its relevance for their operations; develop and disseminate case studies; build the relevant capabilities and skills; and broker partnerships.

Contract Manufacturing - Strategic Partnerships

The use of contract manufacturing organisations (CMOs) depends very much on the industry, although recent trends indicate growth in the provision of services to the Medical Devices and Biopharma sectors. There may be opportunities presented for Ireland depending on the primary business driver for outsourcing and based on a strategic partnership model³⁰. Opportunities are likely to be in the delivery of higher order services including system assembly, manufacture, test, delivery, software and silicon design and customer service. This model is based on strategic partnerships, requiring quality, reliability and flexibility. There are also opportunities for several smaller CMOs that occupy niches and can demand higher margins.

CMOs play a key role as part of the overall eco-system for manufacturing. They provide a solution to start-ups that alleviates the need for capital investment; provide an attractive proposition for attracting overseas entrepreneurs; and can bring together development, design and engineering capabilities for new product introduction and process development working with their client companies. Building on Ireland's expertise in Supply Chain Management (SCM) activities, the potential for Ireland to position itself as an attractive location for CMO management is strong.

Global Supply Chain Networks

Ireland already has a well-developed proposition and track record in SCM in foreign owned subsidiaries. Ireland can build on this to provide a more advanced offering to address the changing needs of the parent company. The increased complexity of managing global supply chains requires strong risk management capabilities, identification and management of hidden costs arising from distance to market and volatility, and strategic partnership management. Likewise, supply chain and related business models are increasingly relevant to Irish firms as they internationalise through acquisition and/or outward direct investment (ODI). Overall, adopting a supply chain model in these instances should enhance the capabilities of the Irish based entity, and present an opportunity to maximise the return to the State arising from its internationalisation. Indigenous firms need to consider a number of related aspects including: acquiring and/or developing skills and capabilities; investing in integrated technology infrastructures; sourcing appropriate partners and due diligence; and determining the functions that could be centralised (e.g. technical support, financial shared services).

³⁰ For example, if the business driver is to gain access to a new technology this will imply setting up a long term relationship and relying on the technical knowledge of the CMO. If the CMO is intended as a back-up sourcing option, then the total cost of maintaining the back-up option will be important. If the intention is to gain additional capacity of a commodity process, then unit cost is likely to be the most important factor

A major element of enterprise policy in the '80s involved the Linkages Programme, which brokered introductions between foreign multinationals establishing in Ireland and indigenous firms that could supply product and/or services. In light of the reduction in the proportion of materials and services sourced locally, EI and IDA Ireland have initiated a joint Global Sourcing Strategy³¹ to boost business connections between foreign MNCs and indigenous firms. Both the foreign subsidiaries and Irish firms would realise benefits (which would also result in economic return for Ireland). For foreign subsidiaries it would reduce the risks and hidden costs in longer supply chains, result in closer supplier partnerships and further embed their activities in Ireland. For indigenous supplier companies it would introduce a new customer base, strengthen their capabilities in selling, product development and customer relationship management and equip them to expand into overseas markets.

New Product Introduction/Pilot Manufacturing

Innovation is at the core of any successful manufacturing firm. The demand for increased customisation, the availability of new materials, the increasing importance of Product Lifecycle Management (PLM) and increased complexity present considerable challenges for firms as they seek to develop and introduce new products. The introduction of combination products or those involving biologics offers even greater challenges.

Consolidation and mergers and acquisitions (M&A) by global multinationals can often present challenges in terms of 'new to them' products and rationalisation etc. In such circumstances, many foreign firms based here need to be in a position to offer New Product Introduction (NPI) capabilities and to be part of the solution following on from M&A activity.

With an increased focus on 'connecting the dots' between state funded R&D and the needs of companies, on enhancing the ability to collaborate across disciplines, and on effectively utilising our problem solving capabilities, Ireland could become a location of choice for piloting/testing new products and developing efficient and sustainable production systems. Further action would be required to develop/provide appropriate test/trial and scale-up facilities to make this a reality and to leverage the existing R&D expertise.

Finally, Irish firms can benefit from access to appropriate facilities and from advisory services and expertise to inform more structured methods for NPI. A key challenge relates to building the capability of smaller firms who have not yet engaged in own product or process development.

Manufacturing Technologies and Materials

Manufacturing Technologies

Ireland has demonstrated capabilities in advanced manufacturing processes and technologies. The *Factory of the Future* requires engagement with advanced manufacturing technologies across the entire operation. These concepts may be beyond the current capability of many smaller firms - but regardless of what stage of development a company is currently at, there is an opportunity to take the next step up.

Adopting existing technologies: For some firms it is about being assisted to identify and adopt existing technologies³² that are relevant to them, to their stage of development and strategic

³¹ A supply chain initiative was launched late 2012 by the enterprise development agencies is aimed at boosting Irish companies supplies to MNCs by €500 million annually (in response to APJ2012 actions 5.11 and 3.3)

³² Technologies can relate to production processes, supply chain optimisation, Product Lifecycle Management (PLM), Customer Relationship Management (CRM), energy efficiencies, eBusiness, open innovation etc

pathway. Firms will likely need to invest in building the necessary skills and capabilities (whether through on-the-job training, in-house or external courses), and to engage in opportunities for peer-to-peer learnings.

Developing new technologies: For other firms it is about being at the leading edge of new developments - engaging in in-house R&D and/or collaborating with Ireland's research capabilities or with research capabilities abroad across the range of relevant domains and platform technologies³³.

The real opportunity (and challenge) is to position Ireland as a Centre of Excellence for manufacturing technologies - to build a reputation for being at the leading edge of technology development and adoption. This would involve: stimulating increased collaboration across companies and research institutes; developing the facilities for trial/test and demonstration of new technologies by large and small companies; making it easier for SMEs (in general) to engage with R&D and/or at a minimum to adopt technologies in the workplace; and encouraging new technology-intensive and software start-ups that are focused on addressing the needs of the manufacturing sector.

Materials

An in-depth knowledge of materials, their characteristics, performance and application should form a critical part of Ireland's distinctive offering in manufacturing. Next generation materials will require next generation analytics for characterisation and next generation processes for manufacture, Product Life-cycle Management (PLM) etc. It is not only about new/advanced materials. New ways of processing/forming or coating/surface engineering for an existing material will enhance its characteristics. Bringing materials from previously distinct sectors and disciplines together can also add value to the final product.

We need to further develop the capabilities of Irish based sub-suppliers in terms of advanced materials, design, testing, prototyping; advance transformational change and reconfiguration of existing manufacturing; and attract new investment from materials sub-suppliers.

A Focus on Indigenous Potential

Over the years there has been an increased policy focus aimed at achieving more in terms of economic activity and performance from indigenous firms. The indigenous sector, and particularly the food sector, has performed well during the recession in export markets. This continued focus is needed, particularly in light of existing constraints for investment in capital intensive operations and the relatively small proportion of start-ups engaging in manufacturing activities.

Start-Ups

Entrepreneurs, and the start-up companies that emerge as a result, provide the feedstock for future exports and employment and the means by which new sectors could take root in Ireland. Start-ups can also increase levels of innovation in the market place, increase productivity and improve competitiveness.

³³ Appendix V sets out Ireland's research institutes that are directly relevant to manufacturing activities and sectors. See also Chapter 7

Out of a total number of circa 11,000 start-ups economy wide, less than 600 (or 5 per cent) relate to manufacturing activities³⁴. This is not necessarily unexpected, as the vast majority of companies trading on the domestic market relate to retail, hospitality and construction. What is of some concern is the relatively low numbers of Enterprise Ireland supported High Potential start-Ups (HPSUs) that are actually involved in *production* - only 6 out of 35 HPSUs in manufacturing related sectors in 2011, compared with 19 in production out of 30 HPSUs in manufacturing related sectors in 2007³⁵.

Manufacturing start-ups face greater barriers to entry and challenges when compared with those involved in services activities. Starting up in production is a more complex, capital intensive and daunting proposition. There are other routes to realising new investment in manufacturing that can alleviate the risk of a Greenfield option. These include, for example: management buy outs and acquisitions; distributors opting to establish manufacturing facilities here based on their in-depth understanding of the market and ability to innovate to deliver to customer needs; an established company setting up a new entity to address a new market opportunity following development of a new product. The development agencies can work with firms to identify the relevant model and broker introductions as appropriate.

The need for capital investment could be minimised in some instances, for example if access to State funded equipment was enabled and/or 'sand pit' trial and test facilities were made available; through the utilisation of onshore CMOs and/or through the use of 3D (additive) manufacturing at prototyping stage (where relevant).

Scaling

The focus on scaling is not new. However, despite the success of a number of Irish firms in global markets, the vast majority remain small and lack the human and financial resources needed to take on the challenge of internationalisation. Enterprise Ireland established its Scaling Division in 2005 to focus on assisting more client companies to increase turnover from the €5m+ levels. Its Leadership for Growth, Chief Operations Officer (COO) and Chief Finance Officer (CFO) management development programmes, International Selling, RD&I and three tiered Lean programmes are all relevant in this regard, as well as advisory services, mentoring and trade missions. It is essential that these initiatives are continued and capture a broader cohort of firms. Managers of firms also need to acknowledge their own limitations, and be prepared to put in the time, effort and resources (human and financial) needed to deliver real change and growth.

A significant increase in scale is unlikely to be achieved by organic growth alone. Successful scaling companies generally engage in M&A activities and/or partner successfully to target larger scale market opportunities that they would not be capable of doing alone. Enterprise Ireland indicates that firms have difficulties in getting sufficient financing at a reasonable price to make an acquisition worthwhile. It is apparent that the issues relating to access to funding hinder growth potential in these instances.

The concept of collaborating to compete needs to become a reality for a greater cohort of Irish companies. By collaborating in order to capture larger scale market opportunities, individual firms engage in a reinforcing 'circle' that enhances capability, opens doors and leads to increased scale. Although there are some good success stories, many smaller Irish firms are reluctant to engage in collaboration. This requires a mind-set change - a change that is easier said than done - but one that is essential for growth.

³⁴ Business Demography 2010, CSO

³⁵ Forfás review of HPSUs (sectors and activities) 2007 & 2011

Promoting the Success of Irish Owned Manufacturing

Much of the analysis of Ireland's indigenous firms is based on the existing data based on economic activity in the State. While this is a valid perspective to take in terms of assessing the return to the State from its investment in supporting enterprises, it falls short in terms of telling the full story of the extent of internationalised activities. Employment based *in* Ireland and exports *from* Ireland continue to be the key metrics captured and used in analyses of the performance of indigenous firms. The fact is that Irish manufacturing multinationals employ almost 75,000 in affiliates overseas³⁶ - an additional 80 per cent on top of the 95,000 employed by them in Ireland. Enterprise Ireland has already embarked on telling the Irish story, and of particular note is the video developed during 2012 which shows Irish firms' success on global markets³⁷. We need to build on such initiatives and continue to promote the story of Irish success (both nationally and internationally) and engender a sense of pride about Ireland's own.

Ireland has a Future in Manufacturing...*if*

There *is* a future for manufacturing in Ireland - a future that can only be realised if action is taken now.

The government does not create jobs - but its actions serve to create the right environment for businesses to invest, thrive and grow. Government action involves addressing constraints as they arise as well as putting in place changes needed to meet the evolving needs of industry.

The development agencies play a key facilitating role, through from marketing Ireland as a good place to do business, to working with and supporting companies to make the step changes they need to in order to build capability and capacity and to remain competitive in a global environment.

Firms too, have a role to play. It is the aggregated productivity and output of each individual firm that contributes to Ireland's GDP growth. Company leaders and managers who recognise the need for change and take the necessary steps to embrace continuous improvement are those that succeed. This is valid for all companies regardless of stage of development or ownership - where taking *one step up* improves their competitiveness and their contribution to Ireland's future growth. Employees and individuals can take the initiative to up-skill and to reinforce Ireland's reputation for its 'can-do' attitude.

All need to work collectively and with conviction if Ireland is to build from its existing manufacturing base to create a compelling and distinctive reputation for manufacturing in Ireland. Critically:

- **Immediate barriers must be addressed** to realise future potential in manufacturing - specifically, relative cost competitiveness and access to finance; and
- **A National Step Change initiative** is needed to place Ireland's manufacturing more to the forefront internationally, to: improve competitiveness, productivity and innovation; to connect to the customer and expand into new markets; and to collaborate to compete and engage in new ways of working.

³⁶ Business in Ireland, 2010, CSO, 2012 . CSO data indicates that Irish multinationals employed almost 249,000 people in foreign affiliates - 30.2 per cent of which relate to manufacturing entities

³⁷ <http://www.enterprise-ireland.com/en/ Where Innovation Means Business>

Action is also needed to address negative perceptions of manufacturing, to develop the skills for the new era of manufacturing and to target investments in RD&I infrastructures to support engineering technologies for manufacturing.

How Will We Measure Success?

There are many factors that impact upon an individual firm's performance, and therefore upon the aggregate of enterprise performance and its contribution to Ireland's future economic growth. As a small open economy, global factors are outside of our control. It is also true that sectors perform differently, that ownership can play a role in performance and that indicators can be impacted by 'outlier' firms (e.g. large scale). Nevertheless we need to have visibility on whether or not the actions being taken by government and its agencies to support the development of manufacturing firms and actions taken by firms themselves are making a difference. The following table sets out a small number of high level metrics that can inform progress, which will vary by sector and by firm ownership as appropriate. They are informed by existing strategies including Trading and Investing in a Smart Economy, the Strategy for Science, Technology and Innovation, international norms (where applicable) and an analysis of past performance.

Table 1 Measuring Success

Measure : Manufacturing Firms	Potential by 2020	Current Performance ³⁸
Employment - net direct jobs	+22,000 by 2016 +21,000 2017- 2020	2012 Gross circa +11,000: Net circa +2,500
Productivity (growth in per hour labour /Ind) ³⁹	6% - 8% annual growth	Ave 5.6% 2007-2010
Innovation⁴⁰		
Expenditure on R&D as a per centage of sales (All)	2% of total sales	0.8% (2000) : 1.6% (2011)
% of all firms spending > €250K per annum on R&D	30% of all firms	9 % (2000) : 20 % (2011)
% of sales attributable to new product development (Irish owned firms)	7.5% - 10% of sales	7% (2010) : 7.4% (2011)
International Reach (Irish owned firms)		
Export Intensity ⁴¹	55% of Sales	48% (2011)
Diversification - Increase the share of⁴²:		
Food and Drink Exports to outside UK	62% of exports (2015)	
Other exports to outside UK	63% of exports (2015)	
Food and drink exports to Asia	7% of exports (2015)	
Collaboration		
Inter-firm Linkages/Sourcing ⁴³	+ €250m p.a.	
Enterprises Engaged in R&D Collaboration	50%	35% (BERD 2009/2010)

³⁸ Current/trend data sourced from ABSEI 2011, AES 2012, Forfás: Trading and Investing in a Smart Economy, DJEI, 2010, Ireland's Productivity Performance, 1980-2011, Forfás, 2012 (Fig 26)

³⁹ Assumes continued improvements in capital intensity, automation and engagement in higher value added activities across manufacturing sectors. Monitoring of progress should also take into account performance relative to comparator countries

⁴⁰ Based on a review of international norms, SSTI targets and past performance, and assumes continued focus on stimulating RD&I activities at firm level and enhancing absorptive capacity. High level metrics are influenced by the sectors that contribute greatest proportion to sales/outputs

⁴¹ Based on analysis of CAGR 2000-2011 on exports, sales and intensities and projecting to 2020, and adjusted to account for sub-supply intensive activities

⁴² Trading and Investing in a Smart Economy, DJEI, 2010 set targets for 2015

⁴³ For manufacturing is estimated at 50 per cent of the total €500m in the IDA/EI in their sourcing initiative 2012

Taking Action

The suite of actions set out below under 4 headline areas encompasses the level of the business environment and the level of the firm. The strategic aim has been set out underpinned by a number of more specific actions. Although each action has a particular focus, there is a strong inter-play between them. Strengthening capabilities at the level of the firm is highly dependent on peoples' capabilities, skills and attitude. You will note, therefore, e.g. that skills related actions pervade many of the areas set out - and at both the business environment level (education) and at the level of the firm. Likewise the concept of collaboration, partnering and peer-learning is reflected in many instances.

	Area of Focus
Redressing Perceptions	
1	Redressing Perceptions of Manufacturing
Addressing Barriers to Growth	
2	Delivering Structural Improvements for Cost Competitiveness
3	Retaining a Competitive and Pro-Business Tax Regime
A National Step Change Initiative	
	<i>A National Step Change Initiative: Strengthening Ireland's Manufacturing Base</i>
	Pillar A Enhancing Productivity and Competitiveness
5	Pillar B Connecting to the Customer & Extending International Reach
	Pillar C Broadening and Deepening Innovative Capabilities
	Pillar D Strengthening Collaborative Actions for Economic Growth
6	Strengthening Ireland's Own - a focus on indigenous potential: start-ups and scaling
7	Developing Ireland's People for Manufacturing - Making the Difference
Infrastructures	
8	Prioritising investment in Infrastructures for Manufacturing
	Addressing Funding Issues for Capital Intensive Manufacturing Activities

Perceptions of Manufacturing

In Ireland, industry cites a lack of awareness of how manufacturing has evolved as a sector - in terms of its complexity and sophistication. There appears to be a general negative perception in terms of manufacturing nationally which permeates into the policy and support system. There is a sense that the 'newer' activities in internationally traded services sectors have grabbed the attention of policy makers and educationalists, to the detriment of manufacturing over the past number of years. It is not a case of either/or - but more a case of redressing the imbalance of recent years.

There *are* opportunities for manufacturing in Ireland over the years to 2020 - which can be realised.

As a priority it is important to redress public and political perception about the potential for manufacturing in Ireland, about the changing nature of manufacturing, its potential to offer job and career opportunities across a range of skills levels and across all regions, and about its valuable contribution to Ireland's recovery.

Ireland *is* in manufacturing and will continue to be in manufacturing in the future.

1	Strategic Action Undertake a strategic campaign of coordinated actions over 2013 to promote <i>Making it in Ireland - Manufacturing 2020</i> nationally and internationally.	DJEI, MDF/ Agencies
1.1	Develop a suite of key messages based on the evidence in this report to inform a coordinated programme of national and international (media, electronic etc) communications for <i>Making it in Ireland - Manufacturing 2020</i> that would be used consistently by politicians, government department and agencies. Build on the existing agencies 'blackboard' campaign (<i>Innovation Ireland</i>).	DJEI and Agency Communications Managers
1.2	Identify and 'recruit' a small cohort of manufacturing champions who would become the faces of manufacturing in Ireland, and who would be supported in promoting manufacturing in Ireland at various relevant events and in various journals and articles over 2013.	DJEI
1.3	Deepen engagement of the Manufacturing Development Forum across Government to maintain a continued focus on the concerns and opportunities facing the sector in the context of significant change.	DJEI
1.4	Undertake an initiative to promote careers in manufacturing. In doing so, Discover Science and Engineering (DSE) should collaborate with manufacturing industry sectoral representative organisations, higher education institutions, SOLAS and relevant professional and trade organisations to deliver this initiative.	DSE/ Industry Assoc

Delivering Structural Improvements for Cost Competitiveness

Consultations with managers of manufacturing firms cite Ireland's relative cost competitiveness as being *the* most significant challenge facing them. Although Irish firms are affected to a greater degree than foreign firms by the domestic cost environment, it would be remiss to interpret this as a non-issue for foreign firms. The fact is that relative costs feature strongly in the Foreign Direct Investment (FDI) decision making process⁴⁴ and that Ireland could potentially reposition itself in the market place for greater levels of investment from FDI (greenfield and expansions) across a broader range of activities if cost competitiveness were improved. For Irish firms trading on international markets, cost inputs determine their pricing structures and affect their ability to compete. For start-ups, a cost competitive environment in Ireland could positively influence their decisions with regards to where to establish production in the first instance.

Of particular relevance to manufacturing firms are: Costs of Employment; Utilities; Transport; Regulatory Burdens and Property Costs. In a number of circumstances, there is a strong interplay between costs, market structure and/or availability of infrastructures - and this is apparent in the analysis in Chapter 7 and the actions below. For further analysis and recommendations see recently published reports by Forfás⁴⁵.

Although much may be outside of the control of government, it is important that actions are taken to address those aspects of costs where government *can* play a role. Equally important is for government to ensure that modifications to existing policies or the introduction of new measures do not (inadvertently) increase the costs for business. In some instances, firms can take a proactive role in reducing costs, e.g. through initiatives to improve energy efficiencies or minimise waste. Much of the control of labour costs (above the minimum wage) falls to firms - although cost of living and inflation are factors that impact on the real wage for individuals and the potential to effectively negotiate wage reductions. Other factors such as the tax wedge (i.e. the gap between what the employer pays and what the employee receives) and replacement rates (i.e. the proportion of out-of-work benefits received when unemployed against take home pay if in work) are also relevant.

2	<p>Strategic Action</p> <p>Make concerted efforts during 2013 to address the step change needed to realise structural reform to improve Ireland's relative cost competitiveness in support of manufacturing and enterprise development, growth and job creation.</p>	DJEI / Whole of Govt
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⁴⁴ Location assessment and decision making is a complex process and depending on the nature of the investment other factors come into play, such as knowledge infrastructures, access to markets etc

⁴⁵ Costs of Doing Business 2012, Overview of the Main Infrastructure Issues for Enterprise, etc
<http://www.forfas.ie/>

2.1	<p>Costs of Employment</p> <ul style="list-style-type: none"> ▪ Continue the measures included in recent Budgets⁴⁶ to ensure that all replacement rates move below the 100 per cent mark and ultimately move toward the 70 per cent benchmark; ▪ Ensure that proposed policy changes do not result in increases to the costs of employment (e.g. pension auto-enrolment); and ▪ Ensure that there are no further increases in the labour tax wedge and provide an indication of when it will be feasible to reduce marginal rates below 50 per cent, by broadening the tax base (e.g. property tax, user charges etc.). 	DoF DoF
2.2	<p>Energy Make concerted efforts to remove additional cost burdens to firms resulting from domestic policy and to enhance competition in the energy market.</p> <ul style="list-style-type: none"> ▪ Continue to raise awareness and to support firms in undertaking initiatives to increase energy efficiencies and reduce use; ▪ In the context of the significant additional costs for consumers arising from the peat PSO, unless there is a clear economic rationale for maintaining them, subsidies for peat generated electricity should be discontinued; ▪ Prior to converting peat plants to biomass, a full cost benefit analysis of the implications for Irish electricity prices and energy security and sustainability should be undertaken; and ▪ As a maturing technology, the price support scheme for onshore wind should be revised so that the price support levels for new onshore wind projects are phased out over time. 	Agencies/ SEAI, Ind Assoc/ Gov Depts DCENR DCENR DCENR
2.3	<p>Waste Prioritise the implementation of the key commitments made in the new waste policy, <i>A Resource Opportunity - Waste Management Policy in Ireland</i>, that will lead to improved competitiveness - in particular there is a need to accelerate progress on:</p> <ul style="list-style-type: none"> ▪ Reducing the number of waste regions from ten to three; ▪ Developing waste plans for the three new waste regions that will provide confidence and facilitate private investment in cost effective recycling and energy recovery infrastructures; ▪ Ensuring that Ireland’s negotiating position at EU level on the new, more ambitious waste targets to be put in place by 2017 is informed by national competitiveness and environmental considerations; and on 	DECLG

⁴⁶ Actions taken in recent budgets include e.g. reductions in social welfare payments (2010), changes to tax credits and tax bands along with the introduction of the USC (2011), entitlement to jobseekers benefit based on a five day rather than six day week where a person is working for part of a week (2012)

	<ul style="list-style-type: none"> Ensuring continued and enhanced efforts by Government departments, agencies, business representative associations and businesses themselves to grow awareness among all SMEs of how best to exploit waste management reduction processes and technologies. <p><i>See also Action area 5 - Lead and Transformational Change</i></p>	Gov Depts / Ind Assoc / Agencies
2.4	<p>Water We need to ensure that moving from the current regime (where water services are provided by 34 local authorities) to Irish Water, leads to greater efficiencies and reduced capital and operational costs as potential economies of scale are exploited and the burden on business is reduced. Key actions required in this area include:</p> <ul style="list-style-type: none"> Prioritise reducing the high leakage levels in urban centres to improve efficiencies and reduce the need for new capital investment; and Develop a water regulatory framework that reduces inefficiencies in the capital and operational costs of water services infrastructure and ensures that water services charges are fully cost reflective and passed on to all customers in a fair and transparent manner. 	DECLG
2.5	<p>Regulation</p> <ul style="list-style-type: none"> Continue to review the decision making processes for environmental and IPPC⁴⁷ licensing, taking account of the need to meet the State's obligations under the relevant EU Directives, with a view to: <ul style="list-style-type: none"> enhancing the process in terms of consistency and time lines; reducing uncertainties in relation to new investments or plant expansions that create jobs; and to reviewing costs of compliance in line with a risk based approach. 	DECLG/ EPA
2.6	<p>Property Related Costs</p> <ul style="list-style-type: none"> Accelerate the revaluation processes for Rates through the introduction of self-assessment or the outsourcing of valuations [the enactment and implementation of the Valuations Bill is critical to expedite the process]. Encourage Local Authorities to continue to exercise restraint in setting commercial rates in 2013 (a reserved function of elected members) and, where possible, to reduce rates. Introduce waivers/50 per cent reduction in Local Authority development levies for a period of 2 years, in the context of the changed economic circumstances, the need to remain 	Valuation Office Local Authorities Local Authorities/DECLG

⁴⁷ Integrated Pollution Prevention Control

	<p>internationally competitive for investment, and the reduced cost of delivery of the required infrastructure for which levies are charged⁴⁸.</p> <ul style="list-style-type: none"> Develop more robust and transparent charging mechanisms that match levies with the economic cost of providing development arising from the new draft guidelines on development contributions. 	Local Authorities
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Retaining a Competitive and Pro-Enterprise Tax Regime

It is important that Ireland continues to strengthen its rankings as a good place to do business, with a particular focus on maintaining its pro-enterprise competitive tax regime. The measures in Budget 2013 for manufacturing and SMEs, and in particular, the reaffirmation of the commitment to a tax regime supportive of investment, is welcome. *Actions 2.1 and 5C.10 are also relevant.*

3	<p>Strategic Action</p> <p>Maintain a pro-business environment with regard to Ireland's tax regime, ensuring that the enterprise perspective remains central to decision making processes.</p>	DoF
3.1	Continue strong coordinated reassertion of Ireland's commitment to maintaining the current 12.5 per cent corporation tax regime and monitoring the competitiveness of Ireland's tax offering.	DoF

Addressing Funding Issues

Irish owned companies cite significant difficulties in accessing finance on reasonable terms - particularly for capital intensive investments and start-ups. Together with relative cost competitiveness, manufacturing CEOs /managers state that these are genuine constraints to the future development of the manufacturing sector in Ireland and to employment creation. For manufacturing, the fact is that capital investment is not a luxury; it is inextricably linked with business development and growth.

Funding sources include bank financing, equity financing options, agency supports which operate under state aid guidelines, and the tax framework. Each of the four funding sources has been affected to some degree by current economic conditions. Actions have been taken in response, including the recently commenced Enterprise Ireland *Development Capital Fund Scheme* which will contribute to alleviating the shortage of risk/growth capital available to more established companies. While initiatives in one area can help to address constraints in another it is a fact that a healthy funding environment for manufacturing will see all four elements playing complementary roles in facilitating the growth and development of manufacturing enterprises.

Industrial restructuring is the on-going process of change in composition of economic activities in terms of sectors and activities and a move toward higher value added output that is sustainable. It

⁴⁸ New Development Contribution Guidelines were published by DECLG in January 2013, available at <http://www.environ.ie/en/Publications/DevelopmentandHousing/Planning/>

presents a particular challenge for Ireland in the current period of high unemployment and fiscal adjustment. Policies and interventions need to be directed toward supporting the attraction of investment in new sectors and activities throughout the country, and in supporting the application of new technologies and new knowledge to enhance the competitiveness and productivity of existing activities. Utilising the full scope for support allowable under EU state aid rules and ensuring that existing initiatives are fit for purpose is important in this context. For example, in relation to the availability of equity, the new Employment and Investment Incentive Scheme (EIS) has potential for enhancement. The use of alternative sources of EU funding is becoming increasingly important in the current constrained environment. There are also enduring issues in relation to bank financing indicating that the required cultural shift in lending practices is not yet complete.

On a different note, some firms have queried the different approaches taken by the agencies when providing supports (whether equity or direct grant aid). The equity approach facilitates cash flow, whereas state held equity would not be a viable proposition for foreign owned subsidiaries. Given the increased mobility of indigenous firms, global competition for investment and the changing economic circumstances, it is timely to review what mechanisms are most appropriate. There are also additional avenues to EU funding that need to be explored further.

4	<p>Strategic Action</p> <p>Ensure that the funding environment is supportive of the needs of the capital intensive manufacturing sector, with all of the elements working effectively, to support the delivery of the step change needed to enhance productivity and innovation.</p>	DJEI/ Agencies
4.1	Develop and implement new <i>Capability Funds</i> for manufacturing to run for a period of 2 years, aimed specifically at supporting capital investment by firms as part of a defined strategic business development initiative to drive increased productivity and competitiveness, consistent with the objectives of the strategy for Manufacturing.	EI/IDA/DJEI
4.2	Ensure that, in the ongoing negotiations with the EU Commission on the state aid modernisation programme, the importance of state support in securing enterprise investment from SMEs and large firms (with a particular emphasis on the needs of manufacturing firms - such as capital investment and technology deepening) is fully reflected to secure the best regime for Ireland and other European regions.	DJEI
4.3	Develop further proposals to make full use of the potential for state support for productive investment under EU state aid rules.	DJEI, Forfás, EI, IDA
4.4	Consider alternative sources of EU funding, building on assessments already undertaken, and maximise the opportunities under EU programmes (including, for example the upcoming Competitiveness of Enterprise and SMEs (COSME) 2014-2020 and Key Enabling Technologies (KETs)).	DJEI, Forfás, EI, IDA

4.5	To provide certainty and enhance the potential of the Employment and Investment Incentive Scheme (EIS) to encourage investment in Irish manufacturing: <ul style="list-style-type: none"> ▪ Extend the EIS scheme to 2020 as outlined in Budget 2013, with early application to the EU Commission to enable approval before the end of Q2, 2013; ▪ Fully exclude the EIS relief from the high income earner restriction; and ▪ Seek an expansion of the EU guidelines in the current EU negotiations so that all medium sized companies, including those in non-assisted areas, can qualify for investment under the EIS scheme. 	DoF, DJEI
4.6	Continue to work with the banking sector to assist them in a cultural shift in lending practices, and ensuring that relevant lending personnel are sufficiently equipped with an understanding of the strategic business development objectives of manufacturing operations and range of lending options in order to make informed lending decisions.	EI/ CRO
4.7	Undertake an analysis of the rationale for the different approaches taken to support indigenous and foreign owned firms and consider what models are most appropriate in the current economic climate (taking into account approaches taken in other EU member states and state aid guidelines).	Forfás, DJEI, EI, IDA

A National Step Change Initiative - Strengthening Ireland's Manufacturing

In light of the disruptive changes underway in manufacturing, a concerted effort is needed to realise the step change required to position Ireland's manufacturing sector for growth. We need to develop and deliver a *National Step Change Initiative*. The proposed initiative builds on a number of interventions already in place to provide a coordinated and cohesive approach across all relevant actors. Actions will be required both at the level of the firm and in terms of enhancing the business environment across four main pillars:

- **Productivity:** driving Lean principles, energy efficiencies and sustainable practices throughout the operation, and adopting technologies new to the firm (including ICTs) and engaging with employees through change processes;
- **Innovation:** enhancing level of engagement and capabilities in R&D and innovation in product, process, business models and organisational change;
- **International marketing and selling capabilities:** building stronger connections with customers and expanding market reach; and
- **Collaborating to compete** more effectively on international markets.

The initiative (and elements of it) will resonate differently for different firms. For example, for firms that are seeking new market opportunities (e.g sub-supply for the Medical Devices market) - advisory services and supports for accreditation will be directly relevant; for some it may be about obtaining supports and/or funding for investment in capital equipment and automation to enhance productivity; and for others supports such as the Innovation Vouchers will assist in stimulating early engagement in R&D. Firms should be facilitated to engage in the way that is most relevant and appropriate to their stage of development. As well as the enterprise development agencies, others have a role to play in helping to deliver on a *National Step Change Initiative*, whether by

way of providing direct assistance or in terms of enhancing the business environment - including for example, banks, fund managers, training providers, standards bodies and utilities providers.

It will require time and commitment by firms themselves and an ambition to deliver more than might otherwise be achieved without support.

Actions are set out across each of the four pillars (designated A to D), and involve actions at the level of the firm and at the level of the business environment.

5	<p>Strategic Action : Overarching</p> <p>Deliver a <i>National Step Change Initiative</i> to strengthen Ireland’s manufacturing base, focused on capability building and enabling companies to: drive enhanced productivity and competitiveness; to internationalise; to deepen engagement in innovation and to collaborate to compete. <i>Specific actions are set out across 4 key pillars.</i></p>	<p>DJEI / IDA/EI through the existing Cross Agency Senior Mgt Team</p>
5.1	<p>Raise awareness of the imperative to engage in a National Step Change Initiative and of the commitment required by managers and employees in the first instance to realise significant benefits to deliver profitable sales, exports and jobs.</p>	<p>DJEI/ MDF, Agencies/ Ind Assoc & Union Reps</p>

Pillar A: Enhancing Productivity & Competitiveness - Lean, Green and ICTs

The nature and extent of change will be specific to a company’s scale and stage of development - in some instances it will be about companies identifying and adopting technologies that are new to them, in others it will be at the leading edge of the *Factory of the Future* spectrum. Technologies encompass those used in the production process (including analytics, simulation, modelling, Lean techniques, CNC⁴⁹, Computer Integrated Manufacturing etc.) as well as Information and Communications Technologies (Tracking & Tracing, Customer Relationship Management, Open Innovation, etc). In many instances it will require considerable capital investment, restructuring and training to realise full potential.

Over the past number of years, Enterprise Ireland introduced supports for companies through its Lean Business Offer and IDA Ireland works with its client base on a transformational change agenda. Often these initiatives are interpreted as (only) being about ‘cutting costs’ or ‘eliminating waste’. However an enhanced understanding is developing of the pervasive nature and end-to-end business implications of these initiatives that require change management expertise to harness peoples’ commitment, attitude and capabilities.

Transformation is ultimately about changing a way of working - about developing competences, problem solving skills and innovative capacities and about delivering on the responsiveness and flexibility needed to deliver increased sales in a highly competitive global market. Leadership and change management capabilities are critical in this regard.

⁴⁹ Machine tools that use programs to automatically execute machining operations - CNC (computer numerical control) machines offer increased productivity, flexibility, consistency and reliability

During consultations a number of foreign owned firms expressed a desire to engage in the structured Lean Business Offer that is delivered by Enterprise Ireland and highlighted that this initiative is not currently available in IDA Ireland.

Through their ManagementWorks initiative, Skillnets offers a number of programmes to SMEs. Initial engagements with firms tend to be in the area of strategy and actions which can be taken to improve their current performance. Of particular interest is the potential to encourage some firms to participate in Lean style programmes as drivers of continuous change and improvement.

From a national perspective, building a more comprehensive data set through a benchmarking process would allow for an increased evidence based understanding of the qualitative capabilities of firms⁵⁰. Such a database would facilitate the delineation of cohorts of firms, monitoring progress and the evaluation of the effectiveness of a more tailored suite of interventions.

5 A	<p>Strategic Action National Step Change Initiative: Pillar A</p> <p>Build on existing Lean and Transformational change initiatives to deliver a single <i>National Initiative</i> to drive enhanced productivity and change, by facilitating access to a <i>common suite</i> of advisory services, benchmarking tools, peer networks and in-firm training to companies (regardless of ownership).</p>	IDA/EI Cross Agency Senior Mgt Team
5A.1	<p>Develop and make available a <i>national</i> benchmarking tool that:</p> <ul style="list-style-type: none"> ▪ Enables companies to measure performance against international norms (sector specific) and which can be accessed in a way that is appropriate to a company's needs and stage of development ranging from on-line diagnostic self-help tools to facilitate data gathering and workshops; and ▪ Builds a comprehensive dataset over time which will facilitate aggregated qualitative analysis, monitoring of progress at a programme level and the development of more tailored and customised suite of interventions. 	EI/IDA/DJEI
5A.2	<p>Review and enhance, as required, the existing Enterprise Ireland Lean Business Programme to deliver to the needs of foreign owned firms, as appropriate, taking into account aspects that may be particular to a foreign subsidiary operating as part of a global corporation.</p>	DJEI/EI/IDA
5A.3	<p>Continue to build and enhance Enterprise Ireland's 'approved' panel of change management specialists and mentors with expertise of dealing with companies across a broad spectrum of capability, sector, scale, ownership and international reach⁵¹.</p>	EI

⁵⁰ A database PROBE is utilised by Enterprise Ireland in its Lean Initiative that facilitates benchmarking against international norms/sectors etc. Although data held relates to indigenous firms only, and to those that have undertaken benchmarking as part of a Lean process, it does capture circa 1,000 benchmarks and could form the basis for the development of the national dataset proposed. It is not, however, a longitudinal dataset

⁵¹ Currently available on Enterprise Ireland's website and includes some international consultancies. This may need to be expanded further to support the proposed cross agency National Step Change Initiative

5A.4	Facilitate peer-to-peer learning across companies, sectors and ownership through a semi-structured model of site visits, case study dissemination and on-line fora (e.g. via LinkedIn).	Ind Assoc & Employee Rep Groups MDF/Agencies
5A.5	Continue to promote the Becoming Lean initiative and Lean training programme introduced in 2012 by Skillnets that would cater to the needs of micro and small manufacturing firms. The newly formed LEOs should be equipped to provide signposting/referrals of the programme to potential client companies.	Skillnets CEB/LEOs
5A.6	Building on existing initiatives employee representative groups should continue to engage with their members to raise awareness of the challenges facing the sector, of its potential, and of the need for adaptability and flexibility. They should encourage high levels of employee participation in opportunities for continuous learning and contributing to a <i>workplace of the future</i> that will provide sustainable and rewarding employment. Effective participation also requires collaborative engagement by management.	Ideas Institute Employee Representative Groups
5A.7	Continue to deliver the Leadership4Growth and management development programmes, and facilitate leaders of Irish based foreign multinationals who would benefit ⁵² modifying the content (only if necessary) to their needs and also in the context of the <i>workplace of the future</i> .	EI/IDA

Pillar B: Strengthening International Reach - Connecting to the Customer

Ireland's Foreign Trade Council continues to focus on strengthening Ireland's economic links and on building the capabilities of firms to target a greater number of international markets⁵³. Building international trade relations requires continued focused and coordinated efforts to identify and address barriers.

At the firm level, Irish based firms are engaging more directly in marketing and sales, in connecting into and/or managing global supplier networks. The sales cycle for more customised and solutions based products is longer than a 'price for standardised product' which requires strong cash flow management, commitment and confidence. The connection to the customer has become increasingly important for all firms - even those multinational firms that may not have direct responsibility for sales but are involved in RD&I need to find ways to tap into market intelligence, customer trends and preferences.

Ireland's capabilities in international sales, in understanding markets and cultures, in connecting to the customer and in developing stronger internal feed-back loops to inform new product and/or services development as well as strategic partnership management need to be further enhanced.

⁵² The L4G programme may be of particular benefit, for example, to smaller scale subsidiaries based here

⁵³ Trading and Investing in a Smart Economy, DJEI, 2010 sets out the actions required to enhance Ireland's exports and trade

5B	<p>Strategic Action National Step Change Initiative: Pillar B</p> <p>Support firms to expand into international markets and deepen customer connections through targeted skills development, peer learning and collaboration; enabled by continued focus on developing strategic trade relations; and coordinated in-market support.</p>	<p>ExportTrade Council Agencies</p>
5B.1	<p>Enhance sales skills and capabilities to address more complex solutions based selling, Customer Relationship Management and Partnership Management - capabilities which would serve to expand into international markets and global supply networks⁵⁴.</p> <p>Include aspects relating to cultural awareness and knowledge of market specific regulations and requirements.</p>	<p>Private Sector providers / HEIs / EI</p>
5B.2	<p>Establish a Peer Learning Group on International Selling that could serve to encourage exporting firms to initiate a step change to broaden their market reach to new territories.</p>	<p>EI</p>
5B.3	<p>Encourage and facilitate manufacturing companies to <i>collaborate to compete</i> - to work together to bring complementary products, services and/or capabilities together to address market opportunities that could not be served by one company and/or to take advantage of a manu-services model.</p> <p><i>Building on Enterprise Ireland's recently launched clustering initiative (October 2012).</i></p>	<p>EI/IDA</p>
5B.4	<p>Develop new (and restore) direct air links with key existing markets (e.g. US West Coast) and high growth markets and maintain air links with key European markets.</p>	<p>DAA/DoT</p>
5B.5	<p>Align the Foreign Earnings Deduction with Ireland's Trade, Tourism & Investment Strategy, recent trade missions and the enterprise development agencies' strategic markets, by including all of the following countries: the Kingdom of Saudi Arabia, the United Arab Emirates and Qatar in the Middle East; and South Korea, Japan, Singapore and Malaysia in Asia.</p>	<p>DoF</p>

Pillar C: Strengthening Innovative Capabilities

For companies to be successful on international markets it is essential that they continuously innovate to meet the changing needs of existing customers, and to develop new products and solutions to respond to unmet demand, to capture new markets and customers. The significant change underway in manufacturing has placed an increased emphasis on the importance of process R&D and, at a minimum, of technology adoption.

From a manufacturing perspective, although BERD has increased over recent years in terms of amounts spend on R&D, the number of firms has remained relatively static. The engineering cohort

⁵⁴ See also Key Skills for Enterprise to Trade Internationally, EGFSN, June 2012

appears to be less engaged in RD&I than other sectors and underrepresented in terms of overall State investment in RD&I. The agencies have worked with industry representatives to define the research agenda for Medical Devices, ICT, Food, Pharma/Biopharma, or are in the process of doing so, to inform HEI industry-led R&D through Technology Centres. There has been minimal engagement in defining the research needs of engineering firms including those that serve the industrial products markets (e.g. Agricultural Machinery, Equipment, Automotive, Aeronautics and Construction) and those engaged in Print & Packaging.

Despite significant investments by the State in developing Ireland’s research infrastructures and capabilities, there is also a perception that investments have not been directed sufficiently toward manufacturing. It is also difficult for companies to navigate their way to the most appropriate resource. It has also been more challenging for SMEs to engage in the existing Technology Centres that are relevant to manufacturing, although some new initiatives introduced by i2E2 (Energy Research Centre) and ICMR (Irish Centre for Manufacturing Research) could point the way for others to emulate. Enterprise Ireland’s Gateways Programme (that replaces the Applied Research Enhancement Centres) should also serve as a point of entry for SMEs in particular to the available research capabilities in HEIs.

It is important too, that Ireland’s IP regime remains competitive and attractive in the international context. Developments of international regimes regarding the treatment of IP and intangible assets need to be monitored on a continuous basis.

Where relevant, the actions align with the work of the Research Prioritisation Action Group (for manufacturing) that was established to progress the implementation of the *Report of the Research Prioritisation Steering Group*.

5C	Strategic Action National Step Change Initiative: Pillar C Reorient State Investments toward enhancing Ireland’s RD&I capacity in Manufacturing, targeted toward specified industry needs (including an emphasis on mechanical and other engineering disciplines relevant to manufacturing) and increase firm level engagement in RD&I.	Agencies/ Research Institutes Gov Depts
5C.1	Undertake a concerted effort to encourage more manufacturing companies to engage in RD&I (with a particular focus on the cohorts with relatively lower take-up to date) ⁵⁵ , building on existing work to raise awareness of initiatives and applicability to firms at different stages of capability and to encourage collaborative approaches (e.g. pooling innovation vouchers).	IDA/EI
5C.2	Facilitate technology adoption by firms that is ‘new to them’, including micro firms, as part of structural upgrading of the manufacturing base.	EI/CEBs/LEOs

⁵⁵ And utilising existing instruments/incentives to the maximum possible to effect the change needed (e.g. IDA R&D Fund, and EI R&D Fund etc.)

5C.3	Establish a Strategic Technology Officer Group to assist companies with the potential to scale to address growth inhibitors through peer learning.	EI
5C.4	Stimulate increased engagement and reduce barriers to engagement by SMEs in collaborating in state funded Technology Centres, by tailoring input, costs and opportunity to suit size and ambition of the firm. The recently introduced model by ICMR and i2E2 should be considered by other Technology Centres ⁵⁶ .	Tech Centres EI/IDA
5C.5	Complete the ongoing audit of State funded equipment in HEI research facilities and assess the potential to provide access to firms on a pay-for-use basis to undertake pre-production trial and test, particularly where equipment may be underutilised.	HEA
5C.6	Raise awareness amongst manufacturing firms of the importance and value of innovation in services (particularly in the context of manu-services), including behavioural analysis, real time analytics and monetisation models.	EI/IDA
5C.7	R&D Infrastructures and Collaboration: Engage with manufacturing firms, particularly within sectors that have been relatively underrepresented to date (such as engineering) to determine and define specific needs at a research programme level (spanning through from basic, to applied to experimental development). <ul style="list-style-type: none"> ▪ Draw on existing capabilities/resources and initiatives to deliver to industry specified needs and increase collaboration between HEIs and industry; and ▪ Establish strategic collaborations with international research institutes and Research Technology Organisations (RTOs)⁵⁷. 	IDA/EI/SFI/ DAFM
5C.8	Following on from action 5C.7 above if an infrastructure deficit has been identified in <i>applied research/experimental development</i> (for testing, prototyping etc.) carry out a feasibility study to assess the potential for establishing a Research Technology Organisation in Ireland.	DJEI (TI) ⁵⁸
5C.9	Develop a consolidated marketing brand and message for the various Research, Technology Centres and Principal Investigators to facilitate easier access by industry to relevant knowledge & expertise and to strengthen Ireland's R&D message overseas in terms of critical mass.	DJEI (TI)
5C.10	Retain and enhance the potential of the R&D tax credit for enterprise as part of the review of the R&D tax credit which was announced in Budget 2013.	DOF/DJEI/Forfás

⁵⁶ The ICMR, i2E2 have introduced a three tier model to stimulate interaction at different levels, including: Board level (significant input and access across the entire Centre); partner level (input and outputs based on specific projects); and subscriber level (basic access level, a first step). See *Technology Innovation for Irish Manufacturing and Energy Competitiveness, Issue 1*, October 2012

⁵⁷ Including, for example the Fraunhofer Institute - which should also inform action 5C.8

⁵⁸ Technology Ireland

Pillar D: Strengthening Connections and Collaboration

5D	<p>Strategic Action National Step Change Initiative: Pillar D</p> <p>Strengthen effective collaboration to deliver enhanced growth and job creation, by stimulating sub-supply connections, facilitating companies to collaborate to compete and by developing further cross sectoral / cross ownership connections.</p>	EI/IDA/SFI / Ind Assoc
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The following sections look at sub-supply connections; followed by cross sectoral collaboration.

Strengthening the Sub-supply Connections - Building the Eco-system for Manufacturing

The connections between foreign subsidiaries based here and Irish firms have weakened in terms of sub-supply over the past decade. While acknowledging that much is now about engaging in *global* supply networks where procurement decisions are made outside of Ireland, there is potential to strengthen linkages and to strengthen the supplier eco-system for Manufacturing in Ireland to address identified gaps currently and as the manufacturing sector evolves. Procurement includes goods, services and licensing of technologies and IP. Enterprise Ireland and IDA Ireland have recently launched a Global Sourcing Strategy⁵⁹ to help strengthen business connections between foreign MNCs and Irish firms.

The agencies will continue to work with indigenous firms - to build up their knowledge, intelligence and understanding of the MNC procurement process and to facilitate peer to peer coaching/learning from companies that are successfully engaging with the foreign multi-national subsidiary. Relevant indigenous firms should continue to be included in FDI itineraries where appropriate, aligned with the systematic approach being taken to broker introductions between MNCs based here and potential suppliers.

For some indigenous firms, there is a basic requirement to acquire accreditation relevant to specific sectors to enable them to reposition their own strategies and target market. The analysis undertaken by the agencies should also lead to greater understanding of gaps in Ireland's market place that could be filled either by attracting FDI and/or stimulating start-ups to address a market need.

Both the foreign subsidiaries and Irish firms would realise benefits which would also result in economic return for Ireland. For foreign subsidiaries it would reduce the risks and hidden costs in longer supply chains, result in closer supplier partnerships and further embed their activities in Ireland. For indigenous supplier companies it would introduce a new customer base, strengthen their capabilities in selling, product development and customer relationship management and equip them to expand into overseas markets.

Much of the analysis undertaken by the agencies in developing the sourcing initiative will also serve to identify existing and/or emerging gaps in Ireland's eco-system to support manufacturing firms and future investment.

⁵⁹ Delivering on Actions 5.11 and 3.3 in the Action Plan for Jobs 2012 that requires that Enterprise Ireland and IDA Ireland establish a senior management team to deliver on key priorities such as maximising procurement opportunities for Irish business with MNCs. <http://www.djei.ie/press/2012/20121130.htm>

	<i>Connections and Collaboration</i>	
	Strengthening the eco-system for Manufacturing	
5D.1	Continue to drive implementation of the actions set out in the Global Sourcing initiative to raise awareness of what is available on the Irish market and to optimise the proportion of goods and services procured by MNCs from Irish sources.	IDA/EI
5D.2	Support the work of the enterprise development agencies and help to raise awareness and signpost companies to advisory supports and services for accreditation, raise awareness with regard to the importance of Standards and sector specific needs and facilitate firms' engagement (as appropriate) on International Standards Development Groups	NSAI
5D.3	Continue to engage in a targeted approach to fill existing or emerging gaps in Ireland's eco-system for manufacturing to include: <ul style="list-style-type: none"> ▪ Targeting investments from mid-tier and/or early stage foreign owned companies (e.g. engineering service houses, equipment providers, and sector specific contract manufacturers); ▪ Fostering start-ups that aim to address identified gaps and that have the potential to export over time; and ▪ Assisting existing Irish firms to re-orient their strategies building on existing competences to serve market needs. 	IDA/EI
5D.4	Promote and facilitate industry-led initiatives such as FUSE, and identify ways in which such initiatives could be replicated without over-engineering them or losing the 'ground-up' commitment.	

Strengthening Cross Sectoral Collaboration to Realise New Opportunities

Although there are many opportunities arising as a result of changes within sectors, it is increasingly apparent that as manufacturing evolves new opportunities present themselves at the blurring of the edges of existing sectors. Some progress has been made in relation to combination products in particular and areas of adjacent possibilities - although such examples are not necessarily well known.

If Ireland is to realise future opportunities, a more proactive role should be taken in breaking down existing silos and in facilitating cross sectoral engagement. This requires a different approach to be taken by government departments, agencies and companies. It necessitates a strong cluster development approach (both within and across sectors), distinguishing between geographic colocation and genuine clustering activities that deliver synergies and higher growth potential than might otherwise be realised.

For manufacturing activities there are aspects of the business and challenges that are common to all - regardless of sector or ownership. This includes aspects such as enhancing energy efficiencies, Product Lifecycle Management and adopting Lean principles all of which provide an excellent 'safe space' in which companies can share experiences and exchange information and knowledge. The Leadership for Growth initiative has also stimulated peer networks that have continued on since

individuals engaged in the programme. These opportunities and networks should continue to be identified and stimulated.

Initiatives such as Ideagen could be broadened to cater to established firms, bringing individuals together from across different sectors and disciplines. The existing Ideagen initiative (launched 2009) targets entrepreneurs, innovators and researchers in the higher education sector. It involves facilitated three hour networking and information sessions. They are organised on a regional basis, focused on a specific sector, and serve to share knowledge on sectoral trends and research activities and to generate innovative ideas.

	<i>Connections and Collaboration</i> Embed a more structured cross agency and cross sectoral collaborative approach to stimulate the potential for identifying and realising 'new' areas of opportunity at an early stage.	
5D.5	Establish focused working groups <i>across</i> the agencies and across existing sectoral departments that would strengthen knowledge sharing and solidify the opportunities in new convergent areas. A more structured process would allow for new areas to be identified at an early stage. It would also help to identify the specific actions needed to remove barriers and/or to support cross sectoral opportunities in areas such as regulation, IP and skills [e.g. green, nutraceuticals, combination products] .	EI/IDA/SFI
5D.6	Develop and disseminate a series of case studies to demonstrate Adjacent Possibilities and Convergence, detailing challenges and how they were overcome.	EI/IDA/SFI
5D.7	Launch an <i>Ideagen Adjacent Possibilities</i> initiative to target established companies from different sectors to stimulate new and cross 'boundary' thinking.	EI/IDA

Strengthening Ireland's Own - A Focus on Indigenous Potential

Start-ups provide the feedstock for future exports and employment. They can be the means by which new and emerging sectors and activities take root in Ireland. Start-ups have a key role to play in creative destruction⁶⁰. They increase levels of innovation in the market place, increase productivity and improve competitiveness. Manufacturing start-ups face greater challenges than their counterparts engaged in services, not least because of the capital intensity of the business, the complexity of the production process and supply chain. Start-ups face challenges in prototyping, material selection and the economics of manufacturing as well as a broader range of regulations that apply to manufacturing (including e.g. IPPC licenses).

⁶⁰ Joseph Schumpeter, *Capitalism, Socialism and Democracy* "a process of industrial mutation that incessantly revolutionises the economic structure from within, incessantly destroying the old one, incessantly creating a new one"

There are a number of strong Irish owned firms operating on international markets and Enterprise Ireland continues to stimulate more companies to export and to build scale and capabilities. However Ireland does not appear to take the same pride in its SMEs that is evident in other countries such as Germany's Mittelstand. Much of the analysis of indigenous firms is based on data that reflects economic activity *in* the State. While this is a valid perspective to take in terms of documenting the return to the State from its investment in supporting enterprises, it falls short in terms of telling the full story of the extent of internationalised activities and the success of Irish companies.

The actions above relating to addressing the negative perception of manufacturing, of promoting career path potential, of cost competitiveness, and enabling access to State-funded equipment for pre-production, trial and test are all relevant to start-ups. In addition, further action can be taken to reduce barriers to entry.

6	Strategic Action Nurture, strengthen and develop Irish owned manufacturing firms, creating a dynamic in start-ups, scaling and in taking pride in achievements to capture opportunities and generate jobs.	Agencies/ CEBs(LEOs) / DoF/CSO
6.1	Introduce a targeted <i>Start Fund</i> for indigenous manufacturing start-ups modelled on the existing Enterprise Ireland Competitive Start Fund which would facilitate feasibility, prototype development and market testing.	EI
6.2	Assess the feasibility of establishing a facility that provides access to entrepreneurs and early stage start-ups to equipment and expertise to facilitate proto-type development of new products/solutions. Consideration should be given to the possibility of private sector provision, and/or equipment being donated by vendors as part of the solution.	EI
6.3	Raise awareness of the contract manufacturing services that are currently available in Ireland, and of the potential of 3D printing (additive manufacturing) as a low cost option for prototyping and home based production at the initial consultation stage with start-ups and through Start Your Own Business courses etc.	EI/IDA
6.4	Develop and promote additional modules catering to the particular needs of manufacturing firms as part of the Start Your Own Business programme, and using manufacturing champions as guest speakers to demonstrate real life examples of overcoming hurdles.	CEBs/LEOs
6.5	To remove a barrier to entrepreneurship, introduce an additional voluntary opt-in PRSI contribution to enable the self-employed (Class S) to qualify for the full range of benefits, including Jobs Seekers Benefit, which is not means-tested.	DoF

6.6	Ascertain the benefits arising to the state from Outward Direct Investment and the extent of activities in overseas markets (sales, employment etc), in order to better inform policy and to enhance the 'Irish story' ⁶¹ . Identify the additional metrics required (if any) for collection by CSO and the agencies.	Forfás/CSO
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Developing Ireland’s People for Manufacturing - Making the Difference

People make the difference. It is people who solve problems, who come up with creative ideas, who share learnings, who close the sale, who build relationships. A highly effective workforce is one of the most difficult to replicate - and an area in which Ireland could genuinely differentiate its manufacturing offering. An effective workforce is one that includes well educated and skilled individuals, bringing a can do attitude to bear in the workplace, and who can work effectively as part of a multi-disciplinary and multi-cultural team. Important too, are effective industry leaders, those with vision, ambition and who lead in a way that is inclusive.

Education and training are fundamental building blocks to ensuring that individuals have the technical skills and competencies to address the current and future needs of manufacturing firms. Actions required include: the need to establish a clear career path framework, to address specific skills gaps, to ensure course content is aligned with today’s and future manufacturing needs, and to strengthen capabilities in innovation, design and new product introduction. The manufacturing sector would benefit greatly from a more structured dialogue between industry and education providers, particularly in relation to skills issues such as project-based work placements, curriculum design and upskilling employees to Masters and PhD levels.

For more in-depth analysis and broader suite of actions refer to the *Future Skills Requirements of the Manufacturing Sector* (EGFSN) published to complement this strategy. This complementary skills report has assessed the future occupational profiles and skills needs of the sector based on the employment scenarios set out here in Chapter 5. A number of the key actions are highlighted below. The Actions above relating to promoting manufacturing as career (1.4), international selling (5B.1), Leadership for Growth (5A.7) and workplace of the future (5A.6) are also relevant.

	Strategic Action	
7	Drive implementation of the manufacturing skills study in a timely manner, to reenergise interest in manufacturing as a career, to address skills gaps, to ensure course content is aligned with manufacturing industry needs and to enhance capabilities in design and new product introduction.	
7.1	Review and set out career paths in manufacturing, engaging industry, employee representatives and relevant providers of education and training and the qualifications bodies including industry representative bodies, SOLAS, Skillnets and Higher Education representatives.	MDF/Industry /Employee Reps/ Educ & training providers

⁶¹ Building on previous analysis undertaken by Forfás : Statement on Outward Direct Investment, 2007

7.2	<p>Use the accelerated apprenticeship scheme to augment the number of apprentices qualifying as toolmakers every year. FÁS (and subsequently SOLAS) should endeavour to ensure that at least 55-60 apprentices qualify as toolmakers each year over the period to 2016.</p> <p>Update the toolmaking apprenticeship syllabus to reflect recent advances in manufacturing materials and processes.</p> <p>Assess the potential for increasing the supply of polymer technicians, including pooling resources for the associated equipment requirements. Providers should also investigate the possibility of funding equipment costs through leasing arrangements or sponsorship by clusters of companies or equipment manufacturers.</p>	<p>FÁS/SOLAS</p> <p>IOTs/Skillnets/ Plastics Ireland/ IMDA</p>
7.3	<p>Examine the potential for formal learning opportunities for machinists, particularly for CNC machining and programming, including the potential for the development of a Machinist Traineeship or Apprenticeship</p>	<p>FÁS/SOLAS</p>
7.4	<p>Target mechanical engineering Level 8 programmes within the next Springboard call with a particular focus on automation, development and design and strongly emphasise enterprise collaboration and work placements.</p> <p>Review course content in mechanical engineering and other engineering disciplines relevant to manufacturing to include a practical grounding in the process improvement techniques currently in use in industry, including Lean and Six Sigma, modules in polymer science & engineering, data analytics and substantial work placement periods.</p>	<p>HEA, HEIs,</p> <p>HEA, HEIs, Engineers Ire</p>
7.5	<p>Identify ways in which a structured work placement programme could operate more effectively to deliver to the needs of the graduate/ under-graduate <i>and</i> to the firm, taking into account the resource commitment required by SMEs in particular.</p>	<p>MDF, Industry Assocs HEIs</p>
7.6	<p>Address the current small scale but critical shortages in Validation engineering, Quality engineering, Polymer engineering, Automation engineering and Supply chain engineering (primarily at NFO level 9) through upskilling employees and the unemployed (Springboard) in partnership with industry.</p> <p>Focus on Manufacturing SMEs in future Irish Research Council calls for the Employment-Based Postgraduate Programme and Enterprise Partnership Scheme. Enterprise Ireland should seek to promote engagement by client companies within these programmes.</p>	<p>HEA, Skillnets, Trade Assocs</p> <p>Irish Research Council, HEA, EI</p>

Infrastructures

The availability of suitable property at the right price and in the right place has long been an essential contributory factor in Ireland's success in attracting FDI. In terms of Gateway locations, ability to deliver property solutions to cater for the next wave of investment in advanced manufacturing (including e.g. Pharma/Bio-Pharma) will also be a requirement in the medium term.

Continued and prioritised investment is needed to ensure that Ireland's infrastructure remain world class and facilitate the efficient movement of people and both physical and electronic products. What is not necessarily readily understood, is that ICTs are increasingly critical for manufacturing firms, many of which are globally connected with suppliers, partners, researchers and customers and operate with increased volumes of real time rich data and graphics. *Note some infrastructure actions have been set out within the Cost section because of the direct implications for costs.*

8	Strategic Action Prioritise investment in infrastructures necessary to support manufacturing firms operating in a connected global environment - enabling the efficient movement of people and goods (physical and electronic).	
8.1	Industrial Property Ensure that appropriate financing mechanisms are available so that the building requirements associated with anticipated FDI investments are adequately catered for in Gateway locations, particularly in relation to attracting the next wave of manufacturing investment.	DJEI/IDA
8.2	Advanced Broadband Local Authorities should work with private sector and semi-states to accelerate roll-out where possible. It is critical that the State investments committed to for post August 2014 in the new national broadband strategy for Ireland (€175 million) are delivered according to the timelines set out and that opportunities to bring forward investment should be explored ⁶² .	DCENR
8.3	Transport Infrastructures While capital resources are limited, it is critical that investment in physical infrastructures and routes to international markets that support economic recovery and the activities of manufacturing firms (roads, ports) are prioritised (See Appendix VI).	DoT

⁶² Delivering a Connected Society - A National Broadband Strategy for Ireland, Department of Communications, Energy and Natural Resources, August 2012

1 Introduction

Background and Objectives

Manufacturing plays a crucial contributing role to any economy. Manufacturing is a driver of innovation and technological advance, provides employment across a broad range of skills levels, and generates additional indirect jobs throughout the economy.

Manufacturing is central to the need for Ireland's economic growth to be based on a more sustainable model of export led growth. Manufacturing contributes significantly to Ireland's exports and has proven to be relatively resilient throughout the current economic downturn. On the other hand, the continuing decline in employment is a cause for concern, particularly in light of the high unemployment levels currently experienced in Ireland.

There are strong industry views that more can be achieved with an increased policy focus on manufacturing. The Action Plan for Jobs 2012 (APJ 2012) places this renewed focus on manufacturing. This longer term strategy has been developed in response to the Action to: *Develop a long term vision for the manufacturing sector and put in place a strategic plan that will help to realise this vision*⁶³.

The Terms of Reference for the study set out the objective to:

Determine what (new) policy actions are needed to support a competitive manufacturing sector in Ireland over the period to 2020 in the context of global trends and the ongoing transformation of the sector, and the issues facing manufacturing in Ireland today.

Purpose of this Strategy

This strategy looks at how manufacturing in Ireland can best compete in the context of the disruptive changes underway globally that have significant implications for the manufacturing sector.

It sets out a vision for what manufacturing can be in Ireland by 2020, and identifies a range of opportunities at a sectoral level and in terms of functions, activities and capabilities. It sets out actions that are needed to nurture and further develop existing strengths and to address constraints to investment and growth. Coordinated and cohesive action is required by all players: government; the enterprise development agencies; the education and research system; by industry associations and by firms.

Structure of the Report

Chapter 2 sets out the key drivers of change globally, followed by the implications for manufacturing firms in Chapter 3. Chapter 4 provides an overview and analysis of manufacturing in Ireland today, looking at key metrics including employment, exports, productivity and investment in RD&I. In the context of global trends, and taking into account Ireland's manufacturing activities, a vision is developed for the sector to 2020 in Chapter 5 and specific areas of

⁶³ Under action 7.1.3 a specific step required that Enterprise Ireland identify barriers to start-ups undertaking manufacturing in Ireland and identify what actions are needed to address them. This action has been incorporated into the overall Manufacturing Strategy - See Chapter 6

opportunity outlined. We put the spotlight on indigenous companies in Chapter 6, focused primarily on the challenges facing start-ups in a capital intensive business.

An overview of the current eco-system and support environment is set out in Chapter 7, followed by a brief synopsis in Chapter 8 that pulls all of the preceding analysis together to document Ireland's strengths and areas that need to be addressed. The final chapter sets out what needs to be done to realise the potential for manufacturing in Ireland.

A Definition for Manufacturing

The broad definition set out in The Report of the High Level Group on Manufacturing (2008) remains valid today. It defined manufacturing as: encompassing a broad range of activities from research and development through design, production, logistics and distribution, to marketing and after sales services (Figure 2).

The definition recognises that activities across the supply chain may be located in different countries and undertaken by different companies across the world, where it makes most strategic or economic sense.

This strategy emphasises the importance of retaining a focus on production - *the making of things* - at the core within the context of the entire supply chain (national and global).

Figure 2 An Extended Definition of Manufacturing



Source: Defining High Value Manufacturing (IFM, DTI, CBI), 2006 : reflected in The Report of the High Level Group on Manufacturing 2008

2 Global Drivers of Change

Introduction

By 2020 manufacturing will be different from what it is today. Some commentators suggest that manufacturing is 'dying' - particularly in developed economies. The reality is that manufacturing is *changing* and as it becomes more complex, a very different set of capabilities will be required - capabilities that bring developed economies very much back into play in terms of investment in manufacturing activities.

This chapter sets out the global drivers of change, and paints a picture of how manufacturing is likely to evolve. We take a global perspective - a perspective which is essential given that Ireland's manufacturing firms operate in a global context.

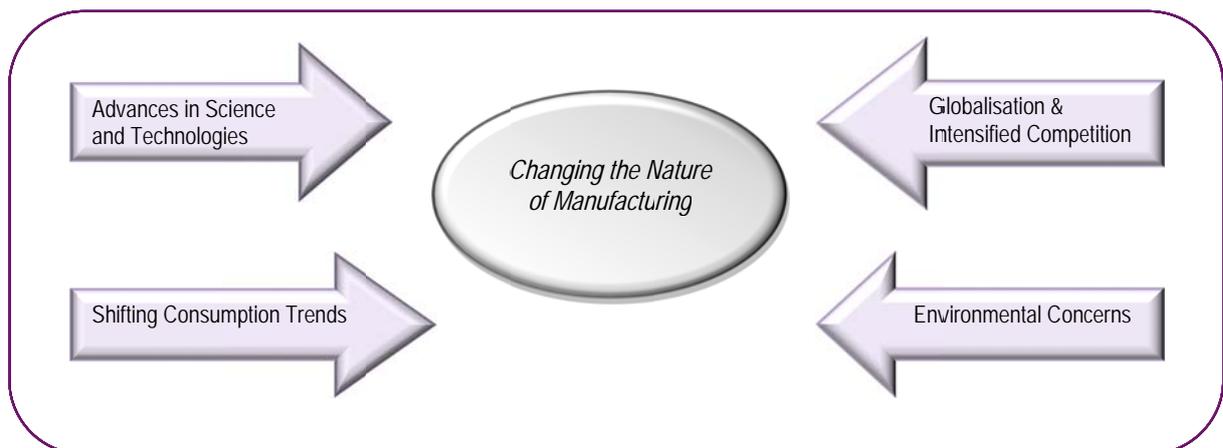
Global Trends in Manufacturing

There are four high impact global drivers that will fundamentally change the way of doing business for manufacturers over the coming years:

- The Dynamics of Globalisation and Intensified Competition;
- Shifting Consumption Trends;
- Environmental Concerns; and
- Advances in Science and Technologies.

We consider each of these global drivers from the perspective of manufacturing, and then set out what the *Factory of the Future* might look like by 2020.

Figure 3 Global Drivers of Change



The Dynamics of Globalisation and Intensified Competition

Globalisation is not a new phenomenon - however, the pace of change continues to accelerate. For some time now, different manufacturing functions have been located across the world as companies seek lower cost inputs or new markets. Companies focus their efforts on their core competences as they operate an out-source or off-shore model for non-core activities. International production, trade and investments are increasingly organised within global value chains (GVCs).

Countries compete to win foreign direct investment (FDI). Manufacturing related FDI flows accounted for 47 per cent of Global FDI flows in 2011⁶⁴, although in general the size of FDI projects (in terms of capital investment and employment) is shrinking. Competition for FDI has intensified and there are indications that the future will no longer be a 'simple' case of low cost versus knowledge and skills. Ireland has a well renowned track record in attracting FDI, and demonstrates an ability to keep pace with the changing dynamics of globalisation and FDI trends.

When looking across a range of literature and commentary there appear to be inherently conflicting messages:

- Because of their low cost offering, emerging economies have been successful in attracting investment by manufacturing firms over the past decade. In terms of manufacturing FDI projects Asia Pacific and Latin America/Caribbean captured 49 per cent of new manufacturing projects in 2011⁶⁵. *Their proposition has primarily been on a low cost offering - a compelling proposition for high volume, low margin activities in particular;*
- *However, the rate of increase in labour and other input costs in developing economies⁶⁶ means that the cost differential no longer compensates for the increased risk and volatility that globalised firms face as they manage highly complex GVCs;*
- *Greater prosperity in emerging economies and higher wages are helping to drive the desire to consume by these growing middle classes, making them much more an exciting market of new consumers and much less a source for low cost labour;*
- At the same time, over recent years, emerging economies have developed significant manufacturing and innovation capabilities themselves, permitting them to produce increasingly advanced manufactured products⁶⁷;
- Some commentators contend that companies that have retained core R&D activities in the home country are losing the ability to innovate because the manufacturing/production processes located off-shore are 'disconnected' from the product development and design process. There are indications of emerging countervailing instances of companies re-localising manufacturing, closer to end markets, particularly for complex production where close interaction between design and production staff enable effective introduction of new products, materials and processes⁶⁸;

⁶⁴ FDI flows represent all capital flow from one country to another - including equity capital, reinvested earnings and other capital

⁶⁵ FDI: Markets Manufacturing, June 2012

⁶⁶ China's industrialised locations are experiencing double digit inflation

⁶⁷ The Future of Manufacturing. WEF, April 2012

⁶⁸ Airbus Industries has a global footprint and recently announced that it will build its first assembly plant in USA providing 1,000 jobs, likewise similar moves have been made by GE and Caterpillar

- There is also evidence of what is called reverse innovation - rather than following the more traditional path of developing high-end products and adapting them for emerging markets some companies are developing technologies locally in these regions and then distributing them globally; and
- Companies within developing economies are now increasingly seeking new markets and internationalising their operations. They more often opt for a mergers and acquisitions (M&A) strategy thereby minimising the risk as they access 'ready made' customer and supplier bases, facilities and expertise.

All of this means that the FDI and outward direct investment (ODI) propositions have become even more complex, challenging yet full of opportunity.

Shifting Consumption Trends

High Growth Markets

Demographics across the world shape demand for manufactured goods and services. Ageing populations in the western economies will drive demand for age-related drugs and medical devices to address mental and physical wear-and-tear (e.g. joint replacements, increasingly made from novel materials). This presents a major opportunity for those manufacturers and their supply chains operating in the pharmaceutical, bio-med, medical devices, functional foods and wider life science sectors.

The emerging markets, such as the BRIC countries (Brazil, Russia, India, and China etc.) are experiencing economic growth rates - which compared with the significantly lower growth rates of more developed economies - are highly attractive⁶⁹. The more affluent consumers in these economies will look to have access to those products, technologies, and services routinely available to, and enjoyed by, their counterparts in western economies⁷⁰.

Changing Consumer Behaviours

At the same time, in more developed economies, consumer preferences are becoming more diverse as individuals seek customised solutions specific to their needs. Consumers no longer have a passive relationship with the manufacturer in the consumption of the product.

- This has given rise to concepts such as manu-services (products wrapped up in services), or servicisation (goods offered as a service such as Cloud Computing). These models are more prevalent in developed countries⁷¹ and involve a radically different business model for manufacturing firms. Consumers now 'form a contract' with the manufacturer for both

⁶⁹ Looking at new and emerging market opportunities from 1995 to 2008, China's economy grew at an average rate of 9.6 per cent, India's at 6.9 per cent and Russia's at 4.7 per cent, compared to 2.9 per cent average annual growth in the United States over the same period. Brazil's consumer spending, equivalent to 60 per cent of GDP, is the highest in the BRIC countries. Growth and Competitiveness in the United States, McKinsey Global Institute, 2010

⁷⁰ Trading and Investing in a Smart Economy, Department of Enterprise Trade and Innovation, 2010 set out target countries for trade, based on Ireland's sectoral strengths. The Export Trade Council was established following to drive implementation

⁷¹ United States (59 per cent); Finland (53 per cent), Singapore (49 per cent), Malaysia (46 per cent) and the Netherlands (40 per cent) have a higher number of 'servicised' manufacturing firms than other countries. Exploring the Financial Consequences of the Servitization of Manufacturing, Neely, A.D. 2008

products and the services, with consumers playing a highly central role in product and service innovation⁷².

- Mass customisation, which refers to the ability of manufacturers to produce a specific product tailored for each individual customer, has increased as the cost of producing small batches (or batch of one) has fallen. This is not necessarily a new concept, but is becoming more pervasive across different sectors including, for example, Automotive, Computer and Electronics and Consumer Goods.

Environmental Concerns & Energy

Concerns regarding the environment and sustainability have increased over the past decades as consumption patterns have changed, global travel has become more frequent and as supply chains are disaggregated across the globe. Manufacturing is potentially one of the most significant sources of negative environmental impact given the carbon footprint arising from material and energy use, and the solid waste, air and water emissions that occur through production⁷³. The implications for manufacturers stem from two sources.

Firstly, consumers have become more aware of the environmental impact of their purchasing decisions. Increasingly, they make informed choices based on considerations such as air-miles, embodied energy, recyclability, waste and packaging materials.

Secondly, Kyoto agreements and regulations set at EU level have direct consequences for manufacturing firms based in Ireland. The EU is relatively well advanced compared with other

Energy Efficiencies - Sustainable Manufacturing

Government policies, which act to increase energy efficiencies and accelerate the demand for cost-effective alternative energy, will provide the springboard whereby a country can leapfrog competing nations.

Deloitte (2010) Global Manufacturing Competitiveness Index

jurisdictions in relation to the environmental agenda - this can result in potentially higher costs for European based firms and/or for those trading with the EU - but can, on the other hand stimulate innovation and set companies at the leading edge in terms of responding to customer needs⁷⁴. Relevant EU initiatives include the Emissions Trading Scheme⁷⁵, the WEEE Directive⁷⁶ and REACH⁷⁷ and others aimed at improving water quality and management firms. Increased resource efficiency improves productivity, drives down costs and boosts competitiveness; and is a key component in the EU's Europe 2020 Strategy⁷⁸ to achieve smart, sustainable

⁷² Exploring the Financial Consequences of the Servitization of Manufacturing, Neely, A.D. 2008

⁷³ Environmental Impacts of Manufacturing Centre for Sustainable Manufacturing and Re-use/Recycle Technologies (SMART) UK, 2007

⁷⁴ Global Manufacturing Competitiveness Index, Deloitte, 2010

⁷⁵ The Emissions Trading Scheme places a cap on the total amount of certain greenhouse gases that can be emitted by the factories, power plants and other installations in the system. Within this cap, companies receive emission allowances which they can sell to or buy from one another as needed. The aim is that in 2020 emissions will be 21 per cent lower than in 2005 http://ec.europa.eu/clima/policies/ets/index_en.htm

⁷⁶ Sets collection, recycling and recovery targets for all types of electrical goods

⁷⁷ Places greater responsibility on industry to manage the risks from chemicals and to provide safety information on the substances http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm

⁷⁸ http://ec.europa.eu/europe2020/index_en.htm

and inclusive growth. Environmental-related rules and regulations can be a driver of innovation in the longer term, but they also place significant cost and administrative burdens on the firm.

Energy is an ever-increasingly important factor of production for all industrial sectors. As energy becomes scarce and countries compete to attain energy security and independence, the cost competitiveness of energy, and particularly country specific clean and sustainable energy leadership, will be a prominent component of country manufacturing competitiveness.

From the perspective of companies, those that invest in energy efficiency and prepare for “supply chain ripples” will be better positioned for the future⁷⁹. The fact is that sustainable manufacturing is no longer a choice for manufacturing firms. Sustainable manufacturing involves minimising negative environmental impacts across all aspects of production involving materials, energy consumption, natural resource conservation, waste management etc.

Manufacturers will increasingly need to take a whole-life view of their products and embrace newer concepts such as ‘re-lifeing’ or de-manufacturing⁸⁰, by for example, designing products to enable the different materials to be identified, separated and recycled. Efforts are increasingly made to create a ‘closed-loop’, circular production systems in which discarded products are used as new resources for production⁸¹.

Technological and Scientific Advances

Technologies are changing the world - the products we use, how we communicate, how we work. The vast array of technological advances makes it challenging to identify what is most relevant to manufacturing in the short and medium term - but it is true today that scientific and technological advances potentially have game changing consequences for manufacturing enterprises.

As a Member State within the EU it is crucial that Ireland remains abreast of, and aligned with, the RD&I focus within the EU. Of particular interest from a manufacturing perspective is the focus on what the EU calls Key Enabling Technologies (KETs) and Smart Specialisation. KETs will be the foundation for the developing of new products and processes. They are defined by the EU High Level Group on KETs as *knowledge and capital-intensive technologies associated with high research and development intensity, rapid and integrated innovation cycles, high capital expenditure and highly-skilled employment. Their influence is pervasive, enabling process, product and service innovation throughout the economy.*

At European level five KETs have been identified as being fundamental for future competitiveness:

- Advanced Materials;
- Nanotechnology;
- Biotechnology;
- Photonics; and
- Advanced Manufacturing.

⁷⁹ The Top 10 Drivers of Change in 2010 and Beyond, Corporate Executive Board, 2010

⁸⁰ A process of recycling that involves the dismantling and/or disassembly of an item to gain the maximum amount of recyclable materials

⁸¹ Eco-Innovation in Industry, OECD, 2010

KETs contribute to the development of disruptive technologies for manufacturing (e.g. reduced material and process rates, energy saving) and for a broad range of sectors including Energy, Transport, Pharmaceuticals, Medical Devices and ICTs.

In mid 2011 the EU Commission launched its *smart specialisation platform*. The concept is simple - based on the premise that, rather than spreading investment thinly across several technology research fields, a more promising strategy is to encourage investment in programmes that will complement the country's other productive assets to create future domestic capability and comparative advantage⁸². This requires each region to identify its best assets and RD&I potential in order to concentrate its efforts and resources on a limited number of priorities where it can really develop excellence and compete in the global economy⁸³.

Ireland's *Report of the Research Prioritisation Steering Group*⁸⁴ is directly relevant from Ireland's perspective. Important too, is how we 'connect the dots' between universities, research centres and businesses.

Making it real for manufacturers: In some instances, research can take a number of years in development before it reaches the factory floor and is economically viable to use. The concept of personalised medicine, for example, has been talked about for almost a decade, but now so-called niche busters are a reality, requiring significant change for Pharma/Biopharma companies in their production processes. For sectors such as ICT, disruptive change is a fact of life, with a much shorter life-cycle from concept to product.

For many firms, knowing what is coming down the line, allows them to adapt and to make the changes necessary for their circumstances in order to remain competitive and relevant to their customers.

The following section sets out a small number of potentially high impact technologies - relevant to *all* manufacturing firms, regardless of scale or sector⁸⁵, although with different emphasis depending on a firm's strategy and stage of development.

Integrated ICT Systems . . . towards the Digital Factory

Information and Communications Technologies (ICTs) are increasingly significant for manufacturing operations. ICTs are pervasive:

- ICTs used across **internal processes**, whether globally dispersed or not, through from product design and testing, production, quality control, procurement, logistics, sales and administration, facilitate greater efficiencies, cost reduction and faster time to market etc. The effective use of ICTs can have a transformative effect on organisational structures, on information management and real time decision making etc.;
- In terms of **external supply chain and design partners**, across the world, ICTs enable procurement information, design codes etc., to be inter-changed efficiently and securely, and without loss of data integrity, facilitating effective communications, partnership management, open innovation and supply network management; and

⁸² Smart Specialisation - The Concept, A Knowledge Economists Policy Brief n° 9, Dominique Foray, Paul A. David and Bronwyn Hall, June 2009

⁸³ <http://europa.eu/rapid/pressReleasesAction.do?reference=IP/11/776&type=HTML>

⁸⁴ Report of the Research Prioritisation Steering Group, DEJI, Forfás, 2012

⁸⁵ Informed by 'Manufacturing Futures-a discussion document', SQW, August 2012 (commissioned by Forfás) and by consultation with firms and researchers

- Firms can connect more closely with their customers, to build relationships, enhance customer services, garner information and facilitate a tighter feedback loop into product development and customisation.

With computer integrated manufacturing, ICTs are already embedded in the production for process control, programming robotics etc. Practices in Lean and Shingo which are being increasingly embraced by manufacturing firms are enabled by effective use of ICTs. Data collection and analytics is becoming increasingly important to enable real-time problem identification and solution, quality control and waste reduction.

For some firms, the concept of the 'Digital Factory' is no longer a *Factory of the Future*, but is in place today. Better understanding and design of

manufacturing systems are achieved by greater simulation, modelling and knowledge management from the product concept level through to manufacturing, maintenance, and disassembly/recycling leading to significantly enhanced Product Lifecycle Management (PLM). For example, testing products in virtual environments rather than on physical test beds can mean that a far more robust solution is developed, and wasted costs of physical tests are reduced.

Companies such as Siemens are exemplars in this regard (see text box below). This model has implications for firms that engage with companies such as Siemens and other global multinationals, whether as suppliers or more strategic supply chain or design partners.

Digital Manufacturing

Digital manufacturing is the use of an integrated, computer-based system comprised of simulation, three-dimensional (3-D) visualisation, analytics and various collaboration tools to create product and manufacturing process definitions simultaneously.

Digital manufacturing evolved from manufacturing initiatives such as design for manufacturability (DFM), computer-integrated manufacturing (CIM), flexible manufacturing, lean manufacturing and others that highlight the need for more collaborative product and process design'

The Digital Factory in Action - Insights from Siemens

Siemens argue that many of the desirable long-term benefits from Product Lifecycle Management (PLM) cannot be achieved without a comprehensive digital manufacturing strategy. It views digital manufacturing as a key point of integration between PLM and various shop-floor applications and equipment: it enables the exchange of product-related information between design and manufacturing functions in the company. This alignment allows manufacturing companies to achieve their time-to-market and volume goals, as well as realise cost savings by reducing expensive downstream changes.

Digital manufacturing systems allow manufacturing engineers to define the complete manufacturing process in a 'virtual environment' with the following elements: tooling; assembly lines; work centres; facility layout; ergonomics and resources. Simulation of production processes is performed, with the intent to re-use existing knowledge and optimise processes before products are manufactured. Also, Siemens seeks to exploit digital manufacturing to deliver feedback from actual production operations which is then incorporated into the product design process, allowing the company to take advantage of what it terms 'shop floor realities' during the planning stage.

Developed by SQW, December 2012

A wide range of aspects need to be taken into account including managing complexity, managing obsolescence, open system applications, costs of implementation, service and maintenance, integration of systems and the reliability and security of internal and external networks. The ability of systems to reconfigure, and learn, in adaptive ways is likely to become increasingly important.

Materials - smarter, lighter, hybrid . . . and new

New materials and new processing methods have the potential to revolutionise existing industries as well as to create new ones. Materials is an extremely broad area and hugely significant for manufacturers. Materials encompass ceramics, metals and alloys, powder, polymers etc. 'Smart⁸⁶', 'Advanced', 'Next Generation' Materials - whatever the term used - present exciting opportunities. Depending on changes in some external conditions, 'smart' materials change their properties (mechanical, electrical, appearance), their structure or composition, or their functions. Mostly 'smart' materials are embedded in systems whose inherent properties can be favourably changed to meet performance needs, for example MRSA resistant paint or wearable computers in textiles⁸⁷.

New materials usually require the introduction of new manufacturing processes as well as new skills, and new mensuration⁸⁸ and quality assurance procedures etc., which themselves often require extensive investment in equipment and knowledge. New materials also need to be understood in terms of their 'whole life' performance and environmental impact. Testing, modelling, and simulation of new materials through the range of extreme operating conditions that may be encountered in their whole life cycle is essential to ensure that relevant design models and criteria can be assured.

It is not only about new/advanced materials. New ways of processing/forming or coating for an existing material will enhance its characteristics - e.g. honeycombed titanium.

By way of example, more recent discoveries such as graphene are likely to provide radical and major opportunities for existing and new manufacturing activities. Graphene has multiple possible applications from sensors to semi-conductors and novel applications as a

Graphene - Ireland Preparing for the Future

CRANN, based at Trinity College Dublin, has announced a new collaborative research partnership with Thomas Swan & Co Ltd, a leading manufacturer of performance and speciality chemicals, based in the North East of England. The collaboration will focus on the industrial scale-up of graphene production.

Graphene is the wonder material of modern science and was the focus of the Nobel Prize in 2010. It has unique properties and is both the strongest and most conductive material known to man. There are many potential applications for graphene including next generation electronic devices, mechanically strengthened plastics and new thermoelectric materials.

http://www.tcd.ie/Communications/news/news.php?headerID=2400&vs_date=2012-4-1

⁸⁶ Smart behaviour occurs when a material can sense some stimulus from its environment and react to it in a useful, reliable, reproducible and usually reversible manner. A really Smart material will use its reaction to the external stimulus to initiate or actuate an active response, e.g. with an active control system

⁸⁷ British soldiers' uniforms could soon use electrically conducting yarn woven directly into the clothing, replacing cumbersome batteries and cabling <http://www.bbc.co.uk/news/technology-17580666>

⁸⁸ Collective word for measuring length, area, volume, density, wider properties of materials

uniquely strong material. Although it is likely to be a number of years before it becomes a reality on the factory floor, it is important that Ireland remains abreast of such potentially disruptive changes.

Miniaturisation and Nanotechnologies

The history of microelectronics is one of increasing miniaturisation of components as succeeding generations of chips pack more and more transistors into a given area. Such miniaturisation is also becoming increasingly relevant in other product areas e.g. for producing sensors, micro-actuators, and complete devices at miniature scale. These technologies hold the potential for generating completely new categories of device such as micro-sized medical devices (micro-diagnostic devices), microelectronic machines, and speckled computing (wireless sensor networks). This offers opportunities for the production of large volumes of integrated devices, which have sensory, communications and computing capabilities that can be distributed to provide a robust network with a wide variety of applications including for example, medical devices, agricultural instruments for maximising yields and traffic management systems. Smart networks of such devices hold major potential for optimising manufacturing and process plants by enabling much more effective monitoring and control of processes.

Bioprocessing

Bioprocessing is becoming increasingly relevant to a range of products. It has significant potential in the development of environmentally sustainable substitutes for fossil fuels. Within the pharmaceutical sector the manufacture of more complex pharmaceutical molecules is being increasingly achieved through biological processes, rather than more traditional chemical synthesis methods. Bioprocessing will also have applications in many other areas including plastics and polymers, new materials and industrial processes.

The development of new bio-related products is also leading to changes in the business models used in particular industries. For example in pharmaceuticals, the large integrated producer businesses are moving increasingly towards a more open innovation model in which they collaborate with smaller specialist bioresearch companies specialising in developing large complex molecules with specialist properties. Within this business model, smaller companies work to develop specialised complex molecules and collaborate with the larger international companies for manufacture, marketing, and distribution.

Additive Manufacture

Manufacturing processes, especially those in engineering, have traditionally involved shaping, casting, moulding, forging, bending, cutting, or grinding materials into their approximate shape. Additive manufacture (also known as 3D Printing) has introduced a completely new approach by building up the product layer by layer into a three dimensional form under digital control from a master design file (known as Model Based Definition). Powdered metals are melted using a laser layer-by-layer to create the final 3-D shape. As a result, products can be made that are extremely complex and without the normal stresses and defects found in traditional manufactured objects.

Today, additive manufacture is being used in relatively specialised areas such as aerospace and in small sizes and relatively small volumes. For the future, additive manufacture offers the potential for distributed manufacture in which parts can be manufactured consistently at sites on opposite sides of the world. The technology also offers the scope to customise at no incremental cost and produce fewer items at lower cost, than would be the case with assembly-line production - a significant benefit given the increasing trend toward customisation outlined above.

Additive Manufacturing - in Practice

3T RPD Ltd was established in 1999 in England and has become a leading provider of plastic and metal additive manufacturing (AM) services throughout the UK and Europe.

It claims to be 'unchallenged as the UK's largest plastic AM provider supplying 50% of the UK market'. The company delivers to industries including Automotive, Medical, Marine, Defence and Pharmaceutical.

<http://www.3trpd.co.uk/>

Although more likely a medium term proposition (particularly in terms of higher volumes), additive processing is one to watch. Many specialists in the field are predicting widespread distributed manufacture of products through the use of additive approaches.

Conclusions

Identifying and understanding the global drivers of change is key for small open economies such as Ireland, and for companies that compete in a global environment. The fact is that manufacturing companies that trade on the domestic market also face increasing competition from international players. But what exactly does all this change mean for the manufacturing company? And what should (can) the company do in response?

The next chapter sets out the emerging *Factories of the Future* - new models for manufacturing, together with the implications for both firms and the policy system.

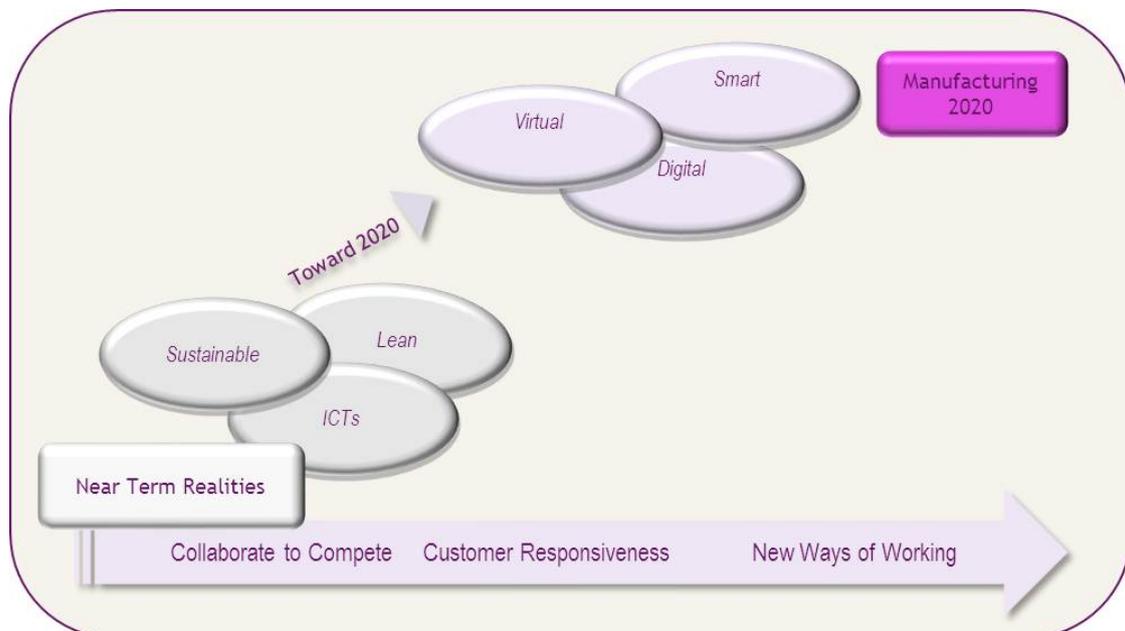
3 Factories of the Future - *Models for Manufacturing*

Introduction

As set out in Chapter 2, changes in what markets are and customers want, advances in technologies and sciences, the shifting dynamics of globalisation and intensified competition are likely to require significant changes in the way the manufacturing businesses organise themselves. The EU Commission report *Factories of the Future Public Private Partnership - Strategic Multi-Annual Roadmap*⁸⁹ describes different factory 'models' that capture the characteristics of how manufacturing is likely to evolve over the years to 2020⁹⁰: Smart; Virtual; Digital.

These 'models' are already evident in such global companies as Siemens, Intel and GE and are likely to have some application for *all* manufacturing firms in how they operate within global supply networks. How they apply will be different according to an individual firm's needs and contexts - but they cannot be ignored. For example, the smaller firm supplying to a larger player may need to adopt technologies, embrace sustainable manufacturing principles, and/or achieve certain standards if they are to remain a competitive supplier. We also look to the near term realities that are pertinent to all firms today relating to Lean manufacturing, sustainable manufacturing and ICTs and the implications for firms in terms of customer responsiveness, collaboration and new ways of working.

Figure 4 The Changing Nature of Manufacturing



⁸⁹ Factories of the Future PPP Strategic Multi-Annual Roadmap, Directorate-General for Research, Industrial technologies

⁹⁰ Ibid. These models are described within the strategic research sub-domain of ICT-enabled intelligent manufacturing: The other sub-domains include Sustainable Manufacturing, High Performance Manufacturing and Exploiting new materials. The 'models' as described here capture the characteristics of the future of manufacturing across all of these dimensions

Factories of the Future - Looking out to 2020

Factories of the Future Public Private Partnership - Strategic Multi-Annual Roadmap sees the need for manufacturing research to focus on 'the transformation of present factories toward reusable, flexible, modular, intelligent, digital, virtual, affordable, easy-to-adapt, easy-to-operate, easy-to-maintain and highly reliable factories of the future'. Within the report, three different 'types' of factory are described that provide an excellent picture of how manufacturing is likely to evolve⁹¹.

When describing the characteristics of *Factories of the Future*, it is important to note that the term 'factory' should not be interpreted as being one physical plant in one location, but is more about the entire manufacturing activity, whether globally dispersed or not. It is also important to note that these 'types' are not mutually exclusive; rather, they are concepts for approaching the process of manufacturing as we progress to 2020.

- Smart

Agile manufacturing and customisation involving process automation control, planning, simulation and optimisation technologies, robotics, and tools for sustainable manufacturing;

Offer flexibility, short-time cycles, and variability-controlled capabilities for the manufacturing process; and

Underpinned with Lean and simple ICT systems, characterised as energy efficient, reliable, and cost-effective production operations, with steadily reducing set-up times in their key processes.

- Virtual

Value is created from global networked operations involving global supply network management, product-service linkages and management of distributed manufacturing assets;

Built on pervasive and seamless ICT systems, which through full integration provide understanding and intelligence from all aspects of the business facilitating and driving decision-making;

In effect - a globally dispersed network of operations functioning as one.

- Digital

Greater simulation, modelling and knowledge management deliver enhanced Product Lifecycle Management through from the product concept level through to manufacturing, maintenance and disassembly/recycling;

Allow manufacturing engineers to define the complete manufacturing process in a virtual environment with elements such as tooling, assembly lines, work centres, facility layout, ergonomics and resources. Simulation of production processes is performed, with the intent to re-use existing knowledge and optimise processes before products are manufactured.

⁹¹ Within the research sub-domain of ICT enabled intelligent manufacturing. *Factories of the Future PPP Strategic Multi-Annual Roadmap*, Directorate-General for Research, Industrial technologies

Data collection and analytics deliver feedback from actual production operations which is then incorporated into the product design process, and facilitates better real-time decision making and quality control throughout the production process.

Near Term Realities

For some companies these concepts of *Factory of the Future* may be just that - a concept - a prospect in the distant future. Right now, all companies operating in this intensely globalised economy face considerable challenges in terms of remaining cost competitive (which does not mean competing on lowest cost). The overall cost of labour along with the total cost of materials, which include logistics costs and material availability continues to be a critical driver of manufacturing competitiveness⁹². However, while managing costs and increasing efficiencies and productivity, firms also need to respond to shifting customer demands. In the immediate term, all companies need to have regard to:

Lean Manufacturing Well established approaches such as Lean, Total Quality Management (TQM) and Zero-Defects are even more fundamental as the basic 'table stakes' for all manufacturers in an effort to minimise production lead times, stocks and work in progress and to encourage 'right first time' production generally. Lean principles apply across the entire supply chain, involving a 'bottom up' approach to problem identification and solutions to enhance efficiencies, increase standardisation and reduce waste.

Sustainable Manufacturing Companies need to respond to the many EU environmental regulations in the first instance. Perhaps more importantly, however, they need to respond to the changing demands of customers for more sustainably produced goods. Sustainable manufacturing processes and practices are pervasive throughout the manufacturing supply chain. There is a shift in thinking from "end-of-pipe" pollution control to a focus on product life cycles and integrated environmental strategies and management systems. Aspects such as energy consumption, emissions, waste, recyclability, materials (renewable/non-renewable) need to be considered⁹³.

The Importance of ICTs As discussed in Chapter 2, ICT is pervasive across all aspects of a business and has the potential to be highly disruptive for manufacturing, irrespective of its scale, sector, stage of development or geographical distribution. Manufacturers need to recognise and embrace this, seeking actively to put ICT at the core of their business approach and operation.

Implications for Manufacturing Firms

As individual companies engage in these models, to whatever degree is appropriate for their strategy and business, they will face the need to change various aspects of how they operate today.

⁹² Global Manufacturing Competitiveness Index, Deloitte, June 2010. For Irish owned firms, in particular, access to finance for capital intensive operations also features as a near term barrier to growth - See Chapters 7 & 10

⁹³ Sustainable Manufacturing Toolkit, OECD highlights how manufacturers can reduce environmental impacts, save energy and increase efficiencies across the supply chain, <http://www.oecd.org/innovation/green/toolkit/>

Companies will face implications for business strategies, for investment in technologies, capital equipment and automation⁹⁴, for organisational structures, and for individuals' skills and competences - although the implications and timing will vary depending on the type of manufacturing (sector or value chain position) or nature of the firm itself.

The following sets out three key common thematic areas that arose during consultations with Irish based firms:

- *Customer Responsiveness* - needing agility and flexibility on the 'factory floor', and market led product development and customised solutions;
- Companies increasingly need to *collaborate to compete* across global value chains, innovation and networks; and
- *New ways of working* are needed that harness the full potential of each person in the workplace.

Customer Responsiveness

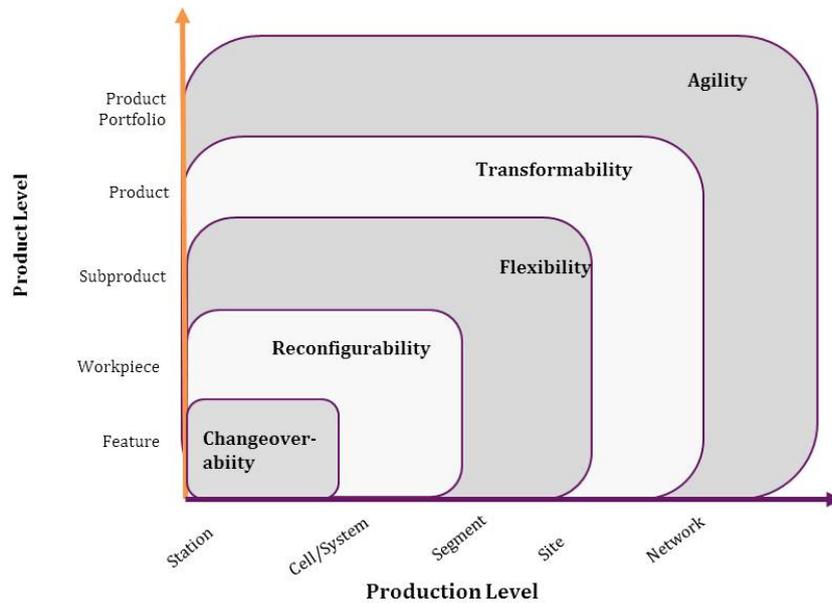
Customer demand is constantly changing. Individual customers want tailored solutions specific to their needs. Understanding customer needs and managing this relationship will increase in importance as companies seek to deliver customised, innovative products and services in an intensely competitive environment. The required responsiveness will have implications for work practices and internal processes for producing product/service (enhanced efficiencies, Lean, velocity of supply chain etc.).

At a minimum, firms increasingly need to be able to demonstrate the ability to minimise time and effort for changeovers or reconfiguration of production systems.

At its most strategic, 'agility' requires companies to be adept at anticipating customer needs and opening up new markets in the first instance, and in having the capabilities, technologies, production processes, and partners in place, to develop new products and services and to drive velocity across the entire supply chain (Figure 5 overleaf).

⁹⁴ In some circumstances it may be about firms optimising existing equipment capabilities in the first instance. Consideration needs to be given to the business case for automation which is informed by volume, complexity, margins etc., before making equipment investment decisions

Figure 5 Changeability at Product and Factory Production Levels



Changeoverability	The operative ability of a single machine or workstation to perform particular operations on a known work piece or subassembly at any desired moment with minimal effort or delay
Reconfigurability	The operative ability of a manufacturing or assembly system to switch with minimal effort and delay to a particular family of work pieces or subassemblies through the additional or removal of functional elements
Flexibility	The tactical ability of an entire production and logistics area to switch with reasonably little time and effort to new, although similar, families of components by changing manufacturing processes, material flows and logistical functions
Transformability	The tactical ability of an entire factory structure to switch to another product family. Requires structural interventions in the production and logistics systems, in the structure and facilities of the buildings, in the organisation structure and process and in the area of personnel
Agility	The strategic capability of an entire company to open up new markets, to develop the requisite products and services and to build up necessary manufacturing capacity

Source: Wiendal et al. (2007)

Inditex Customer Responsiveness Delivering Competitive Advantage

Inditex exemplifies the fast response customer driven manufacturing philosophy and demonstrates how what may be regarded as a 'traditional' sector can be competitive in a peripheral region in Europe

The rapid response system developed by Inditex uses modern techniques for manufacture with a high degree of in-house production, sophisticated data gathering and analysis and a state of the art design and logistics system to enable the company to be competitive in the fast changing fashion industry. The system is driven directly by demand from the shops. Staff talk to customers to gain their inputs about items that customers tried on but didn't buy. This data is gathered through personal digital assistants (PDAs) and linked with the store's point of sale (POS) systems to be fed back to the Headquarters at La Coruna.

Inditex is capable of producing a new product with an average time from concept to delivery in its stores of 15 days - twelve times faster than some of its major rivals who receive new styles once or twice a season. Two highly automated distribution centres in La Coruna and Zaragoza move circa 2.5 million items a week with no item staying in-house more than 72 hours.

Competition in the fashion sector is intense, but few companies have a business model similar to that of Inditex. Whilst manufacturing costs may be higher in the Inditex system, the overall ability to respond quickly enables the firm to match supply with demand in a way that its slower competitors cannot, resulting in higher sales and a reduced level of out of fashion items that have to be sold at a discount - and a distinctive competitive advantage.

Developed by SQW December 2012

Collaborating to Compete

Whatever strategy an individual firm adopts as the environment for manufacturing evolves, the need to collaborate to compete is becoming more apparent. It is very difficult for any company to 'go it alone'. The successful manufacturing firm in the future will be one that spends time developing both internal and external relationships that are key to identifying and sharing knowledge and best practice⁹⁵. The firm actively develops relationships with research institutes, customers, industry networks, standards bodies etc., as appropriate for their specific business. Within the context of the global drivers of change and key trends set out above, the following aspects are particularly important:

Connecting to Global Value Chains

A fundamental issue for manufacturing firms relates to how and where to best position specific activities along the broad value chain - including market analysis, information systems, design, manufacture, logistics, customer services etc. Decisions involve considerations relating to out-sourcing, off-shoring and partnering within global value chains (GVCs). These GVCs are organised around lead firms, global suppliers, platform leaders, etc. Multinational enterprises (MNEs) generally play a prominent role, although the relationships and linkages between firms changes over time. Smaller firms need to take a strategic approach to how they engage in GVCs, building

⁹⁵ Building Wealth Through Relationships - The Role of Internal and External Relationships in the Knowledge Intensive Firm, Thompson M

capability and upgrading their activities to take advantage of opportunities. Excellence at all levels is increasingly important as is demonstrated quality and performance.

Innovation

Increasingly today, it is the customer who defines specific needs and the supplier delivers a tailored solution. To succeed today, businesses must be closer to their customer, building an in-depth understanding of their needs so that they can develop and deliver innovative products, services and solutions. Manu-services, for example, will often require firms to innovate with others that offer complementary services. Market led innovation involves collaboration across firms, HEIs, sectors and regions and requires an open mind set and a high degree of trust based on credibility and excellence.

Open Innovation has been adopted by some of the world leading companies in aerospace, electronics, pharmaceuticals and other sectors. Major companies have recognised that highly centralised company-owned R&D facilities are not the most responsive ways for attracting new ideas and gaining new knowledge from other, often smaller and more agile, companies, research groups and/or customers. Open Innovation creates ways in which problems and potential solutions/opportunities can be discussed openly, and presents considerable opportunities for SMEs in particular. In many cases, larger firms allow the sharing of major facilities, data sets and ideas in order to encourage SMEs, and centres of academic excellence, with new technologies/ideas to seek collaborative development arrangements and regenerate their stock of IP. This has an important role to play in enabling integration and synergy within the supply chain.

Business Networks & Clustering Activities

Companies themselves can come together to form business development networks which can provide member firms access to resources which would otherwise be beyond the scope of a single firm. Individual firms can face a number of limitations when trying to compete in global markets such as scale, expertise etc. Through collaboration, firms can complement each other and specialise in different areas to overcome such barriers to achieve collective efficiency and compete in markets beyond their individual reach.

Business networks, where firms collaborate for specific purposes and where results of the activities have some identifiable and measurable impact on their business tend to result in greater economic impact overall⁹⁶. Networks also facilitate the transfer of tacit knowledge between firms. This allows individual firms to develop or enhance a range of competencies in a more flexible manner, in a way and at a time that is appropriate to the firm's business needs and stage of development.

Many existing networks and collaborations tend to be formed on a sector specific basis. In light of increasing convergence, there would be some benefit in stimulating 'new' areas of opportunities across sectors through sharing of information, knowledge and expertise by individuals from different (but increasingly complementary) sectors - such as pharmaceuticals and food, or medical technologies, electronics and pharmaceuticals.

⁹⁶ Business Networks on the Island of Ireland, Intertrade Ireland, 2011

Ways of Working - Skills and Capabilities

As manufacturing becomes increasingly complex and firms seek to differentiate their offerings, access to high quality skills and talent is crucial. Skills and capabilities encompass a number of dimensions:

- Core technology skills including mechanical and electronic engineering, design, quality control, crafts;
- Business skills and acumen; including supply chain management, risk management;
- Leadership skills in the context of a fast moving, innovative global environment; and
- Soft skills in collaboration, team-working, problem solving and relationship management.

The nature and range of core skills required for manufacturing is changing and expanding as the pace of technology change increases; so too does the demand for 'real-world' mechanical and electronic engineers, industrial designers, technicians etc. Specifically, the increased focus on climate change is generating a rising need of skills related to climate and environmental friendly solutions, technology, production processes and services⁹⁷. Many sectors also forecast a loss of knowhow and shrinking supply of labour available due to the ageing of the manufacturing workforce, and in part due to the image of blue-collar jobs in industry as compared to white-collar jobs in services⁹⁸.

In the more complex manufacturing environment, value creation from human capital will involve a higher level of autonomy, and rely on the judgement, insight and knowhow of individuals, who draw upon their specialist knowledge. In this context, the ability to identify, analyse and solve problems is crucial. Whether in the operation of machinery and equipment, or in the provision of business services, value creation is maximised as individual workers manage complexity, not simplicity⁹⁹.

For all companies - innovation is key to remaining competitive and relevant. The pace of change and changing nature of manufacturing is such that innovation will often stem from the 'factory floor', as well as via customers, suppliers and the R&D laboratory. The iterative nature of new product development and introduction requires a much closer relationship and inter-connectedness between those involved in product development, process development and design for manufacturability.

Softer skills include more intangible attributes such as the ability to adapt, to engage effectively with others from different disciplines or cultures, to build relationships both internal and external to the firm and/or to impart tacit knowledge. People will need to be capable of working effectively as part of a team - including 'virtual' teams where members may be located in various places across the world. Individuals will increasingly be required to complement a core technology skill with, for example, an understanding of business and an awareness of the customer.

At a fundamental level, manufacturing firms will need to consider implications for their own operations, and what steps they need to take to lead/embrace organisational change and people development.

⁹⁷ EU Manufacturing Industry: Challenges and Opportunities for the Coming Years, DG Enterprise & Industry, 2010

⁹⁸ *ibid*

⁹⁹ *ibid*

Implications for Government Policy and the Business Environment

As companies need to change, so too does the business environment need to adapt. By understanding what is happening globally in manufacturing and in setting out what the future potential is for Ireland, it is possible to focus government action in the 'right' way to support manufacturing over the coming years.

Government itself does not create jobs - but it plays a crucial role in ensuring that the business environment is conducive to new investment by foreign firms and start-ups and in continuous investment in the transformation of existing operations in Ireland. The eco-system for manufacturing firms involves factors such as physical infrastructures that facilitate transport of goods, relevant education and skills, access to funding, underpinning R&D capabilities and commercialisation activities, labour market policies, regulations, access to sub suppliers etc.

The development of clusters - where firms collaborate actively to improve their collective competitiveness in the market - has been a subject of discussion for many years, and is perhaps even more relevant today. From Ireland's perspective, it is important that we distinguish between the co-location of many businesses, and genuine clustering which involves a high degree of interaction and collaboration between firms, between firms and research institutes and between firms and education and skills providers. Whereas it may be (relatively) easy to put in place the elements of a manufacturing eco-system, it is considerably more challenging to stimulate an environment of collaboration that provides real competitive advantage. In this context, a key role for government and its agencies will increasingly be one of facilitating knowledge transfer and diffusion and encouraging the building of networks, clusters and centres of expertise.

The development of initiatives requires more considered approaches. While there is a cohort of companies that is at a stage of preparedness to engage in future focused initiatives, others would benefit from initiatives tailored to their needs, aimed at advancing their competences and capabilities. It is important to ensure that smaller firms in particular, are enabled to make changes appropriate to their own circumstances to result in improved productivity, whether through changes in process, investment in capital equipment and technology or Lean systems, engagement in networks and/or reskilling and leadership development.

Conclusions

Ongoing changes in technologies and markets mean that the context for manufacturing is going to continue to change fundamentally, and that standing still is not an option. These changes offer significant opportunities for the future of manufacturing globally. Indeed, for many sectors and firms the *Factory of the Future* is a reality. We can already see a shift toward increasing complexity, the convergence of sectors and technologies requiring multidisciplinary skills, the need for adaptive, flexible production processes to cater to increased customisation, the shift toward nano-scale and broader networks across companies and countries. The changing nature of manufacturing is likely to involve disruptive changes to established business practices.

The chapters following set out an overview of manufacturing in Ireland today. An ambitious, yet realistic vision for manufacturing in Ireland for 2020 is articulated in Chapter 5, set in the context of these new 'models' of manufacturing and based on the foundations already in place in Ireland.

4 Manufacturing in Ireland - a Baseline

Introduction

This chapter provides a brief overview of manufacturing in Ireland, looking at its contribution to Ireland's economy across a number of dimensions:

- Employment;
- Ownership;
- Sectoral Trends;
- Output and Productivity;
- Exports;
- Direct Economy Expenditure; and
- Research, Development and Innovation.

Manufacturing Facts in Brief

- There are 205,700 people employed *directly* in manufacturing - and a similar number of people employed *because* of manufacturing - that is, a total of over 400,000 people;
- Manufacturing provides employment across a broad range of occupations;
- Exports of agency assisted manufacturing companies were €78.5 billion in 2012, up from €54.8 billion in 2000, and have proven to be relatively resilient through the recession;
- Productivity in manufacturing has been increasing over recent years - enhancing the competitiveness of Ireland's firms on international markets;
- Manufacturing firms invested €718.5 million in R&D in 2011, accounting for 39 per cent of BERD;
- Agency assisted manufacturing firms sourced €14 billion of materials and services from Irish based suppliers in 2011 - although this has decreased from €17.5 billion in 2001;
- Agency assisted manufacturing firms contributed €7.6 billion in payroll to the economy in 2011;
- Manufacturing is regionally dispersed, providing employment opportunities throughout Ireland;
- Although Ireland is home to a number of large scale global players, almost 95 per cent of manufacturing firms employ less than 50 people.

The data provides a valuable evidence base on which to build a strategy¹⁰⁰. It is important to note that there are some limitations. For example, the existing NACE code construct does not facilitate insights into emerging areas such as Green Technologies or sub-sectors such as Functional Foods. Nor does the data allow us to identify the range or extent of activities engaged in by manufacturing firms such as R&D functions, customer support operations etc. We have utilised case studies to illustrate the range and nature of activities being undertaken by firms in Ireland throughout the report.

Employment

Since 1998 the number of people in work in Ireland increased from 1.49 million to over 1.84 million today¹⁰¹, a period during which Ireland experienced net inward migration for the first time in decades. While this paints a positive trend, the period 1998-2012 masks the dramatic employment growth in the interim driven by the construction boom and by debt fuelled consumption, followed by a dramatic decline. Ireland is now experiencing its highest unemployment levels since the 80s, which stands at 14.8 per cent today.

While other sectors experienced a degree of volatility over the period since 1998, manufacturing experienced a continuous downward trend in employment since then. There are now 70,000 less people employed in the sector since 1998. This presents a somewhat negative picture of the role of manufacturing in Ireland's economy.

However, manufacturing still employs a not insignificant 205,700 people today¹⁰². It also has a wider employment impact through the creation of secondary employment - meaning that a number of jobs are created indirectly by, and are therefore reliant upon, manufacturing. For example, manufacturing firms generate secondary employment in areas such as logistics, facilities management, construction, as well as a range of professional business services¹⁰³.

As a proportion of total employment, manufacturing has fallen from 20 per cent in 1992 to 12 per cent in 2011, although some of this shift in contribution results from the relative increase in employment in services and in the public sector. This trend is not specific to Ireland, however. Many developed countries within the OECD have experienced a similar structural shift in their economies. OECD analysis indicates that in the UK, US and Netherlands, the contribution of manufacturing to total employment is between 10 per cent and 11 per cent in 2011¹⁰⁴. The notable exception is Germany, which experienced a similar decline in terms of manufacturing contribution toward total employment, but still contributes circa 20 per cent in 2011. Eurostat analysis for a number of European Union countries tells the same story of a general decline in the

¹⁰⁰ NOTE: The data is sourced from CSO (QNHS and CIP) and from Forfás ABSEI and AES surveys and is referenced accordingly. Some differences arise due to the survey timeframes and because of this analysis/data from different sources should not be aggregated (e.g. in relation to sectors). Some adjustments have also been made to allow for trend analysis covering a period over which NACE categories were changed (2002 and 2007). See also Appendix III

¹⁰¹ QNHS Q3 2012, CSO

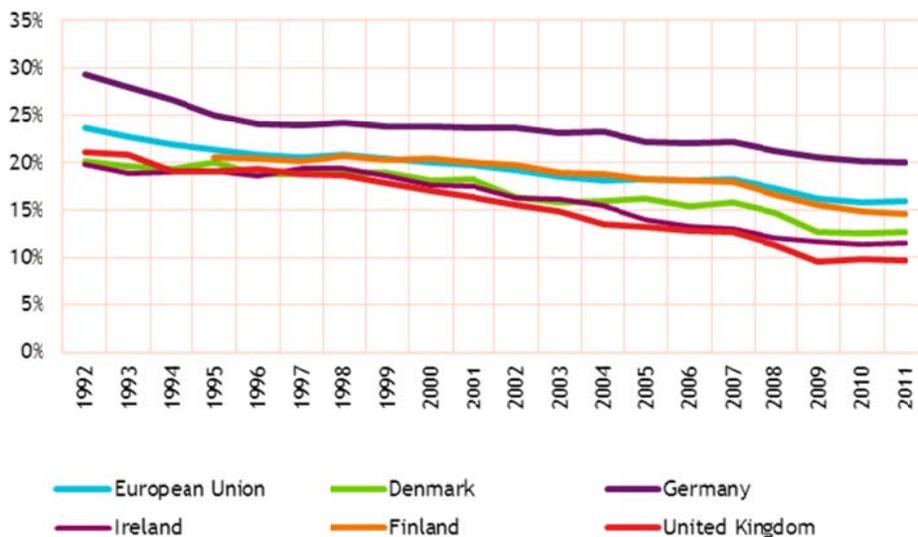
¹⁰² *ibid*

¹⁰³ The Action Plan for Jobs 2012, DJEI, estimates that for every one direct job created in manufacturing (and internationally traded services) an additional job is created in the wider economy

¹⁰⁴ OECD, Statistics Portal

contribution of manufacturing toward employment, with an average for the EU of 16 per cent in 2011 (Figure 6).

Figure 6 Manufacturing in Ireland and Europe as a Per centage of Total Employment 1992-2011



Source: Eurostat Annual Labour Force Statistics

Ownership

In total, there are 12,790 manufacturing enterprises in Ireland¹⁰⁵. Most of these are small in scale, serving domestic markets. Just over 95 per cent of these firms employ less than 50 people¹⁰⁶. In general, the larger firms are foreign owned, with the exception of a small number of firms involved in the food sector such as Kerry Foods and Glanbia.

Enterprise Ireland provides supports to Irish owned companies that are exporting or demonstrate the potential to do so. In 2012, manufacturing firms supported by Enterprise Ireland and Údarás na Gaeltachta employed circa 95,000 people¹⁰⁷ directly.

The enterprise structure in Ireland is differentiated by its success in attracting FDI and the relatively large number of leading global firms based here. Foreign owned manufacturing firms, supported by IDA Ireland, employ over 91,000 people directly across 527 plants¹⁰⁸. Leading manufacturing firms include Intel, Boston Scientific, Pfizer, J & J, Analog, HP to name a few.

Overall, firms assisted by IDA Ireland and Enterprise Ireland represent 90 per cent of total manufacturing employment.

¹⁰⁵ Business Demography 2010 CSO, 2012

¹⁰⁶ ibid

¹⁰⁷ Annual Employment Survey (AES) 2012, Forfás

¹⁰⁸ ibid

Manufacturing enterprises that are primarily locally trading employ in the region of 19,700 people¹⁰⁹. Although a number of these firms may have received feasibility and start-up financial supports from the CEBs they are generally classified as non-agency supported¹¹⁰. The rate of decline in employment in these firms over the period since 2004 has been greater than those directly supported by the agencies. This can be explained by a number of factors, including the relative small scale of these firms and reliance on the domestic market which has been badly hit during the period of the downturn.

Sectoral Trends

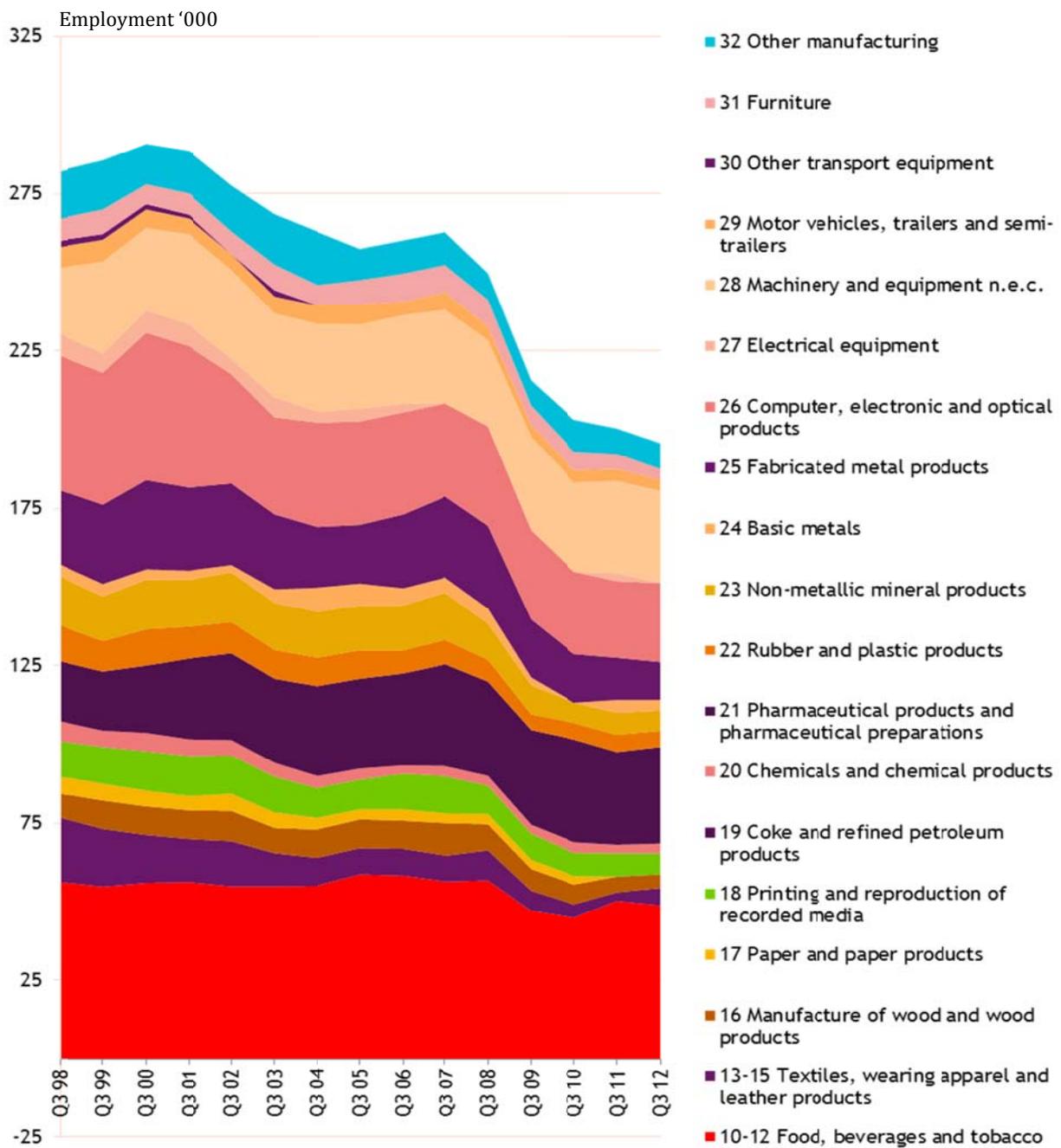
Based on CSO economy-wide data, the largest contributors to manufacturing employment are the Food, Chemicals, and Computer, Electronics & Optical Products sectors, which together equate to 50.2 per cent of manufacturing employment (Figure 7 overleaf). These sectors are largely export oriented and form a significant part of the development agency portfolios. Machinery and Equipment is also a large contributor to employment at 14 per cent. It's a broad sector encompassing machinery and equipment for specific industries such as construction and agriculture as well as more general purpose equipment such as pumps & compressors and lifting & handling equipment. Although declining in recent years, Fabricated Metals employs circa 15,000 people today. While these sectors don't feature as highly in agency export data¹¹¹, they likely play a key role as part of the eco-system for manufacturing.

¹⁰⁹ This is derived using latest manufacturing employment data for agency assisted firms (2012) which was 186,000 (excludes industry activity such as mining and quarrying, and construction, energy, water and waste) and using the Q3 2012 CSO QNHS figure for total employment in manufacturing, 205,700

¹¹⁰ Unless they have transferred to Enterprise Ireland having demonstrated potential to engage in exporting

¹¹¹ Agency export data indicates that Machinery & Equipment contributes 1.7 per cent to total exports and Basic Fabricated Metals contributes 1.3 per cent

Figure 7 Employment in Manufacturing Sectors, Quarter 3 for Each Year, 1998-2012



Source: CSO QNHS, NACE Rev 2112

¹¹² Note: sum data equals 195,600 for Q3 2012. Some sectors that have relatively low levels of employment are not included in this graph due to potential margin of error at detailed sector level. The aggregate figure for Manufacturing Q3 2012 supplied by CSO is 205,700

Although there has been a general downward trend in employment across all manufacturing sectors, further analysis points to a number of areas of interest¹¹³.

In particular, the ICT¹¹⁴ sector has been impacted by a number of global trends:

- In the first instance, Ireland benefited from substantial investment by global telecoms and computer firms during the dot.com era and lead up to Y2K. By 2000 employment peaked at 47,100. The dot.com bust resulted in global employment by these firms being almost halved. At that time, ICT employment in Ireland too experienced considerable decline - but generally fared well in the global context;
- Since then, the continued decline in employment in this sector has been driven by location decisions of foreign firms. As computer products have become increasingly commoditised and prices have dropped, global firms will make logical business decisions to locate operations in lower cost economies to reduce inputs costs. They also locate in high growth markets, closer to a new and expanding customer base.
- More recently the impact of the Dell downsizing has had an impact on a wider cohort of sectors involved in sub-supply.

That said, the ICT hardware sector continues to contribute a significant proportion (12.6 per cent) toward total manufacturing employment at circa 25,000¹¹⁵ and companies such as Intel and EMC play a valuable role as demonstration sites to attract further FDI.

In more general terms, employment in manufacturing continued to decline steadily from 2001 onwards, coinciding with rapid growth in the domestic economy, particularly within construction, public sector and consumption related activities. During this period costs in Ireland rose dramatically, with a 22.5 per cent loss in competitiveness over the period 2000-2008¹¹⁶.

The impact of the global financial crisis that resulted in worldwide consolidation of manufacturing and a sudden drop in demand for exports was exacerbated by Ireland's loss in relative cost competitiveness. Over the period 2007-2008 approximately 50,000 jobs were lost in manufacturing. Aside from the ICT sector much of the decline in manufacturing employment resulted from the post construction boom period that impacted on sectors such as Plastics, Furniture, Wood & Wood Products and Basic Metals.

On the other hand, employment in Chemicals, Food & Beverages and Machinery & Equipment has remained reasonably constant. What is not readily discernible from the CSO data is the continued growth in employment in Medical Technologies and the emergence of Green/Clean Technologies sector.

Further analysis shows an interesting difference in the composition between foreign and Irish owned firms supported by the agencies. Food is by far the dominant sector in the Irish owned cohort¹¹⁷, and there is a good spread across other sectors. Employment is more evenly distributed across three sectors in foreign firms, including Medical Technologies, Chemicals and ICT hardware (Figure 8).

¹¹³ Based on CSO data

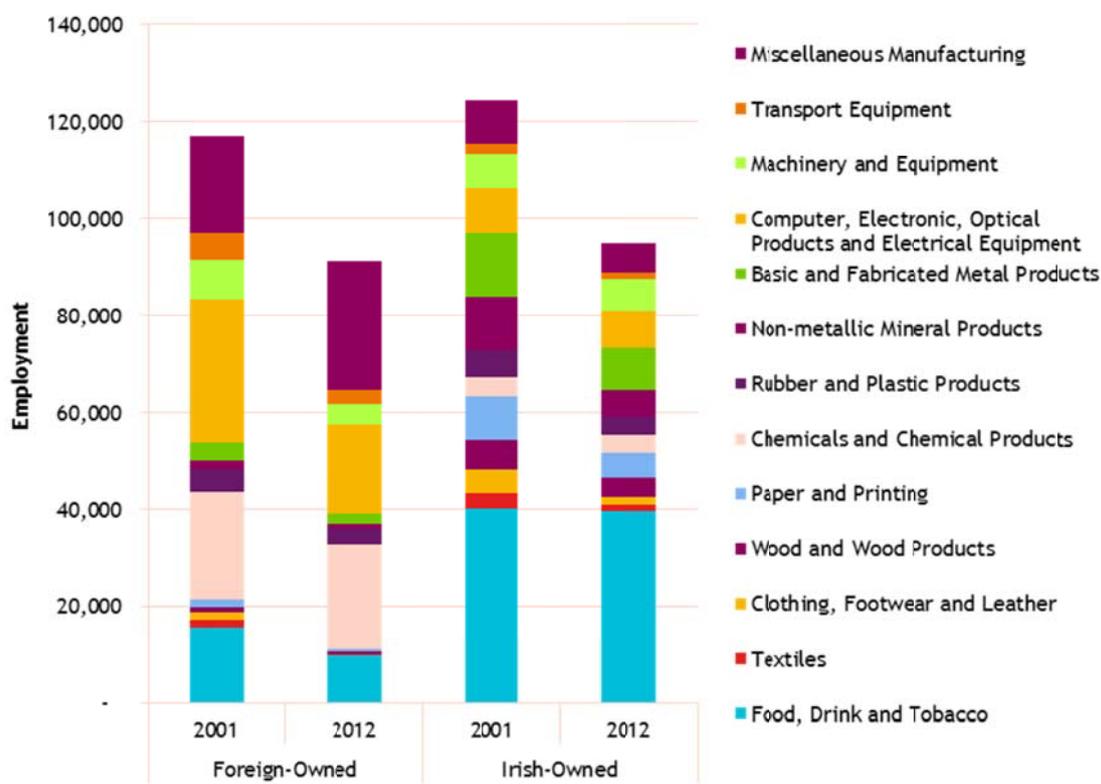
¹¹⁴ NACE code : Computer, Electronic and Optical Products

¹¹⁵ QNHS Q3 2012, CSO

¹¹⁶ The Costs of Doing Business, NCC, 2011

¹¹⁷ Some foreign owned firms sit within the Enterprise Ireland client base including e.g Kraft, Danone

Figure 8 Employment in Agency Assisted Firms 2001-2012



Source: Forfás Annual Employment Survey 2012

Occupational Profiles

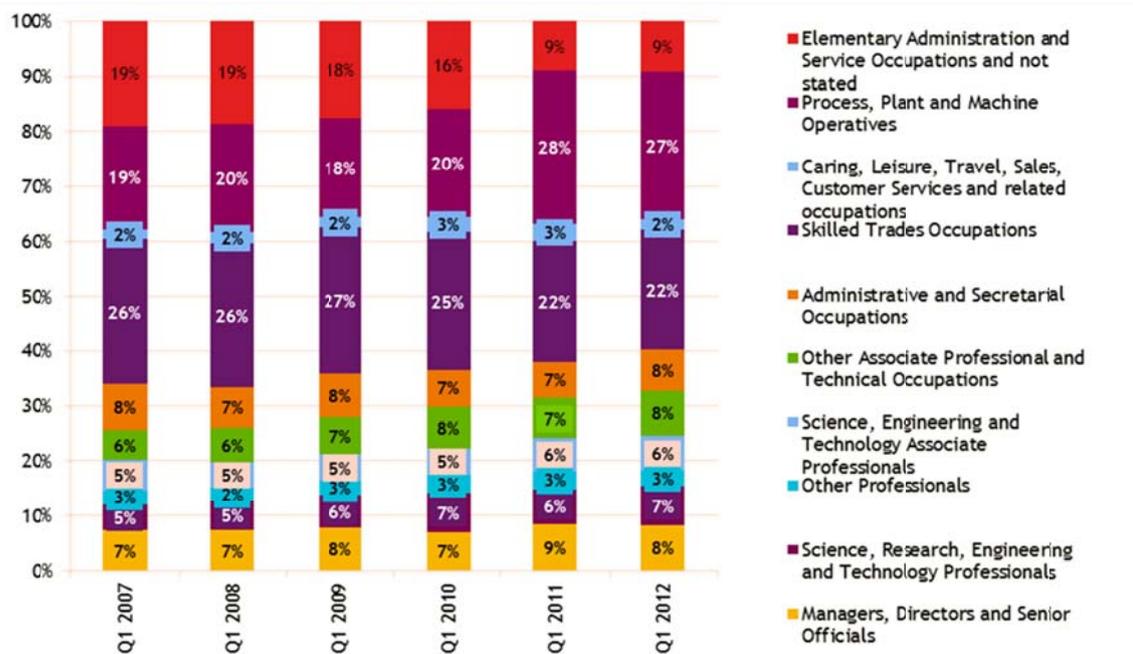
In terms of occupational trends within manufacturing for which data is available it is clear that there is an increasing proportion of higher skilled jobs relative to lower skilled occupations over the period since 2007 (Figure 9 overleaf). From 2007-2012, the proportion of those in managerial, professional and associate professional/technical roles has increased from approximately 25 per cent of total employment to 32 per cent. This highlights that as employment levels have declined over the period (as set out above) those in higher skilled roles have not been impacted to as great an extent as those within production and elementary roles.

This is a function of a number of factors reflecting the changes already in evidence in manufacturing operations. Employment declines have been primarily experienced in more labour intensive activities. The trend toward more technological and knowledge intensive activities increases the demand for higher skills across virtually all roles.

At the same time, Lean manufacturing practices and greater automation further reduce the demand for lower skilled labour intensive roles. For example, elementary/assembly type occupations, as a proportion of total employment, has declined from almost 20 per cent in 2007 to 9 per cent in 2012. Coupled with this decline is an increase in the proportion of those in operative positions relative to elementary roles, indicating an increase in the skills requirements at entry level positions.

In summary, as employment declined from 2007-2012, there has been a greater impact on lower skilled positions, driven by a combination of competitiveness, human capital and technological factors.

Figure 9 Employment in Manufacturing by Occupation 2007-2012



Source: Skills and Labour Market Research Unit (FÁS)/CSO Quarterly National Household Survey

The Changing Nature of Manufacturing in Ireland - *getting behind the employment data*

There is a constant churn of jobs lost and new jobs created, and of firms discontinuing operations, of expansions and of new firms setting up in Ireland.

Employment data can mask the fact that firms themselves have evolved in terms of the nature and range of activities that they undertake in order to remain internationally competitive.

Many foreign owned firms have expanded from (or indeed, replaced) the original investment in manufacturing plants and now have R&D functions, headquarter activities, and centralised functions and are responsible for a number of international operations.

Many indigenous firms are highly productive and innovative and are engaged in research and development. Many more are exporting for the first time. Others have internationalised and have established operations overseas, with a larger employment base than is captured in the data. This evolution is crucial for maintaining and sustaining existing employment in Ireland.

It is a fact that as firms invest in initiatives to 'move up the value chain', and to enhance productivity, the immediate impact may be a reduction in the workforce. As a result, however, such firms are better positioned to take advantage of high growth market opportunities - although future growth will likely be at a lower level of employment intensity, and a higher level of capital and RD&I intensity. The analysis of output and productivity below supports this contention.

We also caution against inadvertently 'writing off' sectors, which although relatively small, play a key role in the overall manufacturing eco-system (e.g. Paper & Packaging, Rubber & Plastics). We are aware of a number of 'traditional' Irish owned engineering firms that have actually increased employment over the past year or two - primarily those that have refocused their strategies toward high growth markets or on niche opportunities and that have built stronger relationships with their customer base.

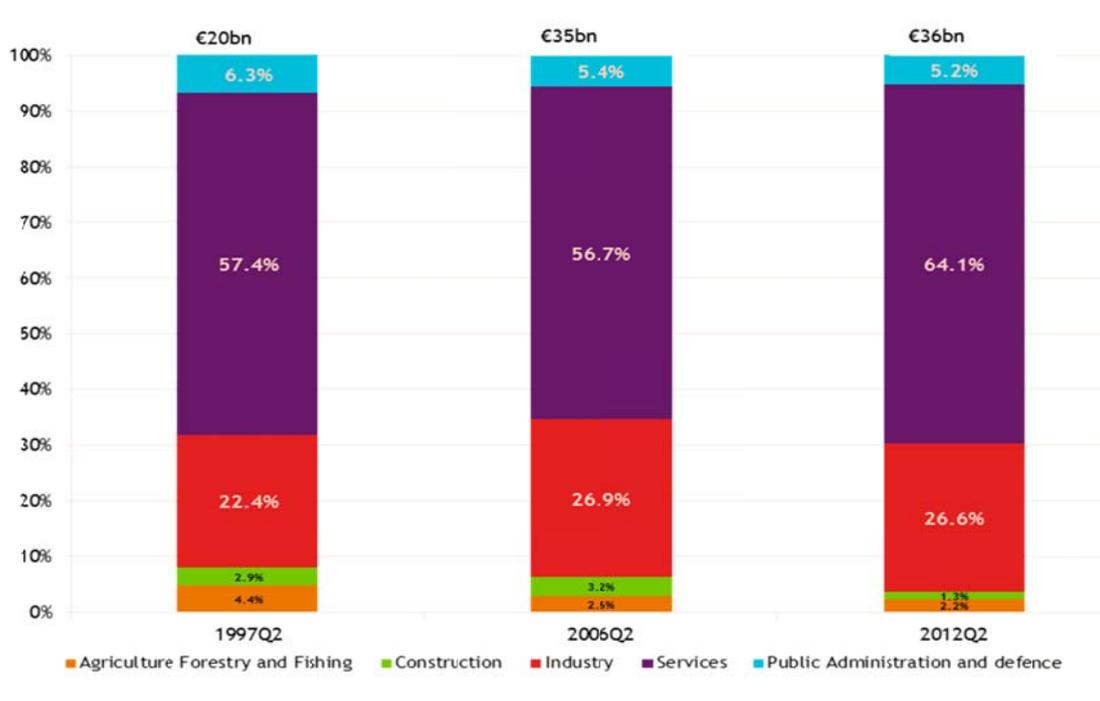
Looking at the concept of adjacent possibilities¹¹⁸ prompts the possibility to draw on core expertise and capabilities (perhaps from a sector that is in decline in Ireland) to stimulate growth in new and emerging sectors and activities - such as the transferability of capabilities and skills in textiles to composites (materials). Because of the limitations in NACE codes, some 'new' and emerging sectors/sub-sectors are not specifically identified in the data, such as Nutraceuticals and Functional Foods, or Clean Technologies.

Output and Productivity

What is evident is that, whereas the total number employed in manufacturing has declined (both in numbers and in contribution), the contribution of manufacturing output toward GDP has increased over the period since 1997. Total GDP has increased from €79 billion since 1997 to €143 billion in the full year 2011¹¹⁹. The contribution from Industry has increased from 22.4 per cent to 26.6 per cent (Figure 10 overleaf).

From a policy perspective, particularly during this period of high unemployment, this phenomenon presents a conundrum.

Figure 10 Contribution to GDP, Quarter 2 for 1997, 2006 and 2012



Source: CSO, National Accounts, Chain-Linked¹²⁰, Seasonally Adjusted, at constant factor cost

¹¹⁸ Adjacent possibilities started with evolutionary biologist Stuart Kauffman, which holds that an idea will catch on, or be readily adopted, if it is sufficiently adjacent (conceptually or technically closely related) to existing ideas that currently dominate a given market. See Chapter

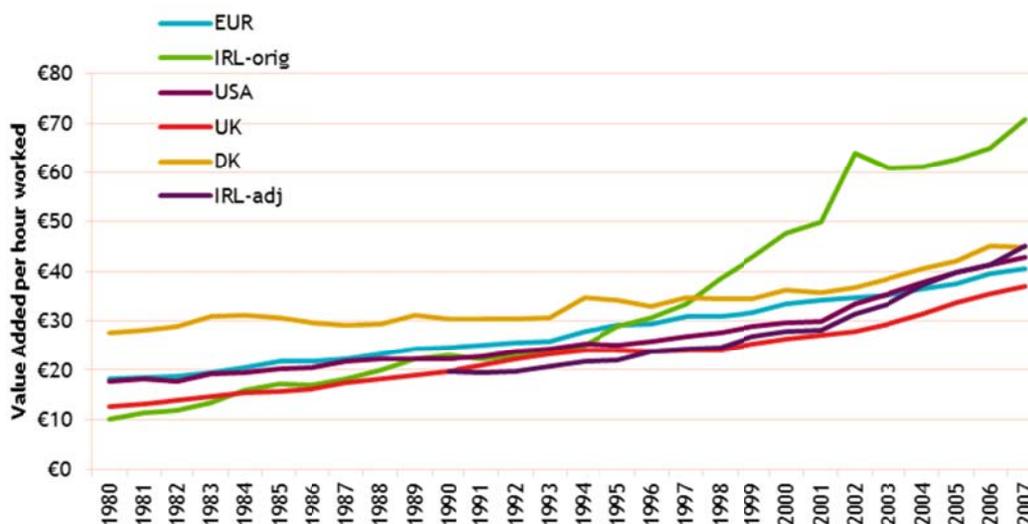
¹¹⁹ Quarterly National Accounts Q2 2012, CSO

¹²⁰ At constant prices, two measures (output and expenditure) are used in GDP. These measures are now being produced using annual chain linked indices. A consequence of this method is that the individual components of GDP at reference year values do not add to the total. CSO National Accounts Extract

According to analysis undertaken by the National Competitiveness Council (NCC), Ireland's productivity performance across the economy has been comparatively strong over the period 1980 to 2011¹²¹. By 2011, Ireland's productivity levels were above the figures for the OECD and Euro area averages, the UK and Denmark. In addition, the productivity gap between Ireland and the US has narrowed substantially. Irish productivity growth rates have averaged 2 per cent per annum between 2007 and 2011, with particularly strong growth recorded in 2009 and 2010. This compares with 1.3 per cent in the US, 1 per cent in the OECD and 0.4 per cent in the Euro area. Above average productivity growth combined with lower than average inflation has resulted in improved Irish competitiveness.

In terms of the manufacturing sector, there is a large variance across sectors. The NCC analysis looks at both 'traditional' manufacturing and 'modern' manufacturing¹²². Although productivity levels (measured in terms of output per hour worked) across the traditional manufacturing sector rose from €12 in 1980 to just below €30 in 2007, it remains below the EU average of €36. Adjusted productivity levels for 'modern' manufacturing rose from €10 an hour in the early 1980s to €57 per hour in 2007¹²³. Overall the average productivity in the entire manufacturing sector is €45 an hour in 2007 (taking into account the adjustments for 'modern' manufacturing) (Figure 11).

Figure 11 Output Per Hour Worked in the Modern Manufacturing Sector, showing both Original and Adjusted for Ireland, Selected Economies, 1980-2007



Source: EU KLEMS 72-Industry Database, March 2011

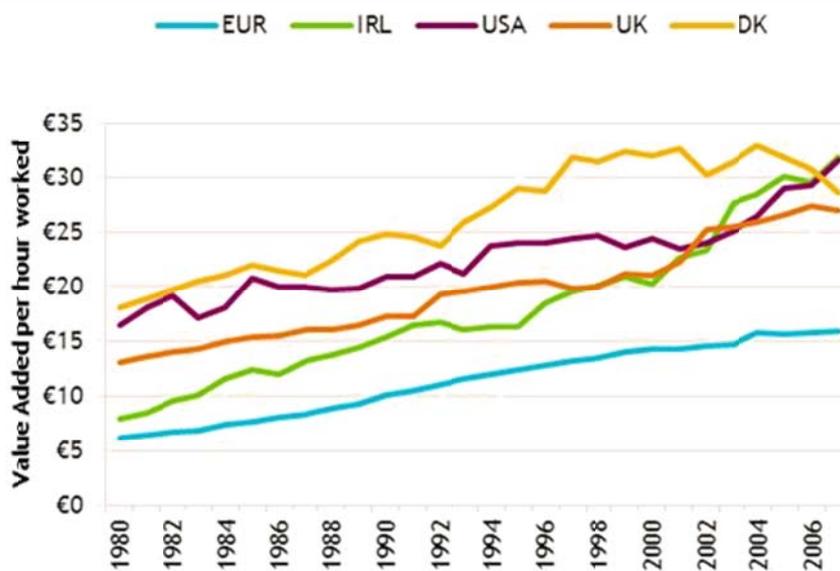
¹²¹ Ireland's Productivity Performance 1980-2011, NCC 2012

¹²² Traditional manufacturing includes textiles, Wood/Paper, Materials/Minerals, and transport manufacturing/furniture (relatively small industries in the Irish economy). Modern Manufacturing includes Chemicals, Electrical Equipment and Printing/Publishing

¹²³ Productivity in chemicals in particular is subject to volatile swings, which may reflect factors unrelated to worker productivity, such as the price of drugs. Using the rich detail contained in the EU KLEMS industry database, observed productivity levels were replaced with US productivity levels (reflecting the fact that the US is the single largest source of FDI into Ireland) to present a more accurate picture. The unadjusted output per hour worked for modern manufacturing was €70 per hour in 2007

Particularly interesting has been the increase in productivity in the Food sector since 2000, to levels of more than twice the EU average in 2007 (Figure 12 overleaf). Since 2002 productivity levels in the Irish food-processing sector have also exceeded its high-productivity Danish counterpart. This improvement is, at least in part, attributable to the breadth of expertise built up by Irish companies, investment in RD&I, and engagement in agency initiatives such as Leadership for Growth and Lean. It is also evident that the stock of ICT capital investment has grown considerably over the period since 1990 and that there is more efficient use of capital by the more traditional manufacturing sectors¹²⁴.

Figure 12 Output Per Hour Worked in the Food Processing Sector, Selected Economies, 1980-2007



Source: EU KLEMS 72-Industry Database, March 2011

Some of Ireland's productivity gains since 2007 have arisen because of cyclical factors. Up to a third of Ireland's productivity growth since 2007 can be explained by the reduction in hours worked (i.e. a sharper reduction in employment in sectors with lower than average productivity has increased average productivity). As the number of total hours worked has stabilised, national productivity growth rates have returned to pre-recession trend. From a policy perspective we need to focus on embedding structural productivity enhancements.

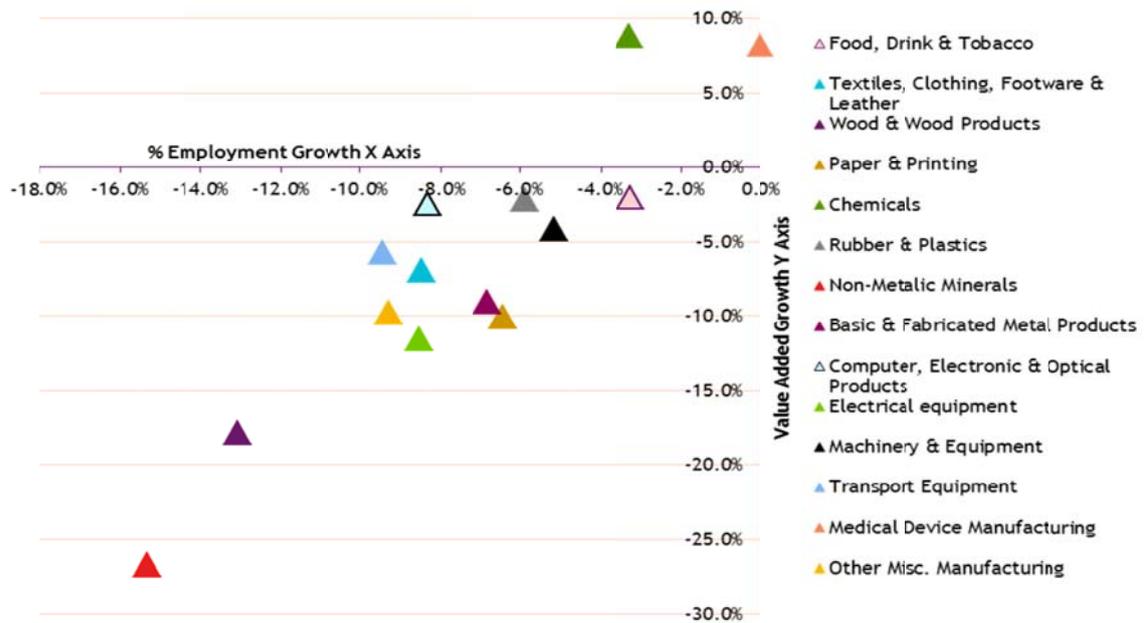
Value Added and Employment

An analysis of employment growth and growth in value added across sectors provides interesting insights. Although based on a short time period, and a recessionary period at that, the following paints a somewhat stark picture facing manufacturing in Ireland today. The high performers are in evidence - Chemicals and Medical Devices - as is the significant negative impact of the construction bust on related sectors such as Wood and Wood Products. There is a cohort of sectors

¹²⁴ The average annual growth rate in the stock of ICT capital in Ireland was in excess of 14 per cent during the 1990 to 2011 period. The corresponding rate of non-ICT capital was 4 per cent

that 'could go either way' with some indications that Value Added has reduced at a lower rate than employment, such as Computer, Electronic and Optical Products, Food and Rubber and Plastics and vice versa, such as Basic and Fabricated Metal Products and Paper and Printing - as individual companies readjust (Figure 13 overleaf - does not indicate scale of sector).

Figure 13 Employment and Value Added Growth, Agency Assisted Firms 2007-2011



Source: ABSEI, based on CAGR 2007-2010 for employment and value added Regionally Dispersed

Success in Ireland - The Shingo Prize for Operational Excellence

Wexford-based medical device company Lake Region Medical (LRM) has become the first company in the Republic of Ireland, as well as the first medical device manufacturer in Europe, to be awarded the global Shingo prize for operational excellence.

The company, a subsidiary of the Minnesota-headquartered LRM, employs 750 people at its manufacturing plant in New Ross in Co Wexford and another 100 people at its international research and development centre in Galway, since it acquired Brivant Medical in 2009.

LRM itself was founded in 1947 in the US by two former Honeywell employees, with an investment of US\$400. The company is an original development manufacturer of minimally invasive devices and components with clinically-focused product innovations. It opened its New Ross manufacturing plant in 1994. The New Ross division of LRM won the Shingo Accreditation Bronze Medallion for Operational Excellence. The Shingo Prize itself is a non-profit organisation that is based at the Jon M. Huntsman School of Business at Utah State University. It is named after the Japanese industrial engineer Shigeo Shingo, who became a global thought leader on manufacturing practices and creating operational excellence.'

Extract from Press Release <http://www.siliconrepublic.com/innovation/item/27651>

Regionally Dispersed

Manufacturing in Ireland is regionally dispersed - almost 83 per cent of employment is provided in locations outside of Dublin, ranging from 7 per cent of total employment in the Midlands to the highest at 18 per cent of total employment in the South West. Manufacturing provides employment across a range of different disciplines and competences for over 200,000 people directly¹²⁵. Manufacturing firms tend also to locate outside of, or on the periphery of urban areas, unlike services sectors which tend to aggregate in larger urban areas. Whereas there is a wide 'scattering' of smaller manufacturing firms in evidence throughout the country, larger firms tend to locate in areas that provide them relatively easy access to an available skilled workforce and to end markets. The regional distribution highlights the importance of physical infrastructures such as road and rail for ease of access to markets, reliable access to critical infrastructures such as energy, waste (including hazardous waste) and waste water and increasingly for manufacturing firms, access to high quality broadband.

There is also evidence of a concentration of particular sectors based on an analysis of location quotients¹²⁶ (LQs) (which is a measure of spatial concentration of sectoral employment); for example Pharmaceuticals and Dairy processing in the South West, and Medical Devices in the West of Ireland. As discussed earlier in Chapter 3, a true cluster involves a high level of interaction between firms, as distinct from the fact that a number of firms are geographically proximate. However, the basis for clustering exists where a regional LQ is accompanied by a large number of firms in the sector in question. Proximity of research institutes is also relevant in this regard.

Exports

As a small open economy, exports are vital to Ireland's economic growth. In 2011 total goods exports were €91 billion¹²⁷ (services exports were €81 billion). Exports have been the only component to contribute to GDP growth over the years since 2009 - reflecting its importance as a key driver of economic recovery¹²⁸.

Agency assisted manufacturing companies account for approximately 95 per cent of total manufacturing exports¹²⁹, which have increased from €54.8 billion in 2000 to €78.5 billion in 2012, representing a 3.2 per cent average annual increase in the period.

The four key contributors are Chemicals/Pharma, ICT/optical products, Medical technologies and Food.

The ICT sector exports have declined overall in value terms over the period since 2000, although have returned to growth post the Dell downsizing. Chemicals/Pharma alone represents 55 per cent of total agency exports - indicating a high reliance on this sector in Ireland's economy. There has

¹²⁵ Based on analysis of CSO data for Industry (taken as a proxy for manufacturing), Q3 2012

¹²⁶ A sector's share of employment in an area divided by the sector's share of employment nationally. An LQ of greater than 1 indicates a disproportionately high share of employment in a sector and an LQ of greater than 2 indicates a significant level of sectoral concentration NUIJ, NIRSA

¹²⁷ Goods Exports and Imports, January 2012, CSO. Goods are categorised according to SITC codes and include some non-manufactured products such as live animals, cereals and mineral ores. These are different from NACE sectoral codes. Using figures from the Balance of Payments, goods exports were €85bn and services were €81bn in 2011

¹²⁸ Ireland's Competitiveness Scorecard, NCC, 2012

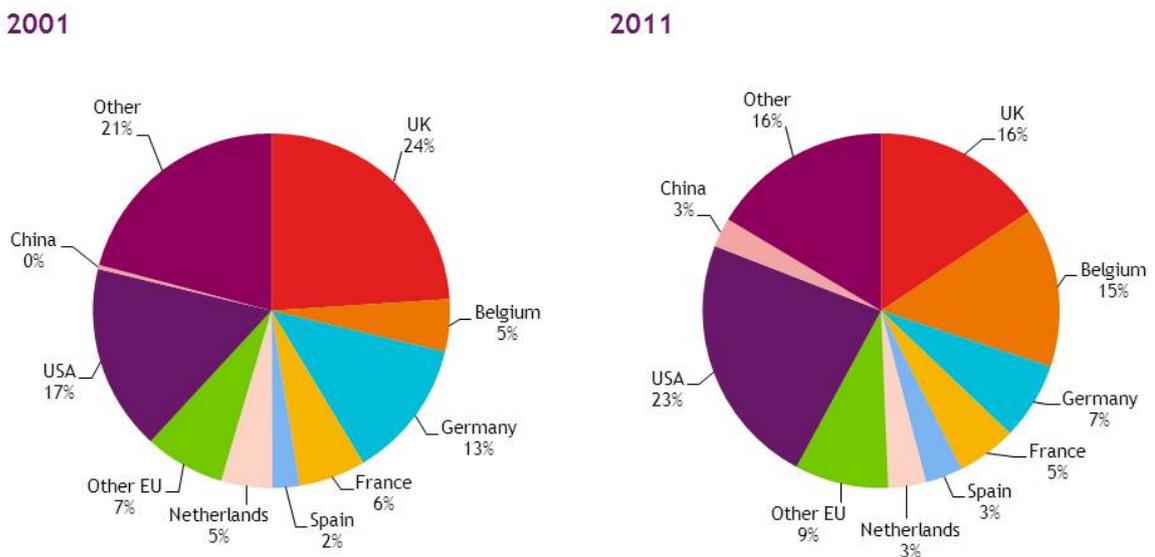
¹²⁹ Based on CIP 2010 data (€76bn) and ABSEI 2010 data (€72 billion)

been much discussion regarding the impending 'patent cliff' for the sector as more products come off patent and the challenge that this presents for Irish based firms. IDA Ireland is working closely with companies to address this within the context of their parent company strategies. Another point of interest is that Chemicals/Pharma relate primarily to foreign owned firms, many of which are involved in the production of active pharmaceutical ingredients (API) and/or formulation which are not for final use. It is reasonable to conclude, therefore that much of these exports are intra-firm - based on transactions between affiliates rather than end customers or markets.

Although on a considerably smaller scale, Food is the predominant performer amongst Irish owned firms. At €5.8 billion, Food and beverage contributes 61 per cent toward Irish owned firms' exports¹³⁰. Although they experienced a recessionary dip, *total* Food exports (by Irish and foreign-owned firms combined) have rebounded with an increase of 11 per cent between 2009 and 2012 to €10.6 billion. The increased focus on the sector since the publication of Harvest 2020, including the targeting of high growth markets; the establishment of the high level Interdepartmental Implementation Committee; the engagement by Food companies in Enterprise Ireland's productivity initiatives and management development; as well as their engagement in programmes offered by Bord Bia and Teagasc are likely to have played a contributory role.

The USA and UK continue to be the main export markets for Irish goods exports, and in 2011 the US represented the highest proportion of total exports outstripping the UK (which was the primary export destination in 2001). A significant increase was experienced in the value of exports to China (approximately 600 per cent). The increase in the proportion of exports being routed to Belgium is interesting, although may be more a factor of the classification by the CSO of final destination (which may not be where the goods are ultimately unshipped) (Figure 14).

Figure 14 Destination of Ireland's Goods Exports, Per centage of Total 2001,2011



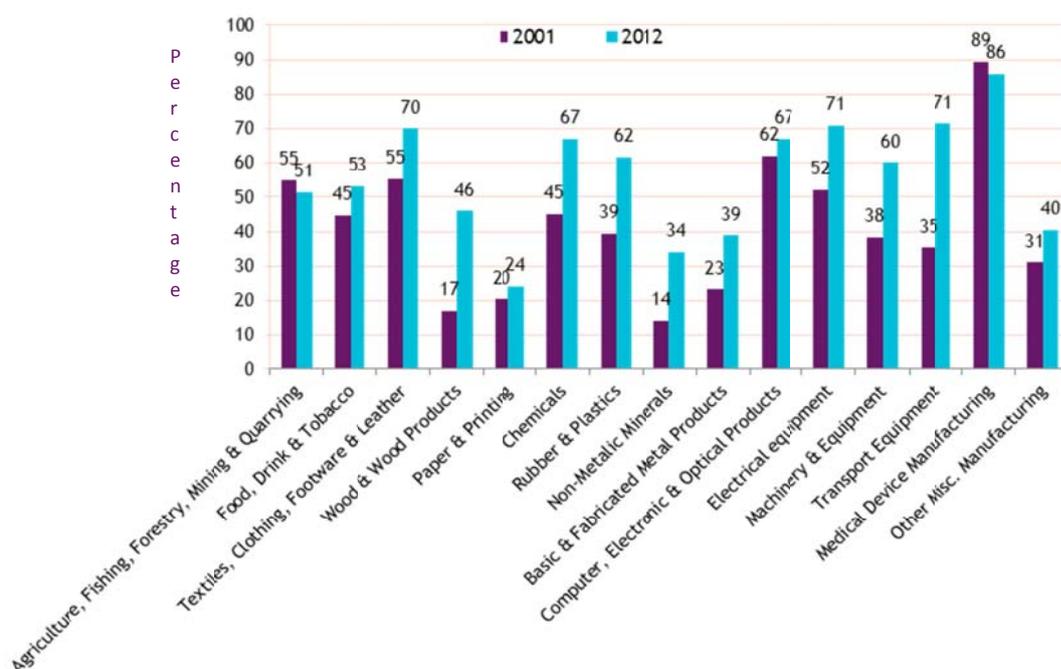
Source: CSO External Trade Bulletin

¹³⁰ Irish owned agency assisted firms. ABSEI 2011, Forfás, 2012

In terms of export intensity, on average agency assisted Irish owned firms exported an estimated 53 per cent of total sales in 2012. Further analysis shows an export intensity ranging from 24 per cent to 86 per cent depending on the sector, providing insights into those most likely to be involved in sub-supply (e.g. Paper & Printing, Wood & Wood Products, Rubber & Plastics) (Figure 15).

Over the period since 2001 there has been an increase in export intensity across all sectors with the exception of Medical Devices (although the export intensity for this sector remains highest at 86 per cent), and Agriculture, Fishing, Forestry, Mining and Quarrying.

Figure 15 Export Intensity (Exports as a Percentage of Sales) of Irish Owned Firms by Sector : 2001 & 2012



Source: Forfás ABSEI

Direct Economy Expenditure (DEE)

Direct Economy Expenditure (DEE) relates to total payroll costs, and materials and services sourced from Irish suppliers. The total value of DEE by manufacturing firms declined by 15 per cent since its peak in 2007, to a value of €21.7 billion in 2011¹³¹. Focusing on materials and services purchases, a downward trend is evident. Irish sourced purchases reduced from €17.5 billion in 2001 to €14 billion in 2011 in current prices. More disconcerting is the fact that total purchases increased over the same period - that is, a lower proportion of inputs is now sourced from Irish based companies (29 per cent in 2011, compared with 41 per cent in 2001).

¹³¹ ABSEI 2011, Forfás 2012

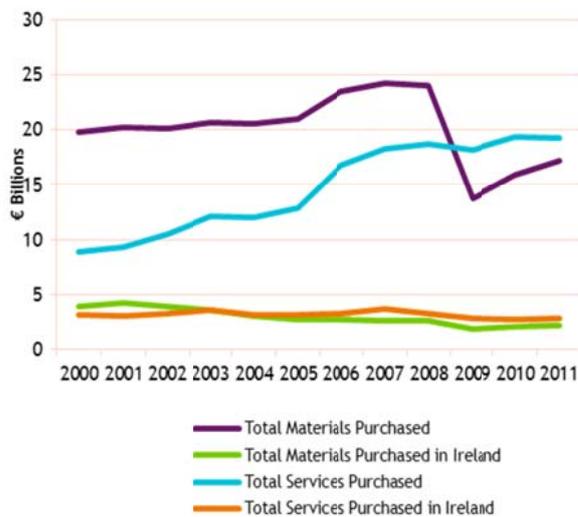
Sectoral analysis shows that the Food sector sources the greatest amount, and the highest proportion, of its inputs locally - which is not surprising given the nature of the sector. The inter-linkage between sectors is also in evidence - such that the 'performance' of purchases sourced locally and the growth/downsizing of a 'primary' sector broadly align. For example Wood & Wood Products reflect the trend of the boom and bust of the Construction sector. The decline in total purchases of materials by foreign firms can be largely explained by the downsizing of Dell.

There are some differences between the purchasing patterns of foreign firms and Irish owned firms. The increase over time in total purchases of services by foreign owned firms is in evidence, more than doubling over the decade since 2000 to reach almost €20 billion, and now exceeding total purchases of materials. The proportion of materials and services sourced locally continues on a downward trajectory.

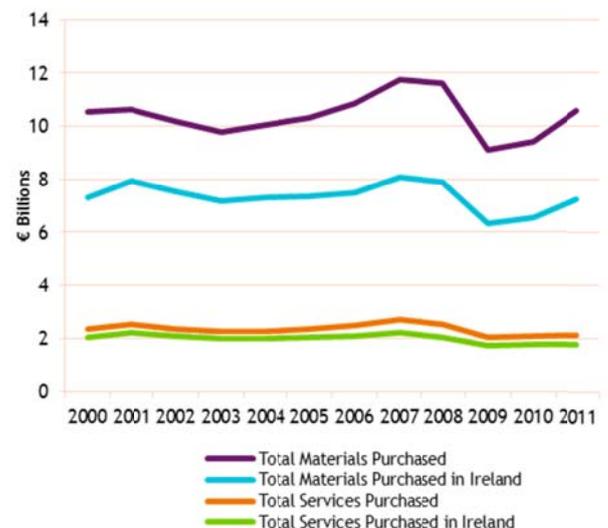
Indigenous firms, on the other hand, procure a higher total of materials than services, although this is highly influenced by the Food sector. The proportion sourced locally mirrors the trend in overall purchases (Figure 16).

Figure 16 Irish Sourced Materials and Services by Manufacturing Firms 2000-2011

Foreign-owned Manufacturing Companies



Irish-owned Manufacturing Companies



Source Forfás ABSEI 2011

There may be many reasons for this decline in procurement of goods and services from the local market:

- Purchasing decisions by foreign firms may be made at a global level, and fall outside the responsibility of the Irish plant;
- Components may no longer be produced in Ireland (e.g. PCB boards as inputs to the ICT Sector);
- The decline in Ireland's relative cost competitiveness may have negatively impacted on sourcing of services, combined with the increasing ease with which services can be traded across borders (logistics, facilities, catering etc.);

- There may be a lack of awareness of what is available from Irish based suppliers; and
- In some instances, Irish producers may not be accredited to meet the required standards for the more highly regulated sectors such as medical devices.

Suffice to say, that this is an area of keen interest to Irish based manufacturers.

Research, Development and Innovation

There has been significant increase in State investment in R&D over the past decade. Since 2000 Gross Expenditure on R&D has more than doubled to €2.8 billion in 2010.

For both manufacturing and services firms BERD was €1.9 billion¹³² in 2011. A steady increase was recorded over the years since 2001 when expenditure was €900 million up to 2009, and has been reasonably stable over the past two years. Of interest is the fact that although the number of firms engaged had been reasonably constant at circa 1,300 over the past decade, the data indicates that 1,608 firms were engaged in 2011, representing a 25 per cent increase on 2009. Other indicators show that for both manufacturing and services:

- The scale of activity is relatively modest with 72.6 per cent of all enterprises spending less than €500,000, and circa 9.6 per cent spending €2 million or more on R&D activities;
- The greater proportion of R&D activity relates to experimental development at 71.4 per cent. Experimental development is closer to market, drawing on existing knowledge to develop new, or substantially improve products, processes, systems and services;
- Approximately 24 per cent of enterprises were engaged in applied research that involves original investigation, primarily directed toward a specific practical aim or objective;
- Although foreign owned firms contributed highest proportion to BERD at 71 per cent, Irish owned enterprises were more likely to engage in basic research¹³³ compared to foreign owned enterprises while the opposite was evident with regard to experimental research. Small enterprises were more likely to engage in basic and applied research compared to medium/large enterprises.

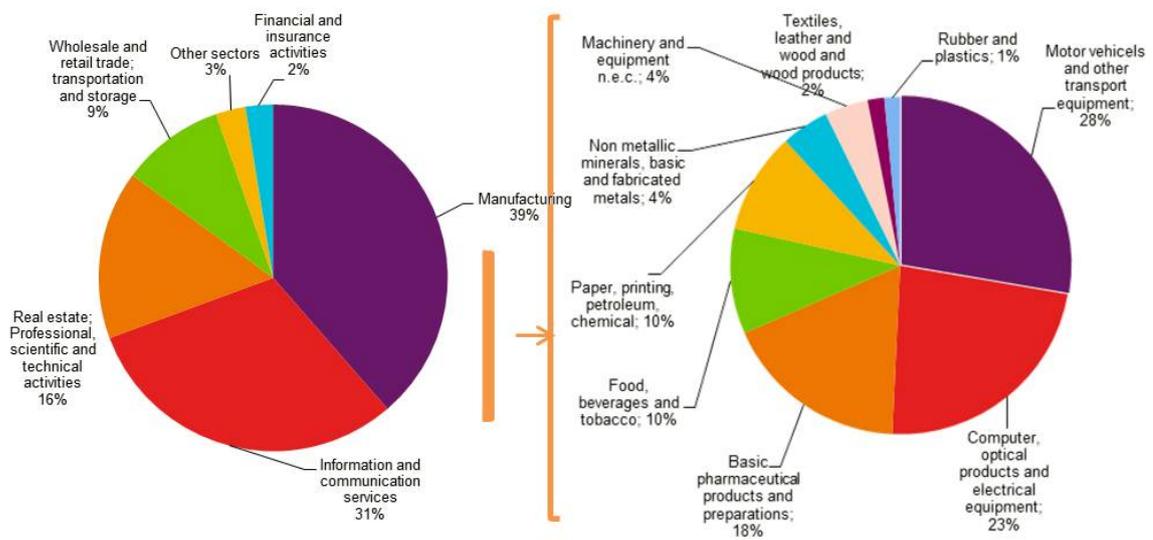
A sectoral breakdown for manufacturing indicates that 18 per cent of manufacturing BERD relates to the Pharmaceutical Products Sector, 23 per cent relates to Computer, Electronic and Optical Products, followed by Food, Beverages and Tobacco at 10 per cent (Figure 17 overleaf).

It is difficult to ascertain the extent of BERD being undertaken by the Engineering sector - but if we look to those most 'akin' to engineering (including Machinery and Equipment, Basic/Fabricated Metals, Rubber & Plastics) it equates to 9 per cent of BERD. In general, engineering firms (in particular foreign owned engineering firms) appear to be relatively inactive in terms of R&D. Analysis undertaken by Forfás indicates that foreign owned engineering firms accounted for less than 1.5 per cent of the R&D projects approved under the IDA Ireland R&D programme over the period 2003 to 2009.

¹³² Business Expenditure in Research and Development 2011/2012, CSO, 2013. R&D is defined as creative work undertaken on a systematic basis in order to create new or improved products, processes, services or other applications

¹³³ Basic Research is defined as theoretical work undertaken primarily to acquire new knowledge, without any particular application or use in view

Figure 17 Business Expenditure R&D (BERD) by Sector, NACE Rev 2, 2011



Source: Business Expenditure on R&D 2011 (CSO/Forfás)

Looking specifically to innovation metrics collated and published in the Community Innovation Survey¹³⁴ (CIS) some interesting facts emerge. Innovation is defined as *the introduction of a new good / service or process, or a significantly improved good/service or process or service*. In general, manufacturing firms tend to be more innovative than many services firms¹³⁵. 54.2 per cent of manufacturing firms are innovation active, almost 14 per cent higher than services.

There is currently greater activity in process innovation than in product innovation in manufacturing firms. As manufacturing processes become increasingly complex, and as firms seek to introduce new products and new materials, to increase sustainability, and to tighten supply chains, process innovation is likely to become even more important. The data does not provide any insights into the extent to which there are inter-linkages between process R&D and product development in the manufacturing context and New Product Introduction (NPI).

The CIS data shows:

- The overall level of innovative activity within Irish firms at almost 45 per cent compares relatively well within an EU 27 context. Ireland ranks 7th overall in terms of innovation activity (rates are highest for Germany - 63 per cent, Belgium - 52 per cent and Finland - 51 per cent). Despite the relatively strong ranking, more than half of all firms in Ireland are not innovation active;

¹³⁴ The Community Innovation Surveys are a series of surveys executed by national statistical offices throughout the European Union and in Norway and Iceland. The harmonised surveys are designed to give information on the innovativeness of different sectors and regions. Data from these surveys is used for the annual European Innovation Scoreboard and for academic research on innovation, with over 200 papers using the CIS data published

¹³⁵ Services firms include: wholesale trade (except motor vehicles); transportation and storage; publishing activities; telecommunications; computer programming, consultancy and related; information service activities; architectural and engineering activities

- Industrial enterprises involved in technological innovative activity have an average Gross Value Added per person of over €194,000 compared to €129,900 for non-innovative enterprises¹³⁶;
- Technological innovative industrial enterprises are more likely to be engaged in exporting (73 per cent), while only 49 per cent of non-innovative enterprises export;
- The principal barriers to innovation for Irish industrial firms (whether engaged in innovative activity or not) are lack of funds (including external finance), high costs involved, and uncertain demand for innovative goods/services;
- Innovation activity amongst smaller firms in Ireland is relatively low at 40 per cent; the corresponding figure for medium and large companies is 61 per cent and 76 per cent respectively; and
- Approximately 32 per cent of all industrial enterprises involved in innovative activity in Ireland engaged with other enterprises and institutions for this activity. Ireland ranks 20th out of the EU 27¹³⁷ in terms of prevalence of innovation cooperation.

Overall, the data suggests that there is room for improvement. The relatively lower innovation rate amongst small firms in Ireland is of concern and suggests a need for policy focus in this area, particularly given the high proportion of manufacturing firms that are small.

Nevertheless it would appear from the BERD data that when smaller firms do engage, they are more likely to be engaged in basic and applied research than is the case with medium and large firms.

Conclusion

Manufacturing should continue to play a key role in Ireland's economic recovery. Despite the fact that the numbers employed in manufacturing have declined, exports and GVA have grown over the period since 1997. It is Ireland's openness to trade and export focus that has placed it in a relatively strong position during this recession. The upward trends in Ireland's productivity levels across a number of sectors, as well as investments by firms in RD&I are positive indicators. However, increasing productivity, while essential, is likely to result in a period of low employment growth in the immediate term. This period might be better described as one of restructuring that will see firms in a considerably stronger position to take advantage of growth opportunities.

The next chapter sets out the areas of opportunity for Ireland's manufacturing in the context of global trends and informed by this analysis. There is a basis for growth - although there is room for improvement if we are to reverse the downward trend in employment in manufacturing experienced over the past decade.

¹³⁶ Based on latest available data, 2010

¹³⁷ Excluding the UK and Greece

5 Manufacturing in Ireland 2020 - Potential for a Strong Future

Introduction

Ireland operates in a global and globalised economy. Manufacturing and sectors within manufacturing are evolving at an unprecedented pace. Although a clichéd statement - *the only constant is change*. Many other developed economies are revisiting their manufacturing strategies. Ireland needs to be serious about establishing a differentiated and internationally recognised reputation for manufacturing.

In developing this strategy, Forfás consulted widely with companies about current performance and medium and longer term potential. What was most tangible was the confidence of the sector in the future for manufacturing in Ireland - and individuals' desire and commitment to making a difference.

A Vision for Manufacturing in Ireland

We set out an ambitious, yet realistic vision for manufacturing in Ireland for 2020. By 2020 Ireland will become internationally renowned as:

A place that excels in manufacturing - and where manufacturing adds value

- A place where manufacturing is focused on the **customer** - *Agile, responsive and collaborative*
- A place where **people** make the difference - *Multi-disciplinary and highly skilled with a distinctive capability in simplifying the complex*
- A place that **innovates** in product development and manufacturing processes - *embracing leading edge technologies*
- A place where **quality** is embedded *across business operations, demonstrated by differentiation and a track record in highly regulated sectors*

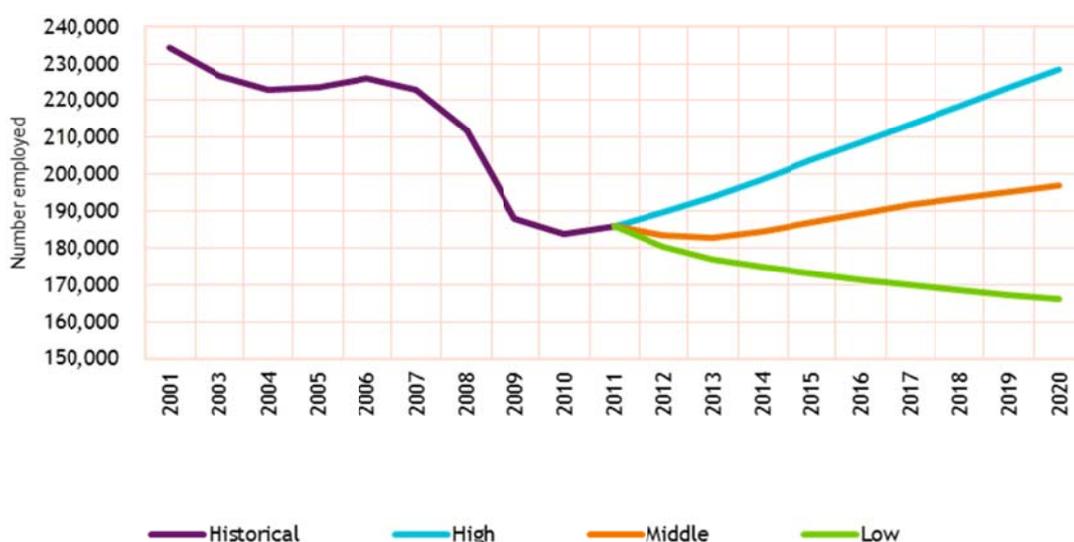
The APJ 2012 set out the overall ambition *to have 100,000 more people in work by 2016 and 2 million in work by 2020* (which equated to an additional 200,000 by 2020 at time of writing). Within this context a *Competitive Manufacturing Scenario* sees the potential for an increase in direct net employment of 43,000 in manufacturing between 2011 and 2020¹³⁸ - direct employment that can have wider positive employment impacts of a similar number of jobs throughout the economy.

This future scenario is not a given. This ambitious estimate will only be realised if actions are taken to address immediate barriers and to make the step change needed to capture new opportunities.

¹³⁸ Based on an analysis of agency assisted employment. The APJ 2012 set out the potential for direct employment of 22,000 people by 2016 - this strategy envisages the potential for an additional 21,000 to be employed in manufacturing by 2020

Some sensitivity analysis leads us toward a mid-range outlook, seeing marginal employment growth. Given Ireland's openness to international trade, external factors over which we have no control may impact upon the *Competitive Manufacturing* high growth scenario. A *Continued Loss of Manufacturing* scenario (a do nothing/or delayed action scenario) could see a further drop in employment in manufacturing of 20,000. More details and underlying assumptions are set out in Appendix II.

Figure 18 Manufacturing Employment Scenarios to 2020



Source: Analysis Based on Forfás Annual Employment Survey Manufacturing Employment Data

It will require commitment from government, the agencies and firms if the *Competitive Manufacturing Scenario* is to become a reality. It requires a more proactive rather than issues based approach to policy development and delivery - so that Ireland is positioned more to the fore-front as it faces intensified competition from other locations for investment and so that Irish firms are competitive on international markets.

Areas of Opportunity

The new models of manufacturing discussed in Chapter 3 set the underpinning framework for the new ways of manufacturing. The *Factories of the Future* (Smart, Virtual, Digital) are the 'now' for many larger global firms. Near term realities face all firms in terms of engagement in Lean principles, Sustainable Manufacturing and the pervasive use of ICTs. Global trends in manufacturing have direct implications for how companies respond to customer needs with agility and flexibility, for how they collaborate, innovate and manage and/or connect to global supply chains and for the ways of working.

A number of opportunity areas are set out below - seeking to build on Ireland's existing sectoral strengths and capabilities in the context of these disruptive changes. Ireland needs to continue to keep abreast of change and to refresh its proposition to attract investment - from new and existing

foreign firms and from start-ups and existing Irish firms across a range of manufacturing and related activities.

A Focus on Sectors: reinforcing the importance of maintaining and reenergising what we have, and on building on strengths in key sectors. New areas of opportunity emerge from adjacent possibilities and convergence. For Ireland, opportunities are considered for:

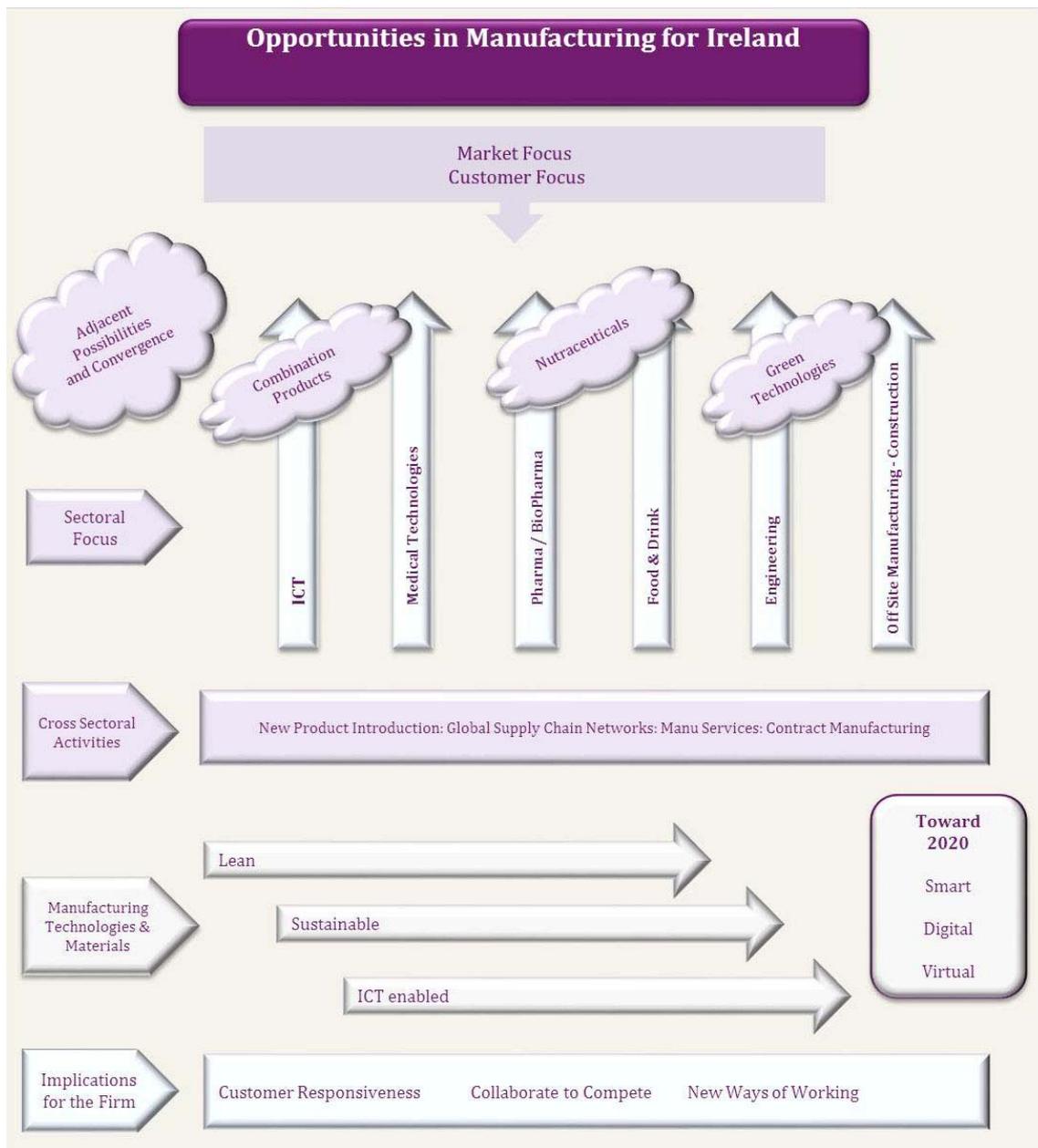
- Food;
- Pharma/BioPharma;
- Medical Technologies;
- ICT;
- Engineering;
- Off-Site Manufacturing – Construction, and
- Adjacent Possibilities & Convergence.

Functions & Activities - Adapting and Responding to Globalisation

- Manu-Services;
- New Product Introduction;
- Contract Manufacturing – Strategic Partnerships; and
- Taking Advantage of Shifts in Global Supply Networks.

Developing and Adopting New Technologies & Materials

The next chapter looks specifically at indigenous manufacturing firms (start-ups and scaling).



A Focus on Sectors - Maintaining and Reenergising What We Have

Concerns have been raised by firms that in the eagerness to identify 'new' sectors of areas of opportunity, the focus may be taken off reinforcing and sustaining the not insignificant 205,700 directly employed in manufacturing today. In order to reach the potential jobs envisaged in the *Competitive Manufacturing Scenario*, it is crucial that a focus is maintained on sustaining the jobs already in existence in manufacturing. Minimising job losses will play a key role in achieving net job growth in manufacturing by 2020.

This is not intended to mean 'propping up' entities that do not have the where with all to adjust. There will always be a constant churn in employment as firms re-structure globalised operations and adapt to economic circumstance. Closures are a reality in the business world. Indeed, policy makers and firms have no control over external factors in terms of economic growth, industry cycles or disruptive technologies.

However, steps can be taken by firms, and by the Government to support firms, to reposition themselves - to invest in identifying new market opportunities, enhancing productivity and in building innovative capacity so that they remain competitive and relevant to their existing and potential customers.

For multinational subsidiaries based in Ireland, their positioning within corporate global strategies is crucial. This may involve garnering responsibility for specific product lines or territories, benchmarking favourably against sister sites, and/or involve responsibility for centralised functions such as shared services, Supply Chain Management (SCM), customer support, RD&I and a broad range of headquarter activities.

Many existing firms in Ireland have already invested in the necessary changes. Many others may not have accepted that there are things within their own control. An overarching priority in this regard is leadership and management capability. Strong leaders will take the actions necessary to:

- Enhance productivity by embracing Lean and/or Six Sigma principles and new ways of working, and by investing in capital equipment and automation;
- Develop innovative capabilities and capacities;
- Invest in upskilling or reskilling employees;
- Seek out and establish new partnerships;
- Identify and embrace new business models;
- Diversify their customer or market base;
- Invest in ICTs to connect with customers, suppliers and partners and to drive efficiencies; and/or to
- Identify ways in which to improve energy efficiencies.

Companies themselves determine the strategic direction most relevant to them - it is not the role of the State to be prescriptive - although it can play a strong supporting role. The enterprise development agencies provide a range of advisory services and supports to assist firms in transformational change, development and sustainable growth.

State interventions at the level of the firm are likely to have considerably less impact if key issues within the business environment are not tackled urgently. There are two critical areas that need to be addressed so that Ireland can realistically sustain its existing manufacturing base in the first instance, and attract further investment (both foreign and Irish) in the second:

Enterprise Ireland - Supporting Lean

- LeanStart with a focus on value, involves a short in-company assignment by an external consultant to introduce Lean principles and complete a specific cost reduction project. Assignments typically extend over eight weeks.
- LeanPlus with a focus on performance improvement, involving a longer term assignment of not less than six months, working with an external business development consultant. The assignment will result in sustained use by the company of Lean techniques and will deliver measurable gains in company capabilities and competitiveness.
- LeanTransform which involves an extensive holistic company transformation programme by an external consultancy team of international reputation. It will embed the culture and competences necessary for ongoing competitiveness gains, sustainable continuous improvement and business transformation across the business and its supply chain.

- Addressing relatively high cost base in areas of direct relevance to manufacturing firms; and
- Finding solutions to address the need of primarily indigenous firms to access finance in a timely manner and on reasonable terms.

Chapter 7 reviews the current eco-system and challenges, and discusses the aspects of cost competitiveness and access to finance (including State Aids) in greater detail.

A Focus on Sectors - Building on Strengths

Successful companies and sectors are those that focus on market opportunities. Aging populations, environmental concerns, increased affluence in emerging markets, increasing digitisation and changing consumption behaviours are driving growth in markets such as healthcare, wellness, food, green technologies (including energy, water etc.) as well as for more customised products and services in markets such as ICTs, consumer products and automotive. Ireland has demonstrated its ability to address market opportunities, and has strengths in a number of relevant manufacturing sectors¹³⁹. None of these sectors is static. Even what may be categorised as mature or traditional sectors are evolving in response to (sector specific) global drivers of change. There is an increased blurring across sectors and previous distinctions are less pronounced. This is particularly evident where we discuss a sector in its own right and in terms of its pervasive impact across all others and in terms of 'newer' convergent areas.

For Ireland, it is about maintaining and further developing sectoral strengths and manufacturing capabilities and about being well connected and strategically positioned within global value chains. Ireland's sectoral strengths are underpinned by distinctive factors such as its natural resource base, excellent track record in regulated sectors and high levels of capital intensity.

The following sections set out a brief overview of sector specific opportunities and challenges.

¹³⁹ It is important to distinguish between a market opportunity and the sector(s) that serve them - a number of sectors may address a particular market opportunity. For example, market opportunities arising in healthcare and in medical devices are serviced by sectors involved in medical technologies, diagnostics, pharmaceuticals, engineering, materials and electronics

Case Study : DePuy Ireland - Transformational Change in Action

DePuy Ireland is a member of the DePuy family of companies within the Johnson & Johnson Medical Devices and Diagnostics Group and is supported by IDA Ireland. Established in Co. Cork in 1997, the 100,000 sq. ft. DePuy Ireland manufacturing facility is the largest in the DePuy family, directly employing over 700 people, and producing 1.9 million units per annum (in 2011/12). To date, the manufacturing focus at DePuy Ireland has been on the production of orthopaedic knee and hip products for global markets; 2012 brought an extension of the product portfolio in the form of orthopaedic shoulder and ankle products.

In 2006, the DePuy Ireland management team initiated a programme of business transformation, seeking a step change in the Cork operation to reposition the facility within both the Group and wider market. This decision arose as a result of recognition that the operating model underpinning the Cork operation had largely run its course, and was constraining further efficiency and output gains. At the heart of this push for a step change in the firm's competitiveness and operating agility was a strategy of pairing a robust Lean agenda with a 'top-down, bottom-up' culture change programme.

Past attempts to embed Lean behaviours in the business had faltered, largely because the underlying cultures on the site had not changed. In developing the 2006 programme, therefore, migration to a 'high performance culture' was recognised as a pivotal requirement and, as such, considerable effort was given to workforce engagement processes. This included involving all staff in the development of 'Behavioural Standards' aligned with the critical operational challenges then facing the business. Six behavioural standards were agreed:

- When there are problems, ask 'what happened?', 'why did it happen?', 'how do we prevent it?' NOT 'who did it?'
- If it needs to be done, get it done
- Listen to people, involve them, and appreciate what they've done
- Don't hesitate to encourage, and to ask for and give help when needed
- Challenge own and others': 'talking behind people's back', 'inaction', 'breach of these standards', 'expectations', 'assumptions'
- Treat others as you'd like to be treated.

Alongside this process of culture change, the DePuy Professional Development Programme was introduced to encourage and enable all staff to think actively about problem solving and continuous improvement. This helped to monitor firm-level competence, and to identify emerging skills needs across the business. A core feature of the Programme has been the commitment to build leadership capability within the facility's operational teams. Open Innovation has also been core to DePuy Ireland's development since 2008, when its Innovation Centre was set up, with a remit to lead process development into next-generation orthopaedic products and advanced manufacturing processes.

Business transformation has unlocked the capacity of the Cork facility and its workforce, enabling significant advances in efficiency and output. The facility is now recognised as a best-practice Lean benchmark within the DePuy Group, a status that has enabled Cork to secure a central role in new product rollout and to attract new products and advanced manufacturing projects from across the global DePuy operation.

De Puy directly attributes the success of its Lean programme to the fact that it engaged, empowered, and maximised the workforce's skills and talent in ways directly aligned with the issues that the business was facing.

Developed by SQW, December 2012

Food

Global demand for food is expected to increase by 30 per cent over the period to 2020, driven by global demographic, socio-economic and consumption trends, and strong commodity prices, allied with rapid economic development in countries such as Brazil, India and China.

There are a number of aspects that have increased in importance and that impact on all firms including: food security and traceability (from fork to farm); adherence to standards; use of technology and enhanced production systems; and brand recognition which is vital to build consumer trust and international reputation.

In Ireland, the Agri-Food sector is highly export oriented, regionally dispersed and is central to the growth of rural economies. It has a significant wider impact on related employment in primary production (circa 85,600 in 2012¹⁴⁰). A number of Irish owned firms are among the world's 50 largest food and beverage multinationals¹⁴¹, and many foreign affiliates of leading multinationals have a strong presence here.

Ireland's Agri-Food sector encompasses dairy products and ingredients; meat and livestock; processed consumer foods and prepared foods; which represent the bulk of exports; and also encompasses seafood, cereals, and fruit and vegetables.

Ireland's research capabilities in Teagasc (Moorepark and Ashtown facilities), the third level sector and the recently established industry/academic collaboration encapsulated in Food for Health Ireland (FHI) are directly relevant to driving future growth and increasing businesses' capability to innovate.

Ireland benefits from its grass based production which is more greenhouse gas efficient than other production systems. There is a continued focus on understanding the emissions implications of doubling output over the coming years and the steps that can be undertaken to minimise impact. Ireland's Green image presents a natural marketing opportunity.

Harvest 2020 sets out opportunities to achieve the potential to increase agri-food exports by 42 per cent by 2020¹⁴² by:

- Exploiting the opportunity presented by the removal of the dairy cap in 2015 by maximising value add in Ireland;
- Consolidating markets for meats and prepared consumer foods within the EU;
- Taking advantage of new and emerging markets for export growth (dairy, beverages, seafood and niche meat products - e.g. 5th quarter products); and by
- Building economic partnerships with high growth geographic markets.

Ireland's increasing investments in food and bio related research strengthens its offering to attract new FDI and expansions of existing operations.

Emerging opportunities include:

- New species development in the aquaculture sector which offers the potential of specialised, organically produced products to address growing international demand; and

¹⁴⁰ QNHS Q2 2012, CSO.

¹⁴¹ UNCTAD, 2007 - Includes Kerry Group PLC and GreenCore Group PLC

¹⁴² Harvest 2020, Department of Agriculture, Fisheries and Food, 2010

- Tapping into the high growth opportunity in the area of functional foods & nutraceuticals segment [see below].

As outlined in Chapter 4, there is an upward trend in productivity within the sector. In general, it is a sector that operates to tight margins in circumstances where the multiples tend to have considerable purchasing power. It is also true to say that Irish firms face international competition on the domestic market.

In the first instance, it is important that companies continue to embrace both Lean and sustainable principles across their entire business operations. This is likely to require investment in capital equipment, process technologies and ICTs and re-skilling of their workforce. In addition, more companies need to build capabilities and to add value through the development and introduction of new products and services. Food companies in general cite Ireland's competitiveness and the challenges they face in accessing finance and/or supports (which operate under State Aid Guidelines) as factors that currently constrain growth potential. The fact that food companies (in general) tend to be more mature and that returns on investment are likely to take a longer time-frame may serve to exacerbate the issues for them.

Pharma/Bio-Pharma

The Pharma/Bio-Pharma¹⁴³ sector encompasses the discovery, development, production and sale of drugs licensed by an appropriate body for use as medications. It is subject to stringent laws and regulations regarding the patenting, testing, production and marketing of drugs. Although global growth rates are not at the scale previously experienced within the industry, the forecast to 2013 estimates a CAGR of 6.2 per cent¹⁴⁴.

The most fundamental change facing this sector is the shift toward personalised healthcare. This effectively means developing solutions that are tailored to the needs of the patient, enabling the delivery of the appropriate treatment, in the appropriate way at the appropriate time. Personalised healthcare is leading growth in innovative delivery mechanisms, companion diagnostics, niche busters¹⁴⁵ and a shift toward biologics¹⁴⁶ - which at the same time is seeing consolidation in the market.

Globally, Pharma companies are facing the expiry of patents, over-capacity, significant R&D costs and a low product pipe-line. As companies face downward pricing pressures from healthcare payers, combined with increased pressures to demonstrate efficacy of new products, they find themselves focusing more than ever before on speed to market and Lean processes while at the same time maintaining high quality and safety as paramount.

The level of sophistication in manufacturing is increasing for Pharma/Biopharma, although Biopharma presents its own particular challenges in production. Manufacturing now requires multi-disciplinary capabilities, new processes and analytical methods, shorter product runs and multi-product 'flexible' factories as companies improve their abilities to adjust to ever-changing market demands. The industry will continue to expand beyond comfortable definitions of

¹⁴³ Pharma relates to drugs based on small molecules. Bio-Pharma is based on large molecule

¹⁴⁴ Datamonitor

¹⁴⁵ Targeted to specific patient cohorts and/or rare diseases

¹⁴⁶ The success of antibody and antibody-based biotherapeutics has fuelled the growth of the Biopharma Sector From both a pipeline perspective and a manufacturing capacity perspective, monoclonal antibodies (MAbs) have assumed a dominant presence in the biopharmaceutical industry

'biopharmaceutical', driven by opportunities to harness advances in research to create novel approaches for treating disease, from cell and gene therapy products to RNA interference (RNAi). As a result, the types of products – and the manufacturing technologies and approaches required – will continue to evolve.

In Ireland, nine out of the top ten global Pharma/bio companies have a manufacturing presence here. Although the majority of these firms are currently involved in Active Pharmaceutical Ingredients (API) and finished products in small molecules, Ireland has a strong and increasing capability in Biopharma and a growing reputation in process development. Many foreign companies based here are faced with the 'patent cliff', which presents an imperative for them to re-establish their offering, reconfigure their existing operations and to provide new solutions to their global parent companies.

Kerry Group Global Technology & Innovation Centre

In October 2012, Kerry Group announced the establishment of an industry-leading Kerry Global Technology & Innovation Centre in Ireland to serve the Group's global and regional customers in the EMEA Region.

The new flagship global technology and customer innovation centre will serve as a focal point for Kerry's strategic customer engagement activities providing access to the Group's complete breadth and depth of technologies, scientific research and innovation expertise across food, beverage and pharmaceutical markets.

Kerry Group will invest €100 million in the new campus which will accommodate 800 people in 2015 and a further 100 positions when fully commissioned by mid-2016.

Kerry Group now employs over 24,000 people throughout its worldwide activities and operations.

http://www.kerrygroup.com/news_index.asp -Press Release 9/10/12

There is a growing indigenous base of companies involved in manufacturing niche and value added generics, contract manufacturing services and VetPharma including Ovelle, Eirgen, Univet, Chanelle and Bimeda. Others are engaged in a range of supporting activities including contract research, clinical trial management, control systems, regulatory services and sub-supply. Ireland's construction sector is a key part of the eco-system, for example, the Irish owned PM group provides leading-edge project management, design and sustainable construction expertise, delivering to the high-spec requirements of the Pharma and Biopharma sectors.

Ireland has a renowned track record in manufacturing quality and regulatory compliance - a fundamental requirement for this sector. After a decade of significantly increased State investment in R&D, Ireland has built capabilities in a number of disease areas¹⁴⁷. At this juncture, it is crucial that the recommendations¹⁴⁸ of the Research Prioritisation Steering Group are

¹⁴⁷ Including Oncology and Cancer, Neuroscience, Immunology and Infection, Genetics and Genomics. Health Life Sciences in Ireland, Forfás, 2009

¹⁴⁸ Including Biocatalysis/Biopharma/Chemistry, Continuous Processing with modelling, Process Analytical Technology, Solid State Pharmaceuticals, Analysis, Formulation science expertise as well as Advanced Materials (including Polymers) and Nanotechnology. Report of the Research Prioritisation Steering Group, DJEI, Forfás, 2011

implemented to strengthen the industry relevance of State funded research particularly in areas of pre-manufacturing technologies and services.

Capturing opportunities for Ireland depends on the ability to respond to the challenges presented by personalised healthcare, to:

- Prepare for more complex and new product introductions through process development, innovation and productivity enhancements (Lean, Six Sigma) and to engage in new ways of working required for the multi-product and flexible factory;
- Continue to develop capabilities in Quality by Design, Process Analytical Technology, information based analytics and Quality Risk Management;
- Develop capabilities and capacity in contract manufacturing operations (CMO) and contract research organisations (CRO) services to support foreign companies based here, entrepreneurs and start-ups (both Irish and foreign owned) and to support established indigenous companies to achieve scale. A strong CMO segment can improve the industry's ability to use capital efficiently and to develop products more rapidly while maintaining the flexibility required to address the ever changing biopharmaceutical demands (see also Contract Manufacturing Operations below);
- Build capabilities in smart materials and packaging, and 'track and trace' RFID to the standards required of the sector; as well as capabilities in new materials and packaging and cold chain management to ensure that the manufacturer's FDA approved storage conditions are carefully observed along the distribution chain;
- Enhance the capabilities of the existing (and potential) sub-supply base. The 'shifting' nature of the sector will have implications for sub-supply (e.g. in a move towards the 'plastic' factory and single use systems); and to
- Build capabilities in IP creation, protection and exploitation, particularly as innovations in process development are likely to become more valuable.

Given the specific needs of the sector for high quality leading edge property solutions it is crucial that advanced solutions are available as part of IDA's marketing proposition. The shifting nature of the sector is likely to have greater demands on high quality water, waste water, waste infrastructures and energy.

Given the range of sectoral strengths in Ireland, convergent areas offer potential including, for example:

- Combination products - such as pre-filled syringes (working with Medical Devices);
- Information based medicines and analytics (working with ICT firms).

ICT Hardware

ICT hardware encompasses electronics and communications products including semiconductors, computer hardware etc. It is difficult to disaggregate hardware from software in the data as increasingly many components/products have embedded software, sensors, operating systems etc. Electronics are now embedded in a wide range of products including medical devices, automobiles and construction materials, and at ever smaller scale.

The majority of the global market share is occupied by a few key players such as Intel and AMD in semiconductors and IBM, HP, Apple and Dell in computer hardware. The ICT sector has a well-

developed global supply chain model, which presents opportunities for smaller, agile, technology intensive and innovative firms.

The sector is one in which the pace of change is phenomenal, where products become commoditised at an early stage in their life-cycle, where mass customisation and manu-services¹⁴⁹ models are well established – as evidenced in the strategies of leading companies such as IBM, Apple and HP. The R&D life cycle is relatively short, iterative and highly competitive and a close connection with the customer is an essential part of the process.

Two of the main challenges facing the IT industry are Information Overload and Mobility. Over 1.8 zetabytes (1.8 trillion gigabytes) of digital data will be created in 2011¹⁵⁰. The pervasiveness of mobile devices, which are projected to grow from 7 billion connected devices in 2010 to 50 billion by 2020, is driving demand at both corporate and consumer levels for constant connectivity for voice, data and video. Cloud Computing has been identified as the industry's solution to manage these challenges through the standardisation and virtualisation of IT hardware and software assets, the simplification of data centre management software and the use of collaboration tools and unified communications.

The global trends present opportunities for Ireland's ICT manufacturing (and software) sector, as:

- The growth in data centres for Cloud Computing is driving demand for servers;
- The 'Big Data' phenomenon is driving demand for increased security data centres and servers; and
- The growth of mobile ICTs is driving demand for more portable and interactive devices with ever smaller and more functional microchips e.g. system on a chip (SOC).

Ireland remains host to a number of leading edge global players, despite a considerable reduction in terms of employment of those involved in ICT hardware manufacturing (as opposed to software)¹⁵¹. There are also a range of Irish owned electronics firms addressing the component, communications and industrial electronics markets, including building management systems. Ireland's supporting research capability for the sector spans Data Analytics, Networks and Communications, Processing Technologies, Sensor Technologies and Nanotechnologies. There is also a number of well-established and active business networks including MIDAS¹⁵², the Cork Electronics Industry Association (CEIA), and ICT Ireland.

Specifically for Ireland, the growth opportunities in ICT/electronics manufacturing are in:

- R&D and/or IP intensive low or medium volume manufacturing activities including semi-conductors, servers, advanced microchips, nanofabrication;
- Intelligent devices and systems integration serving the manufacturing and other sectors aimed at increasing energy efficiencies;

¹⁴⁹ See section below on manu-services

¹⁵⁰ The 2011 Digital Universe Study, Extracting Value from Chaos, EMC/IDC

¹⁵¹ Prior to the Internet/digital era, software replication was classified as manufacturing. Much of the decline in hardware employment post 2000 resulted from global decisions to relocate activities to lower cost economies in response to the commoditisation of electronics products over the past decade and Ireland's declining relative cost competitiveness

¹⁵² MIDAS Ireland (Microelectronics Industry Design Association) is an industry led organisation that defines and develops the future direction for the microelectronics design industry in Ireland

- Advanced integrated circuit (IC) design and fabless manufacture, e.g. System on a Chip, Lab on a Chip; and in
- Furthering the applied research agenda in manufacturing process developments, analytics and optimisation of the supply chain.

As well as being a sector in its own right, the pervasive nature of ICTs means that it has an impact upon all business and sectors. ICTs are an enabler in terms of: access to markets, logistics and supply chain management; building customer and supplier relations; optimising business processes; and engaging in open innovation etc.

The greater use of ICTs in production processes provides opportunities in computer integrated manufacturing, data capture and analytics, modelling and simulation as manufacturing firms continue on the pathway towards the Digital Factory.

In addition, the increasing demand for increased energy efficiency and renewable energy generation has created new opportunities for the electronics sector and for the benefit of manufacturing operations¹⁵³.

Consultations throughout the development of this study reinforced the increasing criticality of adopting ICTs in the manufacturing environment. The question arises as to whether or not Ireland is taking advantage of the depth of expertise in software that it has built up over the years to identify and address the current and future needs of manufacturing or to embrace the cross sectoral opportunities that are emerging (See section on adjacent possibilities and convergence).

ICTS - Making a Difference in a 'Traditional' Sector

Dr. Edmond Harty is the CEO and Technical Director of Kerry-based Dairymaster, a world leader in the development and manufacture of dairy farm equipment. Founded in 1968 by Ned Harty with its headquarters in Causeway, County Kerry, Dairymaster has carved out a reputation, both nationally and internationally, for providing hi-tech solutions for dairy farming. Dairymaster employs 300 people in their Global Headquarters, have 25 overseas staff for managing international operations and a network of over 600 service personnel around the world. Between 70 and 75 per cent of production is exported to more than 40 countries, including the US, Germany, UK, Japan, New Zealand and Siberia. Harty was recently awarded as overall winner of the Ernst and Young Entrepreneur of the Year.

Investing in Technologies & R&D: Dairymaster's innovative product range encompasses five key areas: Milking Equipment; Automated Feeding Systems; Hydraulic Manure Scrapers; Cow Fertility Monitors and Milk Cooling Tanks. Over the past five decades, Dairymaster has developed unique technologically advanced solutions aimed at making dairy farming more profitable by reducing long term costs and labour inputs. Many of its products can be integrated into a fully computerised milking parlour to automatically monitor the progress of each individual animal's yield and the overall management of the parlour.

A customer led R&D process: Dairymaster monitors product performance in the marketplace, and takes a personal approach to its customers - seeing customer feedback as an essential part of its R&D process.

Dairymaster utilises science and advanced technologies in order to make dairy farming more profitable, enjoyable and sustainable.

www.dairymaster.com

¹⁵³ For example increased power supply efficiency, better utilisation of energy in buildings through more intelligent building management systems, greater functional efficiency for electronic systems, and more intelligent switchgear

Medical Technologies

The medical technologies sector is diverse. It covers thousands of products, from simple bandages through implantable devices, screening equipment to the most sophisticated diagnostic imaging and minimally invasive surgical equipment.

As is the case with Pharma, strong growth prospects are driven by ageing populations and the increase in chronic ailments, while increasing wealth is driving demand in emerging economies. High value opportunities such as remote diagnostics, combination products and eHealthcare services are being driven by advances in science and technology and convergence, particularly with ICT and Pharma. Advances in technologies are also enabling the introduction of 'smart' packaging for the sector that can increase compliance, combat counterfeiting, facilitate recycling or increase brand recognition¹⁵⁴. The innovation cycle is considerably faster than that for Pharma/BioPharma - and companies are challenged with demonstrating increased product efficacy, achieving high quality standards while facing downward price pressures from procurers.

Ireland is the 2nd largest exporter of medical devices in the EU after Germany and the sector continues to demonstrate strong growth prospects and burgeoning entrepreneurship here. The Medical Technologies sector is a well-functioning eco-system in Ireland. Twenty of the top thirty global medical devices companies are based here, and there is a growing indigenous base that includes medium sized multinationals, research/technology intensive SMEs, service providers including CROs, laboratory and regulatory services and sub-suppliers¹⁵⁵. Ireland has also built capabilities in relevant research in medical devices, diagnostics, process technologies and materials science as well as platform sensor and nanotechnologies.

Companies are involved in the production of a range of higher-end medical device products including:

- Cardiovascular products (drug eluting stents);
- Drug delivery systems;
- Optical products;
- Diagnostics; and
- Orthopaedics.

Vistakon - Real Time Analytics

Vistakon Ireland (a division of J&J) manufactures the ACUVUE® range of contact lens at its production facility in Limerick. The company now employs over 600 people and runs 31 production lines on a 24-hour basis.

In early 2013 Vistakon announced its plans for an expansion that would see another 100 jobs created, reinforcing the Limerick facility's status as a globally competitive manufacturing centre.

The Vistakon manufacturing lines are characterised by high automation, reflecting the continued investment in robotics, automation and control system technologies. Vistakon is committed to Continuous Professional Development (CPD) and a culture of constant process engineering and innovation.

Developed by SQW (extract) and reflects media announcement 14th January 2013

¹⁵⁴ Technologies such as RFID can provide a solution in the near term. Printed electronics involving the development of conducting inks, which would allow 'screens' on packaging to be updated interactively provide potential in the longer term (HP in Ireland is currently undertaking research in this area), Consumer Packaging, Opportunities for Smart Technologies, Paul LeGood, Corus and Wavell Coulson, NAMEC, 2007

¹⁵⁵ A number of sub-supply firms are categorised under NACE other codes including Rubber & Plastics, and Computers, Electronics and Optical Equipment for example

There is a strong cohort of contract manufacturing firms (CMOs) developing in Ireland, providing services to customers ranging from arm's length product delivery (which is generally lower margin) through to providing solutions that involves developing a strategic partnership, often involving co-development of manufacturing processes for new product introduction. As is the case with Pharma companies, Irish based foreign owned entities need to continually assess how they can respond to global challenges and be part of the solution within the context of their parent company strategy.

To respond to global trends toward personalised healthcare, and to realise opportunities and future investment by foreign and Irish firms, there is a need to:

- Prepare for more complex production by engaging in productivity enhancements and operational excellence across the entire business and by embedding real time analytics capabilities;
- Enhance capabilities in product design and engineering design, process R&D and innovation and the application of novel materials and nanotechnologies to capture opportunities in new product introduction and pilot production;
- Develop its Contract Manufacturing Operations (CMO) base of companies so that they offer leading edge technologies, the 'flexible factory' and a more sophisticated strategic partnering sales model;
- Engage in physician informed product development, ensuring a connection to the customer, and leverage the supporting infrastructures that are available and/or in development¹⁵⁶; and to
- Target opportunities in convergence: e.g. combination products; remote diagnostics¹⁵⁷ and eHealth and increase collaboration across sectors (See also section on Adjacent Possibilities).

There are a number of proposed changes to existing EU directives relevant to the medical devices regulatory approvals process. Of immediate concern is the impact of proposed changes from the existing devolved 'competent authority' model to a centralised approval system on speed to market. The current EU regime means that Ireland can offer faster time to market, and therefore a competitive advantage, for foreign companies based here relative to the US.

Engineering

The designation of engineering as a sector leads to a considerable amount of complexity and a perception of fragmentation and diversity. Engineering is perhaps more correctly defined as a discipline - a discipline that spans mechanical, civil, electrical, software and chemical engineering. Throughout history engineers have solved problems and have figured out how to make things work - and as skilled professionals, engineers are crucial to all manufacturing sectors.

¹⁵⁶ Including the Health Information Hub (in development) and private sector providers such as i360 Medical

¹⁵⁷ The Research Prioritisation Steering Group set out a number of priority areas for R&D informed by their analysis of global markets in which Ireland already competes or can realistically compete as well as other criteria relating to R&D strengths and disciplines. Diagnostics was identified as one of the 14 priority research areas. Report of the Research Prioritisation Steering Group, DJEI, Forfás, 2011

Case Study: Siemens Healthcare Diagnostics Manufacturing - Embracing Lean - Delivering Results

Siemens Healthcare Diagnostics Manufacturing Limited, based in Swords Co. Dublin, is one of fifteen facilities in a global division, which employs 14,000 and generates annual sales of €4bn. A total of 320 are employed at Swords in a 100,000 sq ft flexible manufacturing floor. They produce highly specialist in-vitro diagnostics systems (included under the ADVIA® brand) for application in immunodiagnostic and haematology settings in hospitals and laboratories across the world. Production is complemented by a refurbishment and parts services, QA, compliance, and engineering support services.

The Swords facility has led the Siemens Healthcare Diagnostics Group in its migration from 'stop-start' batch production to a synchronised flow model of manufacturing, within which the elimination of waste has been a core goal. The Siemens Production System (SPS) draws insights from the *Factory of the Future* and Lean methods; and in this context, waste is defined as 'any utilisation of resource that does not benefit clients'.

SPS sought to fully integrate systems, processes, cultures, and capabilities across all activities at the site. The results have been significant. Between, 2009 and 2012, the site productivity improvement programme delivered over €10m of savings, with major reductions being achieved in the product cost and cycle-time areas. The progress achieved has created a platform for ongoing and extensive continuous improvement. This now includes routine activities such as Gemba walks, Kaizen groups, and A3 Problem Solving activities - all focused on creating a pervasive culture of waste reduction, quality improvement and increased efficiency. Consequential changes include bringing Technical Support functions physically alongside production activities, enabling quicker responses, closer alignment, and better prioritisation when production issues need to be addressed.

The engagement, capability, and empowerment of personnel at all levels have been crucial to the success of the changes implemented. Management tools (such as SAP) have been adapted to increase communication, provide better visibility of information and increase process controls. The plant now operates an externally-accredited SkillNets programme in addition to a Continuous Professional Development programme, which received recognition from the Institute of Engineers of Ireland in 2012.

Logistics has been simplified through consolidation under a single third party logistics provider and its integration into the supply-production value stream. There has been a strategic drive to outsource non-core assembly work, whilst focusing capability and developing resilience to demand.

The key elements of the wide ranging approach to change have included:

- A focus on the identification and removal of waste in the value chain;
- Simplifying the way the production process is thought about ;
- The development of platforms and capabilities that enable collaborative approaches to problem solving and quality improvement;
- Launching and, equally importantly, maintaining a robust and visible programme of continuous improvement;
- The adoption of management tools such as MRP and Product Life-cycle Management (PLM) to aid planning and control; and
- The active engagement of supply chain partners in progressing lean approaches.

As a result, the Swords facility has leading position within the global Siemens Healthcare Diagnostics group.

Developed by SQW, 2012

For the purposes of this report, and based on the approach taken to date by the enterprise development agencies, this section focuses primarily on mechanical and electronic engineering and some aspects of chemical engineering (e.g. plastics, materials). Even within these designations, there is huge diversity, primarily due to the very different markets that engineering firms serve - ranging from agricultural, to automotive, to aviation, to computer and medical devices - and global growth rates depend on the market segment. Products range from equipment and machinery to metal and plastics components.

In Ireland, the sector is made up of:

- Irish owned companies that are primarily engaged in sub-supply, delivering components for integration into other firms' end products. They form a key part of the eco-system for manufacturing sectors based in Ireland. Such firms will generally 'follow' their customer, either exporting to the customer destination, or locating in the customer's market.
- Irish owned companies that develop, manufacture and export their own (branded) products to end customers; and
- Foreign owned companies - many of which have been in Ireland for over 20 years - producing products for their parent corporations.

In employment terms, the sector has been in decline in Ireland over the past decade, with many companies negatively impacted by the construction boom and bust cycle. That said, the sector continues to employ in the region of 28,000 people¹⁵⁸. It is generally regarded as a traditional sector, but there are some interesting developments in evidence.

Irish owned firms that have engaged in Enterprise Ireland's Leadership for Growth programme (L4G) have reassessed their own strategies as a result, in some instances shifting their focus to different end markets. They invest in Lean programmes and in RD&I and reskilling, in achieving accreditation and/or in partnering to provide manu-services and have made the changes necessary to deliver a distinctive offering. In contrast however, take-up of R&D supports by foreign owned firms in this sector remains low and traditional work practices remain embedded. Evidence also shows a decrease in sub-supply linkages between foreign multi-nationals and the Irish sub-supply base. There are also a number of gaps in Ireland's engineering skills base, a decline in expertise in toolmaking and plastics over the past decade and relatively few mid-tier engineering/automation houses.

For Ireland, the opportunities are more about capability building and assisting firms to identify and target new market opportunities, by:

- Assisting Irish owned firms to reorient their strategies toward growth market opportunities and foreign owned firms to review their strategic positioning within their global corporations;
- Aggressively marketing RD&I programmes to increase the uptake by foreign owned firms of existing programmes¹⁵⁹, and to encourage indigenous firms to develop their own IP and products for export markets (building on their sub-supply capabilities);

¹⁵⁸ Derived from employment data in the Forfás Annual Employment Survey 2011. In deriving the figure for employment in engineering companies, such companies are considered to be operating in the following sectors: 'basic and fabricated metal products', 'machinery and equipment', and 'rubber and plastics'

¹⁵⁹ As set out in Chapter 4, foreign owned engineering firms have the lowest take up of the IDA R&D programme

- Identifying ways in which to optimise sub-supply opportunities between foreign and indigenous firms, including supporting firms to navigate the pathway to achieving relevant accreditation;
- Building connections with State funded materials research to deliver to the future needs of other sectors such as Biopharma (the plastics factory), medical technologies (nano-scale) construction (smart buildings);
- Building sales capabilities in the context of a more sophisticated solutions-based proposition¹⁶⁰;
- Addressing the image/perception of the engineering sector as being traditional and/or low value added; and
- Re-emphasising the relevance and crucial role of engineering disciplines in process R&D and process operational excellence for all manufacturing sectors.

Off-Site Manufacturing - Construction

Forfás completed a national strategy for the construction sector in early 2013, looking at both the domestic market and the potential for internationalisation. In 2009, Enterprise Ireland identified factory based construction or off-site manufacturing (OSM) as one of the areas offering potential¹⁶¹ although the industry has suffered a significant blow over the period since then. For the purposes of this report, and based on international trends, it is opportune to revisit the potential offered by OSM.

While the concept has been around for some time, experience in other countries such as Germany and UK indicate a change in perception over recent years - from one where off-site buildings were considered to be of lower quality to one where OSM technologies are seen as setting trends in design and energy efficiencies¹⁶².

The interest in OSM is gaining traction as difficult economic conditions in the construction industry have increased the appeal of Lean methods and practices. The influence of the green agenda, technological advancements, developments in quality materials, the rising use of Building Information Modelling (BIM) and sophisticated manufacturing facilities now offer significant productivity gains on projects not possible before¹⁶³. OSM minimises weather interruption and offers a predictable and flexible solution. Based on a survey undertaken by McGraw Hill in the US, productivity improvements are evident in reduced project schedules, decreased project budgets and a reduction in construction site waste.

¹⁶⁰ Firms too, have a role to play in addressing negative perceptions - and there are excellent case studies of engineering firms that have already done so

¹⁶¹ <http://www.enterprise-ireland.com/en/Source-a-Product-or-Service-from-Ireland/Sector-and-Company-Directories/Construction-Sector-Profile.pdf>

¹⁶² This was exemplified by the fact that 'Pappdeckelhäuser' (literally, 'cardboard houses') was once a widely used nickname for off-site manufactured homes in Germany

¹⁶³ Prefabrication and Modularization - Increasing Productivity in the Construction Sector. McGraw, Hill Construction Research & Analytics, Industry Insights and Alliances, 2011

OSM encompasses¹⁶⁴:

Volumetric systems: The most factory-based form of production, volumetric systems use three-dimensional (3D) modules, either in isolation or in multiples, to form the structure of the building. These modules can be pre-finished in the factory to include all fixtures and fittings, requiring a very limited amount of installation work on site.

Panelised systems: The construction of the structural frame for the building using panels assembled in the factory. Panelised systems can either be open (typically delivered to the site purely as a structural element) or closed (typically including additional factory based fabrication such as lining materials, insulation, cladding, internal finishes, services, doors and windows).

Hybrid systems: A combination of volumetric and panelised systems where the high value areas (kitchen and bathroom) are typically formed from volumetric units (sometimes referred to as pods) and the rest of the structure from some form of framing system.

Components: such as mechanical and electrical services infrastructures are being developed with significant assembly work being carried out off-site. Housing technologies and associated production systems have been refined in leading countries such as Japan, USA and Germany both through experience and through suppliers' investment in research and development (R&D).

Ireland has a range of companies that supply into the construction sector including materials and products (including concrete, steel, cement, timber and plastics) and building automation and management systems (control systems, HVAC and Insulation products). With the increased focus on energy efficiencies, developments in the Clean Technologies sector and Smart Materials are particularly relevant for these firms (see sections below).

Although today there is a relatively small number of Irish based firms currently engaged in OSM, including Kingspan (Metro Building System), Shomera, Techcrete, Glenbeigh Off-site and Asgard Cleanroom, it is an area that warrants consideration as the construction sector seeks to recover in Ireland. OSM can help to transform the sector into a highly productive, technologically rich sector - delivering a competitive offering to both domestic and overseas markets.

Civil engineering projects also present opportunities in OSM. For example, companies like Oran Precast manufactured tunnel lining panels for the Cross-Rail project in the UK. Shay Murtagh, working in conjunction with Concast, delivers an innovative light rail system manufactured off-site and installed where minimum disruption is required. As Irish construction and related professional services companies internationalise their businesses, there will likely be greater potential for Irish sub-suppliers to become participants in the overall supply chain. In the immediate term, encouraging clustering between SMEs with complementary capabilities to form around market opportunities would considerably enhance Ireland's overall selling proposition.

The potential for exporting modular and pre-fabricated buildings or elements of buildings may be somewhat reliant on a cost to value consideration, given the relatively high transport costs and home based competition in markets such as UK, Germany and Belgium. Factors such as availability of natural resources (aggregates), the economic realisation of new developments in materials over the coming years (composites and graphene), investments in R&D and the development of distinctive offerings will all play a role.

¹⁶⁴ Modern Methods of Construction in Germany - Playing the Off-site Rule, DTI, March 2004

Case Study: Kingspan Off-site Manufacturing & Modern Methods of Construction

Kingspan exemplifies the trend toward off-site manufacturing (OSM) within the construction industry and the increasing focus on environmental issues throughout the whole of the construction and use cycle. The use of OSM provides the ability to produce building modules within a controlled environment, enabling higher quality, higher productivity and lower material wastage. Ready-manufactured modules also facilitate faster completion and reduced environmental impact.

Kingspan was set up in Ireland in 1972 as a small family business making cladding and related products for the building industry. In the intervening years, it has grown significantly and, with a turnover of nearly €1 billion, is now quoted on the Irish Stock Exchange. The firm's recent growth performance is reported to be up to 25 per cent per annum, with compound annual growth over the period 1990-2010 of some 15 per cent. Its main products include insulated panels, insulation, access floors and environmental renewables (e.g. solar panels).

The company has manufacturing and distribution operations throughout Europe, the Far East, and the USA. The foundations of its growth lie in a commitment to design, quality, and technical expertise, all requirements for the fast-moving international construction industry which is implementing Modern Methods of Construction (MMC) across all sectors (industrial, commercial, institutional, and domestic) to minimise site work, eliminate wet trades, and reduce construction times. At the same time, the push towards environmentally-sustainable buildings incorporating elements of renewable energy is being driven by increasingly stringent building regulations and environmental legislation.

The company has a strong focus on off-site construction methods, and has formed Kingspan Off-Site, now one of Europe's leading deployer of MMC for the private and public sectors. Kingspan Off-Site was formed in 2007 following the acquisition of Pace Timber Systems and Potton, which were combined with Kingspan's then existing timber and steel frame system divisions. The company is at the forefront of delivering environmental and sustainable housing systems which comply with the 'Code for Sustainable Homes' through Levels 3, 4, 5 and up to Level 6 ('Net Zero Carbon').

The off-site technologies and managerial systems utilised in producing these building systems include design and value engineering, physical performance, regulatory compliance, environmental and sustainability analyses, effective order management, and accredited site assembly teams. The integration of the company's complex off-site design/manufacturing and on-site assembly operations is achieved through an Enterprise Resource Planning (ERP) system, developed by SAP and providing a scalable, multi-site, multi-currency platform to support future growth.

Kingspan has sought high levels of growth in its chosen MMC-related technologies and has the objective of being the world leader in these fields. The company's sales growth has been based both on sales growth in existing markets and expansion into new geographical areas. Revenue projections for 2012 show revenue distribution across a range of markets including UK, mainland Europe, Americas, Australasia, ROI and others.

Kingspan has achieved very high rates of growth from its base in the Republic of Ireland by both geographical expansion and by introducing new and improved environmentally relevant building products. In particular, the company has capitalised on the efficiencies, higher productivity and quality that can be achieved through an OSM setting and has focused on construction products that enable buildings to achieve high environmental standards. The company's growth into the UK and Europe has been followed by further growth into the Americas and Far East, in line with its ambition to become a world leader in its strategic markets.

Developed by SQW, December 2012

Adjacent Possibilities and Convergence

The idea of adjacent possibilities started with evolutionary biologist Stuart Kauffman, which holds that an idea will catch on, or be readily adopted, if it is “sufficiently adjacent” (conceptually or technically closely related) to existing ideas that currently dominate a given market, or “field of possibilities”. The core of the idea is that people arrive at the best new ideas when they combine prior (adjacent) ideas in new ways. Adjacent possibilities were considered in the context of *Factories of the Future*¹⁶⁵, based on the premise that economies find it easier to master new products that are similar to ones they already make (utilising accumulated productive knowledge). An example might be the application of the knowledge, expertise and competences in the textiles sector to the development of composites, or of glass extrusion to photonics.

A related concept is that of sectoral convergence. Convergence is primarily driven and enabled by advances in technologies, and results in considerable potential in new products and services and the emergence of ‘new’ sectors such as nutraceuticals and combination products¹⁶⁶.

The areas discussed in the following sections are of particular interest from Ireland’s manufacturing perspective.

Combination Healthcare Products

The high growth in combination healthcare products is facilitated by technological developments and increasing convergence across formerly discrete sectors – Pharma, Biopharma, Medical Devices and ICTs. PRTM Management Consultants estimated the market for combination healthcare products to be around US\$40-50 billion in 2008 and growing at 14 per cent annually.

Ireland already has a track record in the production of drug eluting stents – so the concept of combination healthcare products is not necessarily new.

Innovative lifesciences companies are identifying ways to combine emerging device technologies with drugs or biologics to address a range of needs and to develop highly sophisticated products which deliver substantial benefits to the patient¹⁶⁷. Combination healthcare products include novel drug-delivery systems such as transdermal patches through to the more complex regenerative medicinal products.

There is a window of opportunity for Ireland to establish itself as a location of choice for advanced delivery devices and combination healthcare products.

There is a strong cohort of companies based in Ireland as well as relevant R&D capabilities (including materials sciences, sensor and nanotechnologies) to make this a reality. The IMDA, together with the enterprise development agencies, has hosted a number of awareness raising and networking events for combination products over the past couple of years¹⁶⁸.

¹⁶⁵ The Future of Manufacturing, Opportunities to Drive Economic Growth, World Economic Forum in collaboration with Deloitte Touche Tohmatsu Limited, 2012, incl: Essay- Economic Complexity and the Future of Manufacturing, Hausmann and Hidalgo

¹⁶⁶ Making it Happen, Forfás, 2010

¹⁶⁷ Including for example, convenience, targeted and localised drug delivery, time controlled drug delivery, multi-drug delivery, enhanced reconstructive surgeries

¹⁶⁸ Delivering on the recommendations set out in Health Life Sciences in Ireland, An Enterprise Outlook, Forfás, 2009

Case Study: Shannon Coiled Spring - Adjacent Opportunities - from Construction to Medtech

Shannon Coiled Spring (SCS) was established in 1978. It is headquartered in Limerick, employing 24 people, with a subsidiary in England that employs 56 people. SCS' core business was manufacturing wall ties for the construction sector and various types of springs for the Irish dairy industry. Although the manufacture of micro-components for medical devices had been a small part of SCS' product range, strict standards and regulations together with differing market characteristics had restricted growth in this area for the company.

The management team recognised that their overreliance on the (then booming) construction market was unsustainable in the longer term. They took steps to redress this overreliance and to look to new markets, leveraging their existing capabilities. SCS worked in collaboration with the University of Limerick (UL), to develop new processes, and achieved ISO13485 Accreditation (the International Standard for medical device Quality Assurance).

Since 2005, with some €1.5 million invested, its specialist SCS Shannon Micro-coil division has developed a growing business in manufacturing micro-springs and coils for the medical healthcare industry in areas such as neuro-stimulation, cardiac rhythm management, and minimally invasive procedures. SCS provides both standardised and custom products and specialises in supplying to the R&D teams of multi-nationals and specialty medical design companies, providing quick turn-around from order to delivery.

Micro-components for the medical devices sector are produced using mainly stainless steel wires with diameters from 12.5 micron to 254 in a variety of pitches and diameters. A wide range of 'exotic' materials are also used in the manufacture of the micro-coils including gold, platinum, and nitinol. These materials are important for non-invasive surgery, where there is a need for accurate tracing to enable devices to be positioned accurately within the patient's body. Over recent years, SCS has continued to invest in RD&I, introducing new products and services. Today, the company offers an integrated range of services to the medical devices sector, including: assessing requirements such as material specifications; regulatory processes; validation and documentation; prototype development and testing; and production processes such as welding, micro coiling, grinding and wire forming. The medical devices business is expected to be close to 50 per cent of the overall company's business in 2012, with a further doubling of the medical devices business anticipated over the next three years.

Summing up the company's experience, Managing Director John Walsh said *'Our programme for the future is ambitious and bold and, relying on our past record, we are quietly confident we will achieve a return to the heights we achieved in our past, and surpass it in the very near future in our new endeavours. In our fight back to stabilise and then take the company forward, it is essential to comment on the back-up and help we received from Enterprise Ireland and our Bankers in Ireland and in the UK. They have been brilliant in understanding our dilemma at the time of the markets crashing worldwide, and in getting us over the very big hurdle we faced in reorganising the company'*.

The SCS case study illustrates the importance of recognising that established markets are often subject to pronounced change and that continuing business success may require the development of growth into new alternative areas. For a well-established manufacturer such as SCS, whilst the move into the market for medical devices represented a significant challenge, the 'adjacency' of the diversification allowed them to take maximum advantage of their existing and considerable engineering expertise in coiled spring production and supply. When SCS entered the medical micro-coiling sector, it brought 28 years of experience in the coiling industry, and approached development issues from an engineering perspective, rather than a medical one.

Entering a new field required sustained technical and market investment over a number of years and an important part of the diversification process involved collaboration with UL on the development of new products and accreditation. The company also needed to develop capabilities in working with new materials and to secure internationally-recognised accreditations such as ISO 13485. These strategic developments have put the company into a strong position to compete and grow in new markets in the future.

Developed by SQW December 2012

Combination Healthcare Products in the Market Today

- Drug-eluting stent that opens and inhibits restenosis in coronary and peripheral arteries
- Bone grafting scaffold/sponge coated with a growth protein that promotes bone regeneration
- Implantable polymer wafer that releases a chemotherapy agent to a specific site
- Implantable neuromodulator that enables the targeted, regulated delivery of a drug or electrical stimulation
- Transdermal patch that transports drugs locally and systematically through the skin
- Pre-filled metered dose syringe, injector pen, or inhaler

In terms of a specific market opportunity, the area of silver technologies that support active and healthy ageing provides an opportunity for Ireland¹⁶⁹. Increased home based care and the technologies needed to support self-care and assisted living will become more of a reality with the ongoing shift from a traditional hospital centric model to one that places the patient at the centre. The range of products and services

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that support active and healthy ageing encompass a range of sectors including ICT, Medical Devices, Healthcare services, Pharma and Biopharma.

Because combination products are a relatively new area, it poses numerous technical, business and regulatory challenges. They are challenges that can be overcome and minimised, particularly if they are considered from the outset. For example, the development of combination healthcare products requires collaboration between different disciplines such as chemical, biological, engineering and electronics, and often requires drawing on expertise outside the organisation. There are considerations for manufacturers in relation to Good Manufacturing Practice (GMP) for manufacturing processes and 'smart' packaging, which need to be designed to ensure adequate sterility and shelf life of the active drug¹⁷⁰. R&D processes and approaches may be complicated by a sector's 'norm' in terms of time to market (e.g. ICT versus Pharma). Negotiations relating to IP agreements between collaborators can be complicated by factors such as differing levels of patent protection for devices versus drugs. The regulatory environment for drugs and delivery systems is based primarily on the Primary Mode of Action and as it evolves to cater to new and sophisticated combination products it needs to do so in a way that provides certainty for companies¹⁷¹. Health

¹⁶⁹ The EU's innovation partnership has identified healthcare as a 'grand challenge', including Active and Healthy Aging as a priority area, and aims to stimulate increased innovation and SME engagement

¹⁷⁰ Most drugs cannot withstand the high heat and humidity of ethylene oxide gas typically used to sterilize medical devices in their packages. Combination product manufacturers will need to identify other suitable methods of sterilisation, such as gamma irradiation, electron beam or UV sterilisation

¹⁷¹ The EU recognises six classes of combination product, and regulation is primarily guided by the Primary Mode of Action (PMOA) (i.e. is the drug or the device the major element of the product). While each combination product has a PMOA which determines its assignment to one of three FDA regulatory centres for review, the process of defining the PMOA can be complicated in and of itself. The Irish Medicines Board (IMB) is the relevant national regulatory authority, but for certain categories of products firms must go through the European Medicines Agency

technology assessments (HTAs) become increasingly important for innovative combination products that take into account the full range of healthcare interventions and services provided to the patient (and not just the cost of medicines or device)¹⁷².

These challenges are faced by industry globally - and it is addressing these challenges at an early stage that can give Ireland the edge as a location of choice for combination products. An overarching and crucial differentiator will be the ability to collaborate across former sectoral and technology silos at a number of different levels including academic research and HEI/industry research, firms, industry associations and government agencies, and across government departments.

Functional Foods & Nutraceuticals

The increased focus on health and wellness, developments in enabling technologies and increased knowledge about the pharmacologic effects of certain nutrients has led the development of functional foods and nutraceuticals. The terms are often used interchangeably, although they are two distinct areas with different development paths based primarily on different regulatory requirements.

A **functional food** is similar in appearance to, or may be, a conventional food that is consumed as part of a usual diet and is demonstrated to have physiological benefits and/or reduce the risk of chronic disease beyond basic nutritional functions, i.e. they contain bioactive compound.

A **nutraceutical** is a product isolated or purified from foods that is generally sold in medicinal forms not usually associated with foods. A nutraceutical is demonstrated to have a physiological benefit or provide protection against chronic disease.

Functional foods and nutraceuticals cross the formerly discrete boundaries between Food and Pharma/Biopharma. It can be categorised as a sub-sector within either Food or Lifesciences. Changing consumer behaviours and advances in science and technology are driving growth in this segment, which is estimated to reach US\$130 billion in 2015¹⁷³.

Functional foods and nutraceuticals is a small but increasingly important area of Lifesciences and Food activity in Ireland, although because of data limitations it is difficult to develop an accurate picture in terms of current employment and exports (employment was estimated at over 2,700 in 2008)¹⁷⁴.

Ireland's potential is based on the growing cohort of multinationals involved in the area (primarily infant nutrition), large Irish companies and a growing number of SMEs involved particularly in the development of active ingredients for consumer foods, as well as globally recognised research strengths in gastroenterology and glycosciences and recently established research centres (Food for Health Ireland, and Teagasc's Nutraceutical Research Facility).

However, there are specific issues that need to be addressed if this potential is to be realised. The regulatory requirements for nutraceuticals are complex and companies contend that the European regulatory body is excessively risk averse. Companies also cite the need for a leading edge facility

¹⁷² HTAs involve the evaluation of medical, economic, social and ethical implications of the incremental value, diffusion and use of a medical technology in health care

¹⁷³ Global Industry Analysts Inc

¹⁷⁴ Forfás calculations based on analysis at firm level ABSEI, 2008

which would enable them to test manufacture their products and to develop processes for scaled up manufacturing, as well as the need for an accredited centre for toxicology¹⁷⁵.

Clean Technologies

Clean Technologies encompass a wide range of products and services within the scope of environmental and natural resource use, management and protection. The increased emphasis on the environmental agenda, the related EU Directives and Regulation, rising energy costs and changing consumer behaviours are driving significant growth for environmentally friendly products and services. Europe is expected to deliver the steadiest growth over the coming years¹⁷⁶.

Clean Technologies is a nascent area of opportunity for Ireland, spanning a number of different dimensions¹⁷⁷:

- Clean Technologies can be defined as a sector in its own right - particularly in terms of renewables and the development of technologies, products and services focused on addressing environmental issues (and opportunities);
- At the same time, many manufacturing companies are seeking to 'green' their own products through the use of novel, 'smart' and bio-materials for example - and as more traditional sectors such as the construction and transport sectors 'cross' sectoral boundaries; and
- Manufacturing companies are increasingly focused on Product Lifecycle Management (PLM), improving energy efficiencies and minimising waste management and focused on environmental impacts throughout the production process - adopting technologies, processes and new work methods.

Ireland is well positioned to take advantage of changing consumer demands, to innovate in response to regulatory requirements and to harness its range of relevant assets. From the perspective of renewables, Ireland has one of the best wind energy resources in Europe and has the highest wave energy resource in Europe (with an estimated generation capacity of 60 GW (one-fifth of Europe's total resource)).

Ireland has strong research and development capabilities in wind energy in Dundalk Institute of Technology, University College Cork, Trinity College Dublin and University College Dublin, and in ocean energy in University of Limerick and University College Cork. For clean technologies in general, Ireland has a depth of expertise and capabilities in firms and in research institutes in the areas of materials and device development, Integrated Circuit (IC) design, processor technologies, sensors and nanotechnologies.

A number of agencies work in a coordinated way to deliver integrated guidance and assistance to enterprises across a range of dimensions relevant to this opportunity area - embracing enterprise development and job creation, environmental protection, better regulation, resource efficiencies and R&D in clean technologies including IDA Ireland, Enterprise Ireland, Environmental Protection Agency (EPA), SFI, Bord Bia and SEAI.

¹⁷⁵ Based on Forfás' consultations with a small number of companies in 2010

¹⁷⁶ Europe's overall investment in Clean Tech was estimated at \$50 billion in 2010 and this is expected to grow 2-3 per cent per annum through to 2014, GlobalData, Clean Technology Annual Deals Analysis, 2010

¹⁷⁷ There is no NACE code specific to Clean Technologies. It has been identified as an area of opportunity in a number of industry and policy reports over recent years, incorporating technologies, products and services

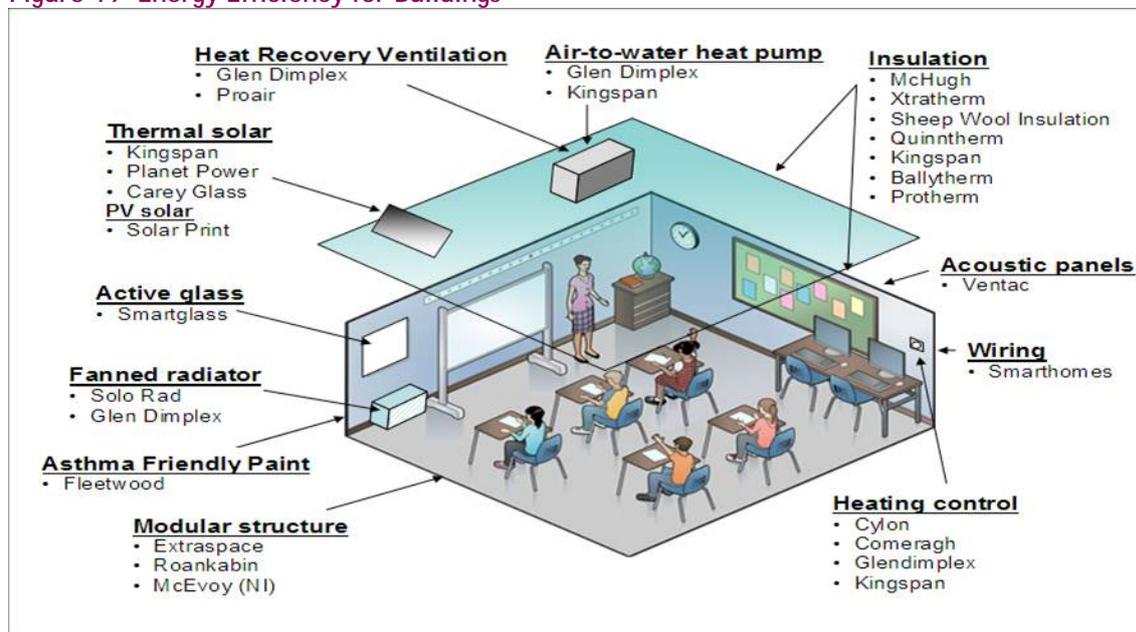
For Ireland, the opportunities include a range of activities involving product development, manufacturing, deployment and services:

- Development, production and/or management of equipment and products to service renewable energy generation and its efficient distribution through smart grid technology;
- Development and deployment of waste and waste water treatment systems;
- Development and deployment of traffic management systems, electric cars and charging systems;
- The monitoring, management and efficient use of energy in buildings using building management systems and more efficient equipment and construction methods and materials; and
- The optimisation of energy consumption in a range of areas including manufacturing processes, data centres etc.

The pervasive nature of the opportunities is perhaps best illustrated by way of example. Figure 19 illustrates the cross sectoral impact and significant opportunities offered for companies operating in Clean Technologies. The illustration relates to energy efficiency for buildings and a similar opportunity profile exists for all sub-sectors.

This sector, which is relatively nascent in Ireland, would benefit from a concerted ‘green’ public procurement initiative that is structured in such a way as to facilitate engagement with technologically based SMEs and collaboration between firms across sectoral and/or domain expertise.

Figure 19 Energy Efficiency for Buildings



Source: Enterprise Ireland

Functions and Activities - Adapting and Responding to Globalisation

Looking horizontally across manufacturing sectors, there are a number of areas of interest from Ireland’s perspective. These will resonate differently for different firms, depending to some extent on ownership and/or scale or reach of internationalised activities. In addition to the areas

set out below, IDA Ireland will continue its efforts to attract a broad range of headquarter activities from manufacturing firms (engaging with both its existing client base for mandate extension and with potential new names). Activities include customer support centres, sales lead generation, RD&I functions, shared services, treasury and IP management etc.

Manu-Services

Servicisation is a relatively recent term that describes the approach of manufacturing firms which seek to compete through the provision of service. Added value is provided by the manufacturing firm through a mixture of software, products and services to the extent that the traditional distinction between manufacturing and services has become increasingly blurred. It can be manifested in a number of different ways - and primarily requires a much closer connection to the customer than is necessary when delivering a (mass produced) product at a certain price point.

In relation to products such as the iPod, iPhone and countless others from medical devices to engineering systems it is no longer obvious whether these are service enhanced products or product enhanced services. While a manufactured product may be at the centre of the business, often there will be more people working on service support, technical information and a range of other services that add value.

IBM is an excellent example of a firm that shifted its emphasis from manufacturing product to providing a broad range of IT services. Cloud computing is a recent example where consumers pay by the hour for computing applications and services - they no longer need to buy the actual infrastructures (servers, routers etc.) or platform technologies - but are offered a service, enabling access to centralised computing resources, similar to what we are used to with electricity for example. Other firms add value by providing bundled solutions or the guaranteed provision of a capability rather than by providing just a physical product alone.

There is the opportunity for Irish firms to add value by embracing a manu-services model, particularly as they internationalise and extend their reach into new markets. A manu-services model can have a transformative impact on what might otherwise be a relatively low value and/or commoditised product.

For the manufacturing firm, this can result in substantial changes in the way it does business. A manu-services approach requires a business model that is somewhat different from the more direct 'price for product' model. It will generally require:

Adding Value through Services & Technologies

Keenans Systems has been in operation in Ireland for almost 35 years, established originally to produce feeder wagons to service the agriculture sector.

The company has invested heavily in R&D over the years, and prides itself in having built strong relationships with its customers.

Building on their core competencies in manufacturing and engineering, they developed a solution that combines the advice of a professional nutritionist, after-sales services and an enhanced product that is tailored to the particular needs of a customer. The customer realises significant benefits through increased quality, consistency, yield, cost reduction and efficiency in dairy and beef production.

Keenan's recently launched award winning iKeenan feeder is equipped with new information and communication technologies which takes advantage of cloud computing, to measure and record loads, control feed ratios, track consistencies and saves on fuel costs.

Keenan's won the Innovation Award at The Space Show 2012. The Space Show is Europe's largest livestock show with over 1,300 exhibitors from over 35 different countries.

<http://www.keenansystem.com/ie-en/cms/ikeenan-wins-innovation-award-at-the-space-show-in-france/>

- A different sales approach;
- Different revenue models;
- New forms of innovation;
- Longer term management of customer relationships; and/or
- Collaboration with partners that offer complementary services.

There are already good examples within Ireland of companies that have embraced a manu-services model. For Ireland the opportunity is to raise awareness amongst firms that can assess its relevance for their operations, develop and disseminate case studies, build the relevant capabilities and skills, and broker partnerships.

Contract Manufacturing - Strategic Partnerships

The use of contract manufacturing depends very much on the industry, with the use of contract manufacturing as a share of cost of goods sold varying from as high as 80 per cent in consumer electronics to as low as 20 per cent within branded pharmaceuticals¹⁷⁸.

Over the 1990s, Ireland gained significantly from the outsource model that was embraced by the ICT sector at the time. Many global ICT firms outsourced their production to large scale contract manufacturers, who benefitted from economies of scale to deliver high volume, usually at very tight margins. In the early 2000s many EMS (Electronics Manufacturing Services) players shifted this production to low-cost geographies - and Ireland's ICT sector suffered somewhat as a result of this trend¹⁷⁹.

Although the most common reason given by companies choosing to outsource is 'cost', in reality the decision nowadays is somewhat more complex. Companies will outsource for a variety of reasons, such as to access capacity, technology, knowledge, and/or markets, and the relative importance assigned to cost can differ¹⁸⁰. Hidden costs can also be a factor, arising due to uncertainty in the supply chain, delays, extended time to market etc. Such hidden costs are important for firms to grasp as part of the outsource/offshore decision.

Outsourcing is a model that continues to evolve - as many Contract Manufacturing Operations (CMOs) provide a broader range of higher order services including system assembly, manufacture, test, delivery, software and silicon design and customer service. This model is based more on strategic partnerships, requiring quality, reliability and flexibility. There are also several thousand smaller companies that occupy CMO niches that can demand higher margins.

In medical technologies the use of CMO offers high growth opportunities as companies seek additional capacity, specialised technologies or local manufacturing for particular markets. Outsourcing in Biopharma also presents a growing market as the industry matures, although it

¹⁷⁸ World Investment Report UNCTAD, 2011

¹⁷⁹ An EMS may specialise in High Mix Low Volume (HMLV) or High Volume Low Mix (HVLM). Mix refers generally to the complexity of the printed circuit board (PCB) assembly with prototype, medical electronics or machinery being lower volume

¹⁸⁰ For example, if the business driver is to gain access to a new technology this will imply setting up a long term relationship and relying on the technical knowledge of the CMO. If the contract manufacturer is intended as a back-up sourcing option, then the total cost of maintaining the back-up option will be more important than the individual unit cost of items sourced. If the intention is to gain additional capacity of a commodity process, then unit cost is likely to be the most important factor

brings with it regulatory and technical challenges particular to it. The fully integrated model embraced by Biopharma companies in the early stages of the sector's development has been replaced by a virtual company model, with limited in-house infrastructure and efficient use of outsourcing. As the Biopharma sector itself has grown so too has the contract manufacturing industry that services it.

For start-ups, the CMO offers a cost effective proposition eliminating the need to invest in their own infrastructures, and/or to develop current good manufacturing practices (cGMP)¹⁸¹.

Ireland has a growing cohort of companies that have developed the capabilities and standards certification and offer contract manufacturing services to the highly regulated medical devices sector. In general, contract manufacturers tend to 'follow the customer' - in that they locate wherever their primary customer locates, so it can be challenging to accurately define the opportunity. Nevertheless, there may be opportunities presented for Ireland depending on the primary business driver for outsourcing and based on a strategic partnership model. An improvement in Ireland's relative cost competitiveness, delivered through coordinated and targeted action would strengthen this proposition overall.

Ireland is already home to a number of foreign and indigenous firms that provide contract manufacturing services (some of which also produce own product). Developing the CMO proposition in Ireland could result in many benefits, as:

- A manufacturing solution for start-ups - alleviates the need for capital investment offering design for manufacture, process design, New Product Introduction (NPI) and optimisation etc.;
- An attractive proposition for attracting overseas entrepreneurs;
- An attractive location for leading edge CMOs - bringing together development, design, engineering capabilities for NPI and process development - with particular strengths in regulated sectors and more complex production; and/or as
- An attractive location for CMO management : which involves the coordination of all related activities including Legal, Finance, Product Development, R&D, Supply Chain and Quality through a centralised Cross Functional CMO Governance Team; Ireland's expertise in SCM, and management of international plants is directly relevant in this regard.

Taking Advantage of Shifts in Global Supply Chain Networks

There are a number of dimensions that provide opportunity for Ireland over the coming years:

- Attracting further FDI in manufacturing and supply chain management (SCM) as companies reconsider their global strategies (new and established MNEs);
- Promoting a supply chain business model to Irish companies that internationalise; and
- Stimulating enhanced engagement by Irish based firms to global supply networks, with a focus on increasing linkages (and supply opportunities) with multinationals based here.

Foreign Direct Investment: As set out in Chapter 2 many globally dispersed firms are reconsidering their offshoring and outsourcing strategies as the hidden costs of managing the global supply chain increase and the input costs in developing economies rise. In this context,

¹⁸¹ Article : The Rise of BioPharmaceutical Contract Manufacturing, BioPharm International, 2007
<http://www.bptc.com/sites/default/files/articles/theriseofcontractmanufacturing.ransohoff.pdf>

Ireland can reposition itself as a location of choice for production of critical elements of the supply chain, particularly when IP protection, complex and sophisticated production and colocation of manufacturing with R&D are factors for consideration.

Management of the global supply chain now requires higher order competences as global firms look for ways to identify and to minimise the hidden costs embedded across the supply network - hidden costs such as fear of supply interruptions caused by lack of visibility, poor communications and lack of systems integration or the risk of failing to maintain the right technological competencies in-house. Global firms are also looking for ways to increase the velocity of the supply chain - that is, speed up the time to market, but without compromising quality.

Ireland could be part of the solution. We already have a well-developed proposition and track record in supply chain management, spearheaded by Dell and supported by RD&I in the University of Limerick (UL), Dublin Institute of Technology (DIT) etc., and by training and development in the National Institute of Training and Logistics (NITL), Smurfit etc. Ireland has developed the expertise to manage the different relationships (external and internal) across the supply chain and can build on this to provide a more advanced offering to address the changing needs of the parent company.

Irish Firms: Likewise, supply chain and related business models are increasingly relevant to Irish firms as they internationalise through acquisition and/or outward direct investment (ODI). Overall, adopting a supply chain model and centralising functions such as procurement should enhance the capabilities of the Irish based entity, and present an opportunity to maximise the return to the state arising from its internationalisation. Structuring an IP licencing model and/or commissionaire model is also relevant in terms of optimising the return to the State.

Indigenous firms need to consider a number of related aspects including: acquiring and/or developing skills and capabilities; investing in integrated technology infrastructures (including, for example, developing and/or sourcing cloud based offerings); sourcing appropriate partners and due diligence; and the functions that could be centralised (e.g. technical support, financial shared services) as part of the overall SCM model.

Sub-supply and Linkages: A major element of enterprise policy in the '80s involved the linkages programme, which brokered introductions between foreign multinationals establishing in Ireland and indigenous firms that could supply product and/or services. At that time, the indigenous firms formed a very important part of the eco-system for manufacturing and of Ireland's attractiveness for FDI. Over the years, the increasing disaggregation of the supply chain resulted in changes in procurement practices, with many decisions now centralised, and not necessarily housed within the Irish based subsidiary. The data set out in Chapter 4 demonstrates that although total inputs for foreign owned subsidiaries have increased over time, the proportion sourced from Irish firms has decreased.

The landscape has changed - however, Irish based MNEs themselves express the desire to deepen engagement with the Irish innovation eco-system. Enterprise Ireland and IDA Ireland have embarked on the development of a joint Global Sourcing Strategy to focus on the circumstances in which strong business connections can be made to the benefit of the firms and ultimately of Ireland's economic growth. In November 2012, the Minister for Jobs, Enterprise and Innovation announced that the agencies will work in cooperation with the aim of increasing inter-firm procurement by €500,000 annually.

Case Study: Aerogen: Collaborating to Compete - Competitive Manufacturing in Ireland

Aerogen demonstrates the achievability of bringing manufacturing back to Ireland from China. The company was founded as Cerus Medical in 1997 by John Power. In 2000, the Galway-based company merged with Silicon Valley based Aerogen Inc. and underwent an Initial Public Offering (IPO) on NASDAQ in the same year. Aerogen was acquired by Nektar Therapeutics in 2005, and re-emerged as an Irish owned company in 2007, following an MBO led by John Power.

The company utilises its proprietary aerosol platform to produce a range of pulmonary drug delivery products. The company's products are protected by over 40 patents and sold in 50 countries worldwide, with 96 per cent of sales achieved in export markets. Since the MBO, the company has achieved five straight years of increased growth and profitability, and is forecasting a further 30 per cent revenue growth in 2012.

The core element of the company's products is an aerosol generator, based on an electroformed metal sheet produced with millions of micron-sized tapered holes. The sheet is scanned and punched into discrete aperture plates, each containing over 1,000 holes. These plates are assembled with a vibration source, causing the sheet to vibrate at many thousands of vibrations per second and generate small aerosol droplets of consistent size. The aerosol generator is then assembled into various nebuliser devices which deliver medications to upper respiratory systems the lungs.

Bringing manufacturing back to Ireland: Aerogen decided to bring the assembly of its aerosol generator, together with its main product line (the Aeroneb Solo™ nebuliser), back from China to Ireland. The process of re-entry, which began in 2007, involved collaborating with expert partners in Ireland. Two partners were key : Molex (at Shannon) for process re-development inputs and the automation of the nebulizer core assembly; and the University of Limerick's (UL) Enterprise Research Centre and the Materials/Surface Science Institute for materials. Development support was provided under the Enterprise Ireland Innovation Partnership Scheme. Working with Molex and UL, a joint programme of development was specified, focused collectively on design-for-manufacture optimisation, resulting in reduced product-to-product variability and higher yields.

An important factor in bringing manufacture back to Ireland was a recognition of the benefits of co-locating product and process development within close spatial proximity, so that face-to-face interactions could be achieved and that trust and confidence could be built up to solve problems iteratively and generate ideas. A major benefit of co-locating product and process developments is that new product development is now flowing from the process development activity itself. For example, the ability to reduce variation and to increase yields can lead to the development of enhanced products with new price points.

For Molex, the partnership involved leveraging and building on their well-established ICT manufacturing expertise to establish a medical device capability within their facility in Shannon.

The benefits of moving production from China back to Ireland has resulted in: greater integration of product development and process development; lower manufacturing costs due to process automation; better product consistency and process capability; less time and resources in managing the supply chain; lower freight and logistical costs; shorter lead times; reduced risk of IP infringement; growth of engineering expertise through collaboration with UL and Molex; reduced need to send staff to the Far East to support manufacture; customer satisfaction through ability to see and visit the factory; and less working capital tied up.

Also key was the ability to work closely with UL in areas of research, such as metallurgy, using the University's expertise and specialist equipment for simulation/modelling, microstructure characterisation, surface morphology, and vibration analysis.

Developed by SQW 2012

A key consideration has been the ongoing need for Irish firms involved in sub-supply to invest in achieving the standards required by MNEs, to enhance sales and marketing skills in order to capture opportunities for strategic partnering and to build up knowledge of the changing needs of their customer and potential customer base (e.g. in materials). Generally the sales cycle can take a number of months and requires commitment over the medium term.

IDA Ireland already involves relevant potential supplier indigenous firms in itineraries for FDI firms and, working with Enterprise Ireland, is continuing to build awareness of the competences and capabilities of Irish firms. Analysis of what is currently available could also lead to greater understanding of gaps in Ireland's sub-supply eco-system for manufacturing that could be filled either by attracting FDI and/or stimulating start-ups to address a market need. It is important also to note that connections between Irish based MNEs and indigenous firms extend beyond 'traditional' sub-supply to involve technology licensing and collaboration on R&D.

Both the foreign subsidiaries and Irish firms would realise benefits (which would also result in economic return for Ireland). For foreign subsidiaries it would reduce the risks and hidden costs in longer supply chains, result in closer supplier partnerships and further embed their activities in Ireland. For indigenous supplier companies it would introduce a new customer base, strengthen their capabilities in selling, product development and customer relationship management and equip them to expand into overseas markets.

New Product Introduction/Pilot Manufacturing

Innovation is at the core of any successful manufacturing firm. The demand for increased customisation, the availability of new materials, the increasing importance of Product Lifecycle Management (PLM) and increased complexity in terms of scale and functionality present considerable challenges for firms as they seek to develop and introduce new products. The introduction of combination products or those involving biologics offers even greater challenges.

There are a number of dimensions worth considering from the perspectives of foreign and Irish owned firms:

Firstly, consolidation and mergers and acquisitions (M&A) by global multinationals can often present challenges in terms of 'new to them' products and rationalisation etc. In such circumstances, the Irish based subsidiary may find itself in competition with its affiliates for the integration/production of acquired products, and needs to be in a position to offer New Product Introduction (NPI) capabilities and to be part of the solution. Often (and particularly in the case of Pharma/Bio and Medical Devices) this involves a reconfiguration of the Irish plant, very different skills sets and a problem solving attitude. Irish based MNCs need to make the transformational changes necessary to place them in a favoured position and to become increasingly aware of, and engage with, the support system available to them as part of Ireland's competitive positioning (including R&D capabilities, skilled workforce, R&D tax credits, IP environment etc.).

Secondly, the literature review undertaken for this study indicated that in some quarters there is a concern that large globalised companies are losing the ability to innovate - to translate ideas into a commercial reality - because the R&D function is geographically disconnected from production. The pilot manufacturing and NPI process involves an iterative cycle, engaging sales and marketing personnel, researchers, product developers, and engineers as they develop and modify a product for manufacturability. Consultations with companies confirm that a face-to-face interaction between all disciplines speeds up the process, stimulates ideas and problem solving (See also Aerogen case study on page 71).

With an increased focus on 'connecting the dots' between state funded R&D and the needs of companies, on enhancing the ability to collaborate across disciplines and on effectively utilising our problem solving capabilities, Ireland could serve to become a location of choice for piloting/testing new products and developing the efficient and sustainable production systems.

Further action is needed to develop/provide appropriate test, trial and scale-up facilities to make this a reality and to leverage the existing R&D expertise.

Finally, Irish firms can benefit from access to appropriate facilities and from advisory services and expertise to inform more structured methods for NPI. A key challenge relates to building the capability of smaller firms who have not yet engaged in own product or process development.

Advanced Manufacturing Technologies

Lean, Green, Digital

Chapter 3 set out the significant change that is facing manufacturing firms - change that offers considerable opportunities to increase efficiencies, reduce costs, add value for the consumer, embrace new business models, find new routes to market, enhance innovation and connect to the customer. It is true that some firms are further along the pathway in terms of the Smart, Virtual and/or Digital factory - but regardless of what stage of development a company is currently at, there is an opportunity to take the next step. For every manufacturing company it is about being Lean, Green and Digital - enhancing productivity and sustainability is a must. Each and every firm can contribute to Ireland's future growth - by enhancing its own performance and productivity

Adopting existing technologies: For some firms it is about being assisted to identify and adopt existing technologies that are relevant to them, to their stage of development and strategic pathway. Technologies can relate to production processes, supply chain optimisation, Product Life Cycle management, Customer Relationship Management (CRM), energy efficiencies, eBusiness, open innovation etc.

Firms will likely need to invest in building the necessary skills and capabilities (whether through on-the-job training, in-house or external courses), and to engage in opportunities for peer-to-peer learnings.

Developing new technologies: For other firms it is about being at the leading edge of new developments - engaging in in-house R&D and/or collaborating with Ireland's research capabilities across the range of relevant domains and platform technologies¹⁸².

Of particular relevance is Ireland's recent investment in two technology centres whose applied research is informed by the needs of industry. The aim is to produce readily implementable, practical, commercial solutions for manufacturers of all sizes and sectors.

- **The Irish Centre for Manufacturing Research (ICMR Ltd)** which is geared toward helping companies improve performance. Its current projects include cycle-time reduction, virtual metrology and predictive maintenance and the management of tacit knowledge within the workforce; and
- **Innovation for Ireland's Energy Efficiency (I2E2)** is focused on strategies and technologies that can improve energy efficiency in factories, plant, equipment and buildings.

¹⁸² Appendix V sets out Ireland's research institutes that are directly relevant to manufacturing activities and sectors

The real opportunity (and challenge) is to position Ireland as a Centre of Excellence for Manufacturing Technologies - to build a reputation for being at the leading edge of technology development and adoption.

This would involve:

- Stimulating increased collaboration across companies and research institutes;
- Developing the facilities for trial/test and demonstration of new technologies by large and small companies;
- Making it easier for SMEs (in general) to engage with R&D and/or at a minimum to adopt technologies in the workplace; and
- Encouraging new technology-intensive and software start-ups that are focused on addressing the needs of the manufacturing sector.

Adopting Lean and Green Principles

- Enterprise Ireland's Lean Business Offer provides support at different levels, appropriate to a firms' circumstance.
- The Ideas Institute works proactively with firms through change management processes.
- IDA Ireland provides advisory services to companies seeking to transform their operations as they face new opportunities in manufacturing.
- The EPA provides a range of supports for business, tailored to their needs, for the development and implementation of resource efficient practices.
- The IMDA is working with its companies to develop a tailored benchmarking process and programme to improve operational excellence.
- Increasingly firms are facilitated by the agencies to engage in peer-to-peer learning and there is the potential for cross sectoral knowledge sharing.

Materials

Materials are the basic building blocks of all products and processes. The utilisation and employment of materials in the manufacturing process requires an in-depth knowledge of a material characteristics, performance and application, and perhaps more so in the context of increased focus on sustainability, miniaturisation/nano-scale product development and technology convergence. R&D in materials has led to many innovations that have transformed industries via new process development and new product development. Because materials is such a broad area (and integral to product development and manufacturing) is it difficult to be prescriptive in terms of specific opportunities for Ireland.

Ireland has invested significantly in a number of research centres and technology centres in support of materials science (exploring the design and properties of novel materials) and materials engineering (development of existing materials for commercial application, environmental impact etc.). Centres include, for example CRANN (Trinity College Dublin), Tyndall (UCC) and Materials Surface Science Institute (MSSI, University of Limerick), as well as Applied Research Enhancement Centres based in IoTs that work closely on applied research with SMEs including South Eastern Applied Research Centre (SEAM, Waterford), Centre for Advanced Photonics and Process Analysis (CAPPA, Cork) and Microsensors for Clinical Research and Analysis (MICRA, Tallaght). Ireland has

also been successful in leveraging EU funding¹⁸³. It is important that firms leverage the expertise available and embrace innovation in materials.

In broad terms, potential in materials stems from:

- **The utilisation of existing materials** Re-engineering of existing materials adds value, for example; new ways of processing/forming or coating/surface an existing material will enhance its characteristics - e.g. honeycombed titanium. The convergence of technologies and sectors also presents opportunities for materials to be applied in new ways.
- **Development of new novel materials** (commonly referred to as 'Advanced', 'Smart', 'Next Generation' Materials). The development of new / next generation materials requires next generation analytics for characterisation and next generation processes for manufacture, PLM etc.

Connecting to Applied Research Capabilities in Materials - Mincon

Mincon, an internationalised Irish company headquartered in Shannon, came to the limelight when its product played a key role in saving the miners trapped in a Chilean mine earlier in 2012.

Mincon manufactures rock drill hammers and bits in what might be regarded as a 'traditional' manufacturing sector. Its corporate strategy is to make the customer the focal point of everything it does, and Mincon values customer feedback to inform its RD&I.

In the latter part of the 1990s, Mincon began production of a new generation range of "Down-the-Hole" Hammers and Bits. It has collaborated with the South East Advanced Materials (SEAM) applied research enhancement centre at Waterford IoT to design superior drill heads to survive the extremely challenging environments of geothermal heating wells in Nordic countries. The company participated in an Innovation Partnership scheme supported by Enterprise Ireland with SEAM bringing finite element modelling (FEM) and metallurgical know-how to the table.

Source: www.mincon.com and *Technology Ireland*, Enterprise Ireland July/August 2011

From an enterprise perspective, the adaption of new / next generation materials will likely require companies to revisit their own strategies, for example:

- What parts/components will be provided by sub-suppliers?
- What can be sourced from local suppliers?
- What will be developed and produced in house?
- What reconfigurations will be required in house in terms of processes, PLM, and analytics?
- Where will development/prototyping be undertaken - and by whom?
- What new partnerships will be needed?

Sub-suppliers will need to reassess their own product range, capabilities, and align themselves to address the changing needs of their existing and potential customers.

¹⁸³ According to the Eighth Interim Review of Irish Involvement in the Seventh European Union Framework Programme for R&D, in the period ranging from 2007 to November 2011, Ireland drew down approximately €35 million under the thematic programme NMP (Nanotechnology, materials and processing) and surpassed the target of 1.25 per cent of funding awarded to Irish participants by 0.7 per cent

It is crucial that materials RD&I capabilities and expertise form part of Ireland's overall manufacturing proposition for product development, design, process development and PLM. Ireland can:

- Further develop the capabilities of Irish based sub-suppliers in terms of advanced materials, design, testing and prototyping;
- Attract FDI from materials sub-suppliers;
- Build capabilities in partnership management, new business models (the economics of new materials), PLM; and
- Build linkages and collaborations between relevant parties and across formerly discrete sectors/industries for sub-supply, design, prototyping etc., and between industry and academia.

Conclusions

This chapter has set out the many opportunities that exist for Ireland in manufacturing. What is increasingly evident is the blurring between and across sectors and the absolute imperative for transformational change for the industry in Ireland to be *Green, Lean and Digital*. Making the connection to the customer, anticipating and responding to their needs through innovative products, services and solutions is critical to success. Collaboration is an essential part of doing business today - effective collaboration requires people with the right skills, competences and attitude.

Ireland does have a number of strengths which differentiates it from others - strengths which can be further nurtured and built upon. At the same time, there are a number of barriers to growth that remain. Actions are also needed to fill the gaps so that Ireland's eco-system evolves to meet the changing needs of manufacturing firms here.

Chapter 8 summaries these strengths, barriers and gaps based on research, analysis and consultation. Chapter 9 then sets out what needs to be done to realise the potential and lead Ireland's manufacturing sector to growth.

The next chapter looks specifically at the indigenous base and the potential to encourage more start-ups in manufacturing activities.

6 Taking Pride in Ireland's Own - Driving Investment and Growth in Indigenous Manufacturing

Introduction

Ireland's economic fabric has been distinguished by the intensity of FDI investments over the years. Ireland has benefited from such activity, particularly in terms of productivity, international exposure to best practice, enhanced capabilities etc.

Over the years there has been an increased policy focus aimed at achieving more in terms of economic activity and performance from indigenous firms¹⁸⁴. Indigenous firms include those that trade on local markets and those that internationalise - some through exports, others through outward direct investment (ODI) or overseas activities. Today, Enterprise Ireland offers a range of supports aimed at building scale, enhancing internationalisation capacity and capability, supporting high potential start-ups and at enabling a greater number of companies to export¹⁸⁵. The City and County Enterprise Boards (CCEBs)¹⁸⁶ offer financial supports and advisory services to start-ups, and in general cater to companies that employ less than ten people¹⁸⁷.

Often the performance of indigenous firms, and particularly agency assisted indigenous firms, is compared with that of foreign firms based here. Although indigenous manufacturing firms provide a similar level of employment in Ireland to that provided by foreign owned firms, they tend to be overshadowed in terms of scale of output and exports. In terms of the data, what is often overlooked is the extent to which some Irish firms are internationalising - ODI has increased significantly over recent years, so that today it is estimated that Irish owned multinationals employ 249,000 people and generate €71.9 billion turnover in overseas affiliates¹⁸⁸. A number of Irish firms are multinationals with investments in global markets and recognised brands, others have gained leading positions in niche markets and many demonstrate high levels of innovation.

This section focuses specifically on the following aspects:

- Realising greater investment and growth in indigenous manufacturing firms - through start-ups and scaling; and
- Telling the full internationalisation story of indigenous companies and measuring 'success' (beyond exports and employment in Ireland).

The competitiveness of manufacturing firms and the supporting business environment forms a key thread throughout this report and is not repeated in this chapter.

¹⁸⁴ Enterprise policy has been informed by Ahead of the Curve, Ireland's Place in the Globalised Economy, Enterprise Strategy Group, 2004; The Report of the Innovation Task Force, 2010; Making it Happen, Growing Enterprise for Ireland, Forfás 2010; all of which highlight the potential to enhance the contribution of indigenous firms to Ireland's economic growth

¹⁸⁵ Enterprise Ireland has dedicated teams established in its Scaling and Potential Exporters Divisions

¹⁸⁶ The CEBS will transfer to Local Enterprise Offices (LEOs) during 2013. The LEOs will continue to provide supports locally to micro firms

¹⁸⁷ There may be some exceptions, particularly where companies demonstrate the potential to export at an early stage of their life-cycle, and these companies are supported by Enterprise Ireland

¹⁸⁸ Business in Ireland 2010, CSO, Nov 2012. Manufacturing activities employs 75,000 and generates €15.5 billion in turnover. Other activities relate to distribution, construction, services and other industrial

Start-ups in Ireland

The APJ 2012 recognised that creating an indigenous engine of economic growth was central to the revitalisation of the Irish economy. Entrepreneurs, and the start-up companies that emerge as a result, were identified as providing the feedstock for future exports and employment and the means by which new sectors could take root in Ireland. Start-ups can also increase levels of innovation in the market place, increase productivity and improve competitiveness.

Given the variety of data sources it is challenging to build a comprehensive economy-wide picture of new activity in manufacturing.

Analysis of the CSO business demography indicates that the total number of enterprise start-ups in the economy 2010 was 11,237¹⁸⁹. Of these, a relatively small proportion, five per cent (590), related to manufacturing sectors. The majority of these manufacturing start-ups in 2010 were in the area of basic metals and fabricated metal products (168), furniture and other manufacturing (73) paper and paper products (61) and food (58)¹⁹⁰. It is difficult to ascertain what proportion of these progresses to export or reach any degree of scale - or has the potential to do so.

The low proportion of manufacturing start-ups economy-wide is not necessarily unexpected, as the vast majority of companies trading on the domestic market relate to retail, hospitality and construction. The proportion of manufacturing start-ups has improved slightly since 2006, although this may be more a factor of the considerable reduction in construction related firms in the overall total. In real terms, manufacturing start-ups have declined from 764 in 2006 to 590 in 2010.

What is perhaps of greater concern is the relatively low numbers of companies actually involved in production that are represented in Enterprise Ireland's high potential start-up HPSU cohort (six in production out of 35 in manufacturing related sectors - compared with 19 in production out of 30 in manufacturing related sectors in 2007). Can more companies involved in manufacturing sectors be encouraged to set up production in Ireland?

In terms of entrepreneurship, the recently published GEM report highlights that the prevalence of those aspiring to be an entrepreneur in Ireland in the future has reduced from its relatively high levels in previous years¹⁹¹. What is perhaps most telling is the marked increase in the number of individuals starting a new business through perceived necessity (32 per cent)¹⁹².

This could be interpreted in two ways: one - that Ireland is now tapping into individuals who have the capability to start a new business, but were inhibited by a fear of failure; or two - that now a number of people are starting a business, but do not necessarily have the aptitude to develop and grow a company to scale. A minority of early stage entrepreneurs expect to have significant jobs

¹⁸⁹ Business Demography 2010, CSO - defined as 'births'. New businesses are identified by VAT employer, Corporation tax or Income Tax registrations. This data includes all firms - firms trading on the domestic market, and those with the potential to export as well as newly registered Greenfield (FDI) start-ups

¹⁹⁰ *ibid*

¹⁹¹ Entrepreneurship in Ireland, 2011, The Global Entrepreneurship Monitor, Paula Fitzsimons and Colm O'Gorman, 2012.' Aspiring to be an entrepreneur 'is 8.5 per cent in 2011 compared with 11.2 per cent in 2007 and 10 per cent in 2008 (Table 2)

¹⁹² *ibid*. Ireland has a higher rate of necessity entrepreneurs than the norm across the OECD and the EU, including Spain and Greece

growth¹⁹³ and nearly six in ten have, or expect to have customers outside the country¹⁹⁴. This perhaps begs a more fundamental question relating to entrepreneurial ambition, rather than something specific to manufacturing.

The GEM analysis shows that in terms of sector activity of early stage entrepreneurs, 23 per cent in Ireland related to 'transformative sectors' - a category that includes Construction, Manufacturing, Transport, Wholesale and Utilities. Germany had 27 per cent in this category with Poland the highest at 47 per cent and Czech Republic at 34 per cent. Because this is such a broad category it is difficult to reach any real conclusion with regard to the proportion relating specifically to manufacturing.

Overall, the picture painted is a challenging one for manufacturing start-ups in Ireland.

Start-ups - a Broader Perspective

It is worth looking at the many different ways of starting up a manufacturing company, besides the most obvious Greenfield model. A Greenfield model describes a situation where a company starts from scratch. This is generally considered a high risk strategy and the most challenging - and involves significant investment in property, equipment and people. Other ways of starting up that serve to reduce risk include:

- **Diversifying into new markets/products:** An established company may set up a new entity to address a different market opportunity following development of a new product/service (this may be particularly pertinent in situations where brand is important and/or where the market segment is quite different from that served by their 'primary' product range). Risk can be minimised if they share location with their existing operation.
- **Management Buy-Out (MBO)** involves the purchase of a controlling share of a company by management/ key executives. A MBO of existing/established firm can avoid closure and help sustain activity in a firm (including foreign subsidiaries).
- **Acquisition** is the purchase of one company by another. Some acquisitions may be triggered by investors that require an exit - others may arise as foreign entities seek access to new markets. For the acquiring firm or entrepreneur, it means accessing existing equipment, expertise and capabilities and/or customers rather than building up from scratch - although a change in strategy and/or investment in reskilling etc., is often required. From Ireland's perspective, acquisitions by a foreign firm can often mean increased investment for a firm in need of a change in strategic direction and/or capabilities¹⁹⁵. This can result in the acquired entity having greater potential overall as a strategic unit within a well-resourced parent company. Spin-outs can result from acquisitions (perhaps by way of a management buyout), particularly where some of the products/services are not aligned with the acquiring company's strategy, yet offer potential in niche markets.

¹⁹³ Ibid. 20 per cent expect to have significant jobs growth within five years - well ahead of the OECD average (12 per cent) and the EU-27 average (12 per cent)

¹⁹⁴ This is similar to the per centage in other countries (OECD average is 59 per cent, EU-27 average is 56 per cent, and EU-15 average is 59 per cent). However, this represents a slight decline in Ireland on the 2010 position when it was 64 per cent

¹⁹⁵ There is a clear process in place to facilitate the transfer of an acquired company or a management buy-out from one agency to the other (EI/IDA). Acquisitions of indigenous firms can mean that Enterprise Ireland results are negatively impacted if a key performer transfers to IDA Ireland. This should not impact upon business realities, but needs to be acknowledged when considering overall trend analysis on the performance of indigenous firms

For Ireland it is about optimising the potential for embeddedness and growth of an acquired entity.

- **Distributor turned manufacturer:** Strengthened by a good understanding of the market, distributors may opt to establish manufacturing facilities here. Often this model involves innovating to develop 'better' products and solutions based on a deep connection with the customer. Although aimed initially at the domestic market (and also playing a key role as part of the overall manufacturing eco-system), these innovative companies are also potential exporters¹⁹⁶.
- **A virtual manufacturing company** will often outsource production to contract manufacturers (CMOs), retaining a focus on core activities such as R&D, IP management, Supply Chain Management, marketing and customer relationship management. Spin-outs from academic R&D for example, may not actually engage in production themselves. As discussed earlier the CMO model is being increasingly adopted in the medical devices and biopharmaceuticals sectors. From Ireland's perspective, it is about how we can harness this activity on-shore, providing a competitive solution and proximity of RD&I with production.

Why Ireland for Manufacturing Start-ups

During consultations, insights were garnered from companies that recently established in Ireland or that had transferred manufacturing back to Ireland from overseas locations and from the enterprise development agencies. Locally based production offers:

- Better responsiveness and flexibility to deliver to the customised products and services that are increasingly demanded by customers;
- Greater hands-on quality control;
- Better control over the entire supply chain, greater overall certainty and reduced volatility;
- Closer connections between RD&I and manufacturing that facilitates the iterative problem solving process needed for new product introduction and pilot manufacturing that benefits from an interdisciplinary approach between researchers, production engineers, quality managers and marketing;
- Depending on the geographic markets being served, it can be more cost effective to manufacture in Ireland, taking into account the hidden costs of off-shoring, lead times and quality; and
- The potential to structure an internationalising business in a tax efficient way, underpinning activities with substance, risk management and control.

Decisions to establish in Ireland depend on a firm's strategy, its cost model and customer base. From Ireland's perspective, it is about ensuring that entrepreneurs and proprietors give due consideration to what Ireland may have to offer as part of their decision making process.

¹⁹⁶ Enterprise Ireland's Potential Exporters Division has identified this as a cohort with potential for growth

A Business Environment Conducive to Start-ups

There is a range of pro start-up initiatives already in place, aimed at making it easier to start a business in Ireland. The following sets out an example of what is relevant to start-ups, although it is by no means an exhaustive list:

- A range of exemptions are in place to support start-ups and small firms including: corporation tax relief for companies in their first 3 years of trading (which can also be carried forward beyond the first three years if unused - Budget 2013); the ability to report on a cash basis for VAT returns; and VAT registration thresholds of €75,000 for goods and €37,500 in services;
- The microfinance fund launched by the government provides €40 million in additional lending over the next five years to micro firms (managed by Microfinance Ireland). It aims to address firms across all industry sectors that do not meet the conventional risk criteria applied by banks. Microfinance Ireland works in partnership with the CEBs¹⁹⁷ who can assist with training and guidance in preparing a business plan;
- Enterprise Ireland offers equity investment on a co-funded basis to innovative high growth potential start-ups (based on clearly defined performance criteria) and the CEBs provide a range of financial supports¹⁹⁸. Start Your Own Business courses and advisory services to start-ups;
- The equity landscape in Ireland has developed substantially over the past 10-15 years - providing an unprecedented level of funding available for start-up/early stage and fast growing segments of Irish business, helped by State and private sector joint initiatives such as the Seed and Venture Capital Scheme; and
- The SCS (Seed Capital Scheme) and the EIS (Employment and Investment Incentive Scheme) provide tax relief to individuals investing in qualifying firms.

Despite a relatively positive business environment, start-ups, and capital intensive manufacturing start-ups in particular, face considerable challenges.

Barriers & Challenges

Many of the challenges facing manufacturing firms are set out in Chapter 9 which provides an overview of Ireland's supporting eco-system. It is fair to say that these relate to start-ups as well, and will not be repeated in this section. Some may have a greater potential to hinder early stage activities, including:

- Access to capital and funding for what tend to be capital intensive start-ups. Many manufacturing start-ups do not fit the VC paradigm - VCs typically seek fast growth and fast returns on investment. Added to this, the current risk aversion culture militates against the 'unproven' entrepreneur, and the fact that early stage start-ups are often unwilling to access equity based on fears of losing control of the business;
- Dampened demand and low growth (nationally and internationally) is likely to extend the initial phase in a start-up's life cycle, impacting on working capital requirements, proprietor confidence and tenacity;

¹⁹⁷ This partnership will continue with the Local Enterprise Offices when they are established

¹⁹⁸ Subject to certain criteria

- The range and complexity of various regulations, standards and processes - through from Health and Safety, to employment legislation to integrated pollution prevention control (IPPC) licences and sector specific regulations. The Report of the Advisory Group for Small Business highlighted this as a particular issue for start-ups and set out a number of recommendations¹⁹⁹. The report also highlighted the positive steps being taken by some agencies/bodies to ease the administration burden for small firms²⁰⁰;
- Cost competitiveness is an issue both for companies trading on local markets that compete against international players operating here, and for those targeting overseas opportunities that face intense competition from companies with lower input costs.

There are other challenges that are particular to start-ups and actions can be taken to make it easier for early stage proprietors to overcome them:

- Fear of failure is often cited as a barrier to entrepreneurship or start-ups. This relates to a cultural mind-set, and is challenging to address. More specifically, although so called 'necessity' entrepreneurship has been on the increase, the current economic climate has also brought into stark reality the difficult situation that individuals can find themselves in if their company fails. Under the existing system, owner/managers do not contribute under Class A PRSI and therefore cannot avail of unemployment benefits in the event of business failure - this can act as a barrier to engaging in entrepreneurship;
- The need for up-front capital investment for manufacturing activities could be minimised, particularly at pre-production stage of development. For example:

There has been considerable state investment in equipment to support R&D activities in HEIs throughout Ireland. The extent to which this resource is fully utilised is unclear, although there is a perception that there may be spare capacity. Early stage companies could be facilitated access to such equipment, to enable them to trial and test products and processes at a pre-production/ pilot production phase of their development²⁰¹;

There may be potential to support the establishment of trial and test facilities, whether associated with HEI research and technology centres, and/or provided by the private sector as is the case in the US (See text box);

Entrepreneurs could be made aware of the potential of 3D printers (additive

TechShop - Facilitating Manufacturing Start-ups in the U.S.

TechShop which started in 2006 now boasts a total of six outlets throughout the US. Its facilities offer access to a broad range of leading edge equipment and design software. TechShop is part fabrication and prototyping studio, part hackerspace, part learning centre.

For a monthly or annual fee, members can reserve and use TechShop's tools upon successful completion of equipment-specific Safety and Basic Use classes. Staff members are available full time to help individuals develop their ideas and improve technical skills.

TechShop offers a space that encourages collaboration and peer learning amongst those with a passion for making things.

Many successful manufacturing companies started out using TechShop.

www.techshop.com

¹⁹⁹ The Voice of Small Business, 2011, report of the Advisory Group for Small Business

²⁰⁰ Including for example, the Health and Safety Authority BeSmart initiative <http://www.besmart.ie/>

²⁰¹ There is an audit currently being undertaken by the Higher Education Authority of what is in place

manufacturing) for prototyping, and home based production where appropriate, through initial consultations, Start Your Own Business (SYOB) courses etc.; and/or

Introductions could be brokered to the services provided by on-shore CMOs.

- The establishment of a manufacturing activity tends to involve a greater degree of complexity than is the case for many services entities. In this regard it would be beneficial to offer a specific manufacturing follow on module to Start Your Own Business courses delivered by the CEB network.

Scaling

The need for scaling is not a new concept²⁰². Despite the success of a number of Irish firms in global markets, the vast majority of Irish companies are relatively small and lack the human and financial resources needed to take on the challenge of internationalisation. This challenge is perhaps even greater for manufacturing firms that might be the case for digitally enabled internationally trading services.

Enterprise Ireland established its Scaling Division in 2005 to focus on assisting more client companies to increase turnover from the €5m+ levels. Their Leadership for Growth, Chief Operations Officer (COO) and Chief Finance Officer (CFO) management development programmes, International Selling, RD&I and three tiered Lean programmes are all relevant in this regard, as well as advisory services, mentoring and trade missions. Enterprise Ireland's experience is that developing strong leaders is critical to delivering success in this area. It is essential that these initiatives are continued and capture a broader cohort of firms. Managers of firms also need to acknowledge their own limitations, and be prepared to put in the time, effort and resources (human and financial) needed to deliver real change.

A significant increase in scale is unlikely to be achieved by organic growth alone. Successful scaling companies generally engage in M&A activities and/or partner successfully to target larger scale market opportunities that they would not be capable of doing alone. Expertise and advisory services are available in Ireland to assist firms in search, due diligence etc. Enterprise Ireland's experience with their client companies indicates that they have difficulties in getting sufficient financing at a reasonable price to make an acquisition worthwhile and have tended not to proceed in these circumstances. It is apparent that the issues with regard to the funding environment hinder growth potential in these instances (See Chapter 7). When an acquisition has been completed, firms face challenges in relation to best approach to integration, including changes that may be required to management structures. The area of effective change management comes into play in this regard.

The concept of collaborating to compete as set out in Chapter 3 needs to become a reality for a greater cohort of Irish companies. By collaborating in order to capture larger scale market opportunities, individual firms engage in a reinforcing circle that enhances capability, opens doors and leads to increased scale. Although there are some good success stories, many smaller Irish firms are reluctant to engage in collaboration - whether for R&D or for closer to the market activities. This requires a mind-set change - a change that is easier said than done - but one that is essential for growth (and often for sustainability of a firm).

²⁰² Highlighted in Ahead of the Curve, Ireland's Place in the Globalised Economy the Enterprise Strategy Group, 2004, Making it Happen, Forfás, 2010, The Action Plan for Jobs 2012, DJEI, 2012

It is important also to acknowledge that ODI is an integral part of an Irish companies' internationalisation strategy. ODI has increased rapidly over the period since 2000. ODI has benefits both for the firm and for Ireland's economy. Although it is difficult to fully quantify the economic return to the State, benefits are realised in terms of increased innovation, productivity growth, repatriated profits, highly skilled employment in headquarter operations and management development through exposure to international best practice²⁰³.

Those same factors that work to attract leading multinationals to locate in Ireland should be actively marketed to Irish owned companies so that they maintain core operations here as part of their internationalisation strategies and that the economic benefit to Ireland is optimised.

Promoting the Success of Irish Business

Much of the analysis of Ireland's indigenous firms is based on the existing data based on economic activity in the State. While this is a valid perspective to take in terms of documenting the return to the State from its investment in supporting enterprises, it falls short in terms of telling the full story of the extent of internationalised activities. Employment in Ireland and exports from Ireland continue to be the key metrics captured to document the success of indigenous firms.

In today's increasingly globalised economy, Irish firms are themselves locating in overseas countries - Irish firms are the FDI for other jurisdictions. They are acquiring existing plants in other countries to access new markets, to capture capabilities and/or to benefit from lower input costs; they are choosing to locate close to strategic business customers; they are establishing sales and marketing arms in-market. Their activities in overseas markets generate sales, employment and help to build a reputation for Ireland's capabilities. Yet, much of this is not reflected in the baseline data for agency supported companies presented in Chapter 4.

CSO data indicates that Irish owned multinationals employed almost 249,000 people in foreign affiliates - 30.2 per cent of which relate to manufacturing entities²⁰⁴. Putting this into perspective, it means that Irish owned manufacturing multinationals employ almost 75,000 people throughout the world in addition to the 95,000 captured in agency supported indigenous firms. This fact is becoming part of the Irish 'story', in building a sense of pride about Ireland's own. Many point to Germany's Mittelstand as an example of how the SME is respected, supported and acknowledged for its key role in the economy. Enterprise Ireland has already embarked on telling the Irish story, and of particular note is the video developed during 2012 which shows Irish firms' success on global markets²⁰⁵. Is there further potential to raise the profile of existing Irish manufacturing SMEs and to build Ireland's Mittelstand equivalent?

Conclusion

The actions set out in this report in Chapter 9 contribute toward supporting and accelerating the growth of indigenous firms. Of particular interest to start-ups are the recommendations relating to access to pre-production and early stage trial and test facilities. Improvements to cost competitiveness and access to finance are crucial. Ensuring the availability of relevant skills,

²⁰³ Statement on Outward Direct Investment, Forfás, 2007

²⁰⁴ Business in Ireland 2010, CSO, Nov 2012

²⁰⁵ <http://www.enterprise-ireland.com/en/Where Innovation Means Business>

facilitating access to State funded research capabilities and facilitating clustering initiatives are all valid in support of growing companies to scale.

There are a small number of additional actions that are set out particular to encouraging more investment in manufacturing start-ups and driving increased scale.

7 Ireland's Ecosystem for Manufacturing - an Overview

Introduction

As a small open economy, Ireland is impacted by global economic cycles and shifts in industries - factors over which it has no control. The Irish Government does however, play a crucial role in providing a supportive business environment in which all enterprises can establish, thrive and grow - in creating the right conditions that will enable firms to increase their competitiveness, productivity performance and ability to innovate.

It is evident that manufacturing is changing at an unprecedented pace - changing in a way that has implications for all firms, regardless of scale. The business environment is not, and should not be, static. It needs to continuously evolve to meet the ever changing needs of firms.

The business environment encompasses a range of elements including the fiscal environment, education and skills, RD&I and physical infrastructures as well as Ireland's cost competitiveness relative to other countries.

It is also worth mentioning that 'Manufacturing' is not a sector per se, rather it is a description of an activity that is undertaken across a range of sectors. In this context, there are 'horizontal' elements within the business environment that are relevant to *all* manufacturing activities - although they may impact upon different sectors to varying degrees. There are also aspects that are specific to a particular sector (e.g. regulations, standards or specialist skills).

There is a perception that manufacturing may have been somewhat overlooked from a policy perspective over the recent decade. This review sets out the current environment from the perspective of manufacturing, highlighting what *is* in place as well as identifying the gaps and challenges in light of the global trends and implications set out in Chapters 2 and 3; and the opportunities set out in Chapter 5.

This chapter includes analysis of:

- Cost Competitiveness:
- Costs of Employment;
 - Utilities;
 - Transport;
 - Advanced Broadband;
 - Property Related Costs; and
 - Regulatory Burdens.
- The Funding Environment;
- Education and Skills;
- Research, Development and Innovation; and
- The Role of the Enterprise Development Agencies.

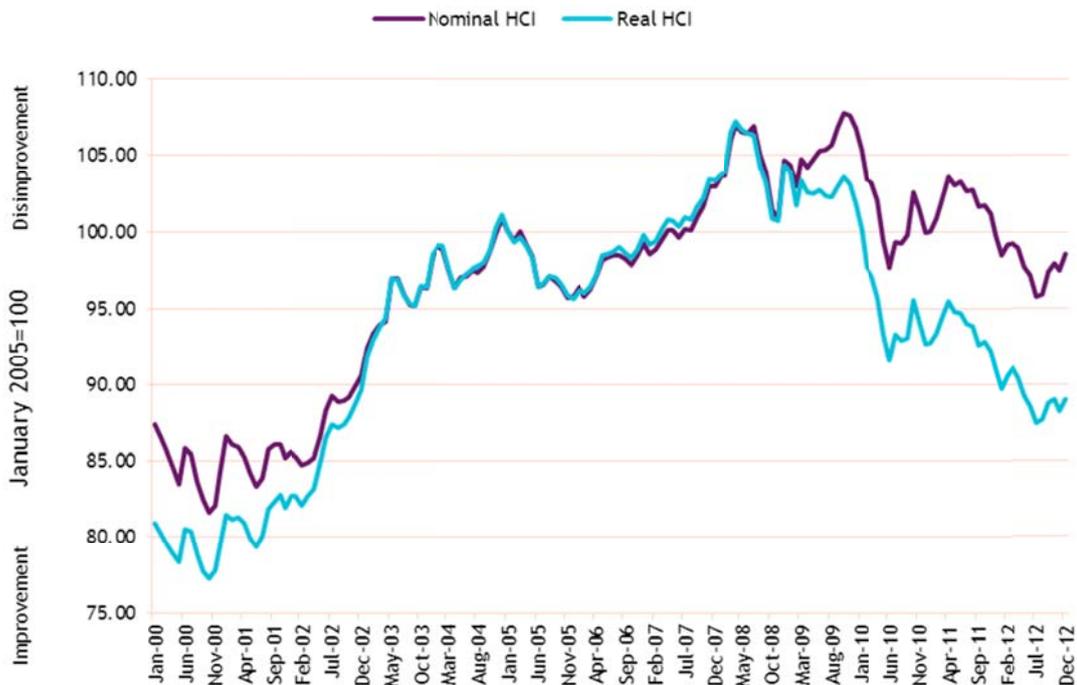
Actions have been set out in Chapter 9.

Cost Competitiveness

Companies and the enterprise development agencies continue to cite Ireland's relative cost competitiveness as a significant barrier to stimulating new investment and to sustaining existing activities even though Ireland's cost competitiveness has improved over the past few years.

The Harmonised Competitiveness Index²⁰⁶ (HCI) indicates that Ireland's relative cost competitiveness disimproved considerably (both in real terms and nominal terms) over the period since 2000. Between January 2000 and April 2008, Ireland experienced a 32 per cent loss in cost competitiveness reflecting an appreciation of the euro against the currencies of our trading partners (nominal HCI) and higher price inflation. Since then Ireland regained some of its competitiveness because of falls in relative prices and favourable exchange rate movements and from April 2008 to July 2012 Ireland's competitiveness improved by almost 19 per cent (Real HCI) (Figure 20). The concern is that over half of this improvement is due to favourable exchange rate movements²⁰⁷, and that these recent gains could be quickly eroded as the euro strengthens (as it did at the end of 2012) or if prices increase more rapidly than our competitors.

Figure 20 Harmonised Competitiveness Indicators, 2000-2012 (January 2005=100)



Source: Central Bank of Ireland, Forfás calculations

The pace of improvement in cost competitiveness has slowed and upward pressures are emerging (i.e. rising consumer price inflation, positive, albeit weak, growth in wages). In terms of

²⁰⁶ The nominal Harmonised Competitiveness Index is a nominal effective exchange rate for the Irish economy that reflects, on a trade weighted basis, movements in exchange rate vis a vis 56 trading partners. The real HCI, deflated by consumer prices, takes into account relative price changes along with exchange rate movements

²⁰⁷ Nominal HCI fell by 10.6 per cent. The Costs of Doing Business 2012, Forfás

domestically driven costs, it is of concern that recent price falls in Ireland are largely a cyclical response to the Irish and international recession rather than a response to structural changes in the Irish economy.

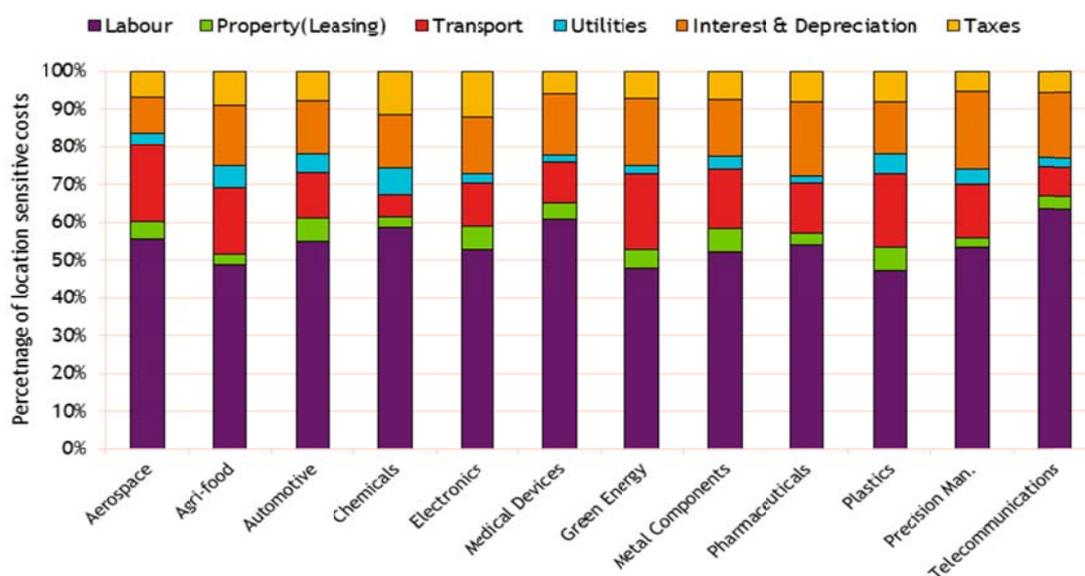
For Ireland, a concerted and focused effort to realise structural change is needed to ensure that prices do not escalate and erode competitiveness when the Irish economy returns to stronger rates of growth.

Ireland's cost competitiveness can be improved in two ways: through reductions in costs nationally; and/or at firm level through improvements in productivity (which is discussed in other sections of this report).

The analysis below, based on the Forfás *Costs of Doing Business* report focuses primarily on those costs which are location sensitive – that is, those costs that can influence decisions on where to invest²⁰⁸. From a policy perspective it is important to acknowledge the difference in input pricing structures for services and manufacturing firms. For services firms, a higher proportion of their costs are location sensitive, with labour costs representing a significant element.

For manufacturing activities overall, it is estimated that less than half of input costs (45.9 per cent) are location sensitive although this varies by sector: e.g. 62.9 per cent of total costs in the medical devices sector are location sensitive compared to 33.3 per cent in the chemicals sector. The analysis also shows that Irish firms are affected to a greater extent than foreign owned firms by locally influenced costs. The most significant costs relate to labour (ranging between 48 per cent and 62 per cent of location sensitive costs depending on sector). Others include: utilities; transport and property which are discussed in more detail below²⁰⁹ (Figure 21).

Figure 21 Manufacturing Sectors' Cost Profiles (Location sensitive costs only)



Source: KPMG, Competitive Alternatives 2012, Forfás Calculations

²⁰⁸ Location insensitive costs include inputs for which the price is set in international markets, such as materials and equipment. In general (although not in all cases) location insensitive costs do not influence decisions on where to invest

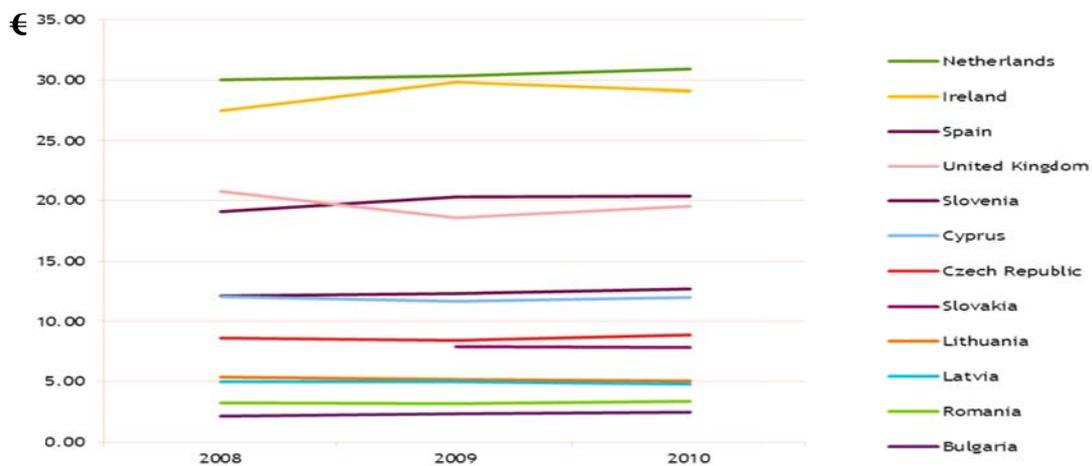
²⁰⁹ Cost of credit is included in the section on Access to Finance

The following sections set out a brief analysis of the current situation in relation to cost competitiveness, recent actions and priority challenges facing manufacturing firms. The analysis relating to utilities and transport takes into account infrastructures and market structures where relevant, given the strong inter-play between these factors and costs to business.

Costs of Employment

From 2009, growth rates for Ireland’s total labour costs have been lower than the EU-27 and Euroarea-16 average²¹⁰ which has resulted in a gain in relative labour cost competitiveness. At the same time, at €35,856 per annum, average compensation levels in Ireland across the entire economy in 2011²¹¹ were higher than those in Germany and the UK. Ireland also ranks as one of the higher cost environments in terms of hourly labour costs in Manufacturing (Figure 22). Although the chart below reflects primarily CEE economies, it does demonstrate that in terms of hourly labour costs for Manufacturing, Ireland was almost 49.3 per cent more expensive than the UK in 2010.

Figure 22 Hourly Labour Costs in Manufacturing



Source : Eurostat Database Direct. Accessed 17th October 2012

In terms of unit labour costs (ULCs)²¹² Ireland has become more competitive as reductions have been experienced over the past number of years - in 2010 real Irish ULCs fell by 4.6 per cent, a substantially larger fall than was recorded for either the EU or Euro area. ULCs are heavily influenced by composition effects, reflecting changes in both productivity and costs. Recent improvements in ULCs result from a reduction in output from low productivity sectors, an upturn in high value added export oriented sectors, and a reduction in compensation per employee²¹³ (Figure 23).

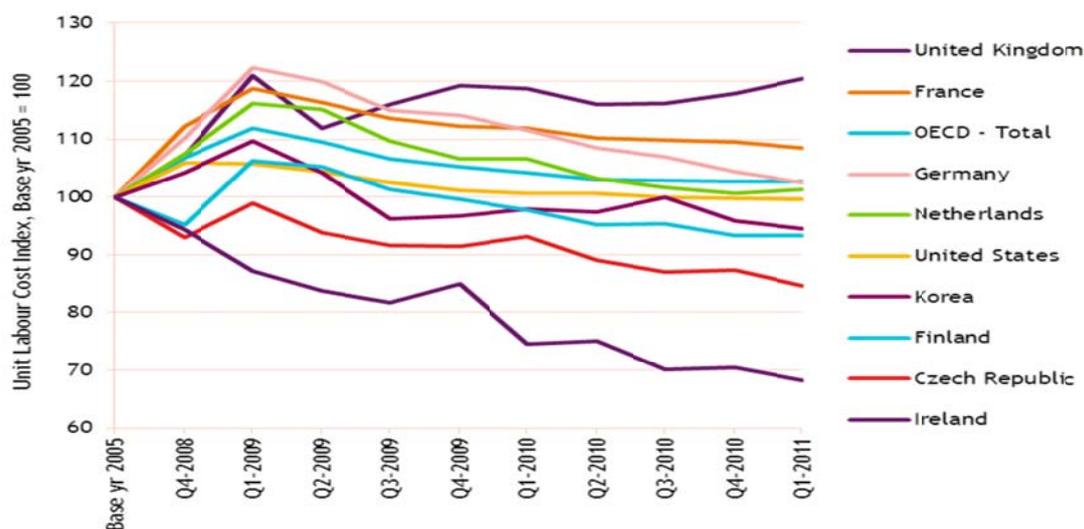
²¹⁰ From a high of 9.1 per cent growth in 2001, growth in Irish labour costs have fallen in both 2010 (-1.6 per cent) and 2011 (-1.7 per cent). Total labour costs include wages, taxes on income and employer and employee social security contributions, Population and Social Conditions, CSO Labour Cost Index, Eurostat

²¹¹ Which includes services as well as manufacturing activities

²¹² Unit Labour Costs measure the average cost of labour of unit per output

²¹³ The Costs of Doing Business 2012, Forfás

Figure 23 Unit Labour Cost Growth in Manufacturing in Selected OECD Countries, Q4 2008- Q1 2011, Base 2005 = 100



Source: OECD Statistics Portal, accessed 06th November 2012

While it is difficult for government to directly impact wage levels (outside of the public sector), it is important to acknowledge that steps *are* being taken by Government to address areas over which it has more direct influence. For example, the Industrial Relations (Amendment) Act came into force on July 2012 which is intended to make the JLC/REA²¹⁴ system more responsive to changing economic circumstances and labour market conditions - although it is unclear at this stage what the impact might be in terms of improved labour cost competitiveness.

That said, there are a number of areas that firms have identified as being of concern.

In Ireland, the difference between the employer's cost of hiring an individual and the individual's actual take home pay, has widened for all income categories (in particular, as a result of changes to tax bands and credits and the introduction of the Universal Social Charge), while the tax wedge in most OECD countries is unchanged or falling²¹⁵. The difference is wider for higher paid workers in Ireland, which is of particular concern as Ireland competes internationally for mobile talent.

It is true that government faces the not insignificant challenge of introducing reforms to address exchequer finances. However, while seeking to reduce exchequer spending, there is a serious risk of transferring additional costs of employment onto business - a move that would be counter to Ireland's pro-business reputation. Firms had raised concerns prior to Budget 2013 in relation to proposed modifications such as sick pay and pensions, which were not introduced subsequently²¹⁶. Nevertheless, as a point of principle it will be important for DJEI with the Enterprise Development

²¹⁴ Joint Labour Commission, Regulated Employment Agreements

²¹⁵ For a single person with no children on 167 per cent of the average wage (€66,000 p.a.), the difference between what the employer pays and the employee receives has increased as a result of increased labour taxes. This differs from the trend reflected in the OECD 28, which experienced an average decrease in taxes on labour. The downward decrease on taxes on labour was evident amongst key competitors e.g. Poland, the Netherlands, and Switzerland

²¹⁶ Requiring employers to make contributions to employee pensions under auto-enrolment as well as the increased regulatory requirements for defined benefit schemes

Agencies to continue to work closely with the Department of Finance to ensure that the enterprise perspective remains central to decision making processes.

In addition to factors relating to labour costs, replacement rates may affect an individual's ability or motivation to enter the workforce²¹⁷, and this can have a knock-on impact on the labour costs of manufacturing companies. In general a replacement rate in excess of 70 per cent is considered to act as a disincentive to work - that is if an individual can receive more than 70 per cent of in-work income in benefits, they will demand a higher wage in the market to retain a monetary incentive to work²¹⁸. The impact of changes to the cost of labour, and to out-of-work benefits, on the replacement rate must continue to be given consideration.

Utilities

Energy

A reliable and competitively priced supply of energy is vital for business and its ability to compete successfully in international markets. Some of the factors which affect Ireland's energy cost competitiveness are outside our control - Ireland is heavily reliant on fossil fuels and imports around 90 per cent of its energy needs. As a result, energy costs in Ireland are significantly determined by international fuel prices, particularly gas. There is also greater volatility in the price of gas generated electricity than in hydro or nuclear generation where the costs are fixed. Only about half the cost of gas generated electricity is fixed which means that Ireland is more exposed than many of our competitor countries to price volatility.

There is a small proportion of the cost, however, that is controllable (i.e. non-fuel costs) and effort should be made in bringing these costs in line with Ireland's main competitors²¹⁹.

In terms of electricity costs, there is a very different picture painted for large energy users and for SMEs and it is important that due consideration is given to both cohorts. Although the large manufacturing players generate the higher proportion of exports, over 99 per cent of manufacturing firms based in Ireland are SMEs²²⁰ and employ 57 per cent of the manufacturing workforce. For large energy users in Ireland costs (excluding VAT) are the 7th highest in the euro area, although are below average. The temporary rebate introduced for large electricity users has had a positive impact on prices but this is currently being phased out, resulting in an increase in uncertainty regarding post-2012 electricity prices. Costs for SMEs are the 4th most expensive in the euro area²²¹, more expensive than Germany, the UK, Poland and France. Electricity costs for SMEs in Ireland rose by 14 per cent between 2010 and 2009, eroding some of the competitiveness gains achieved since 2009.

From a national perspective, the challenge facing Ireland is to reduce energy costs while delivering on its security of supply and environmental sustainability objectives. At the same time the move to

²¹⁷ The replacement rate measures the proportion of out-of-work benefits received when unemployed against take home pay if in work

²¹⁸ It should be noted that the standard measures of replacement rates exclude a number of factors. For more information see: Replacement Rates and Unemployment Department of Finance, 2009 and Replacement Rates 2010, Tax Strategy Group 10/04

²¹⁹ Overview of the Main Infrastructural Issues for Enterprise, Forfás, 2012

²²⁰ 95 per cent of firms employ less than 50 employees, with 4 per cent employing between 50 and 250 people. Business Demography 2010, CSO

²²¹ Industrial gas prices are the 6th highest in euro area but are below the euro area average. Costs of Doing Business 2012, Forfás

the single European electricity market is likely to require significant and costly changes to the all island electricity market.

Forfás and the NCC have researched aspects of energy pricing that *can* be influenced through domestic policy and should be acted upon, including for example, a revision of the price support scheme for onshore wind as the technology matures and the delivery of essential energy infrastructure investment in a timely and cost efficient fashion for business²²². The *Costs of Doing Business* report contends that unless there is a clear economic rationale for maintaining them, subsidies for peat generated electricity should be discontinued, and that prior to potentially converting peat plants to biomass, a full cost benefit analysis should be undertaken. The recent OECD Economic Survey of Ireland and the IEA's review of Irish energy policy²²³ both highlighted a number of actions that should be accelerated to enhance competition and reform of Ireland's electricity market. The feasibility and modality of implementing these recommendations needs to be worked through in the context of the new energy policy framework.

Water and Waste Water

Water is one of the most important resources in the operations of many manufacturing plants, in particular for pharmaceutical and food companies. Along with the supply of water, waste water treatment facilities are necessary.

Water availability is one aspect, the *quality* of the water supply is crucial - particularly so for companies involved in pharmaceuticals and food. A disruption to the supply or quality of water to a manufacturing facility can have significant negative repercussions and a large financial cost to the firm. The increase in the demand for environmentally friendly products and for information on environmental standards used in the production processes of manufacturing firms is also creating pressure on manufacturing firms to upgrade their use of water purification technologies.

In terms of water costs, Ireland ranks 6th most expensive from 15 countries benchmarked, although the costs have remained relatively static since 2007. Of note, however is the significant variations across counties within Ireland for water and waste water services with Wicklow at the highest end of the scale at €3.00 per cubic meter and Kildare at the lowest at half that²²⁴.

A number of significant developments have occurred or are in train in relation to water infrastructure. In particular, an implementation plan for a water utility, *Irish Water*, has been developed by the Department of Environment, Community and Local Government (DECLG) and is currently being rolled out. A single utility will create greater transparency and consistency in the area of water charges which is currently a significant issue for enterprise. A core principle of the new utility should be to support enterprise development and competitiveness²²⁵.

²²² Government Policy statement on the Strategic Importance of Transmission and Other Energy Infrastructure, Department of Communications, Energy and Natural Resources, July 2012

²²³ Energy Policies of IEA Countries - Ireland 2012, IEA, July 2012

²²⁴ Costs of Doing Business 2012, Forfás

²²⁵ Overview of the Main Infrastructural Issues for Enterprise, Forfás, 2012

Waste

Ireland does not compare well with other countries in terms of waste management infrastructure, given its heavy reliance on landfill to date. The recent publication of the Government's new waste management policy *A Resource Opportunity, Waste Management Policy in Ireland* is welcomed²²⁶. It sets out a number of guiding principles which will shape policy, placing prevention and waste minimisation at the forefront of waste policy and using landfill only as a last resort. The recently published *National Waste Report* highlights progress being made in this regard - noting that Ireland's municipal waste recovery rate increased by 5 per cent in 2011 to yield an overall recovery rate of 47 per cent, and the municipal waste recycling rate (excluding energy recovery) had reached 40 per cent, the same as the EU average²²⁷.

A Resource Opportunity delivered much needed policy certainty to the waste sector, thereby facilitating the planning and investment decisions (including private sector investment) required to underpin continued development of our recycling and energy recovery infrastructure.

While welcome, it will take time to deliver the necessary investment to provide a sufficient stock of alternative waste infrastructure to minimise Ireland's reliance on landfill. For firms, therefore, waste management costs remain an issue in the immediate term. In this context the increased emphasis on Lean principles and waste reduction throughout the manufacturing process (Product Lifecycle Management (PLM) and re-lifeing) can be part of the solution that is in the firm's control and should reap positive benefits in terms of a firm's costs of waste management (See following section).

Ireland ranked poorly in terms of landfill gate fees (including levy) in 2011 and benchmarked 3rd highest against 8 comparator countries²²⁸ although the gate charge can be negotiated. The increase in the landfill levy from €20 to €50 per tonne in September 2011 (intended as a strategic measure to reduce dependence on landfill) has meant higher costs to firms and a dis-improvement in Ireland's relative competitiveness.

Manufacturing Firms - Focusing on the Lean, Green Agenda for Competitive Advantage

As set out earlier in the report, resource efficiency (i.e. encompassing energy, water and waste management) has become an imperative in the context of a more sustainable, low carbon future - driven by regulations and by customer demands.

Companies need increasingly to take control product lifecycle management (PLM) and energy usage throughout the workplace. Supports are available through the enterprise development agencies and Sustainable Energy Authority of Ireland (SEAI) and the Environmental Protection Agency (EPA), focused on sustainability, Lean principles, and R&D in technologies, materials and processes. Recent Government investments in Technology Centres such as the i2E2 Energy Research Centre can play an impactful role by working with companies to develop innovative technology solutions.

²²⁶ A Resource Opportunity - Waste Management Policy in Ireland, Department of Environment, Community and Local Government, July 2012

²²⁷ The National Waste Report, 2011, EPA, March 2013

²²⁸ Annual Waste Benchmarking Analyses 2007-2010, Forfás, 2011

There is also evidence of companies collaborating to address challenges. For example, the Large Industry Energy Network (LIEN)²²⁹ has worked together to improve energy performance. Through collaborative action, companies avoided energy costs of €60 million in 2008 alone. Some have improved their energy efficiency by over 30 per cent over the last decade²³⁰. Others have collaborated to develop alternative sources of energy and energy self-sufficiency. A *Green Enterprise Guide* has been developed by the EPA, SEAI, Forfás, Enterprise Ireland and IDA Ireland²³¹. The guide provides directional information on where businesses can go for assistance in relation to water conservation, waste prevention, energy efficiency and clean technology. The guide also provides an overview of the key State agencies involved and the programmes and assistance they offer.

Developing Energy Self-Sufficiency - the Cork Lower Harbour Energy Group

The Cork Lower Harbour Energy Group involves collaboration between four healthcare manufacturing sites - Janssen Biologics, DePuy, GSK and Novartis.

Each manufacturing site aims to develop a renewable energy source on-site, that will help reduce dependence on energy generated through fossil fuels and which will drive down the cost of operations for each site.

It is anticipated that consumption of electricity from fossil-fuel based generation will be reduced by up to 30 per cent, eliminating approximately 22,000 tonnes of CO² emissions per annum, delivering significantly improved environmental as well as financial performance.

Their renewable wind energy plan was approved by Cork City council in 2012.

The improved cost competitiveness of each site in order will serve to sustain operations and to attract additional investment into Ireland.

Source: Cork Lower Harbour Energy Group, <http://www.clheg.com/>

Transport Costs and Infrastructures

As Ireland is an island location, costs involve a number of elements including the less tangible costs of 'time to market' which are impacted by infrastructures, modes of transport and services. The costs of transport are particularly relevant to manufacturing firms as opposed to services firms, given that they are involved in the movement of goods. They also have significant implications for Irish owned logistics providers that form an essential part of the eco-system for manufacturing in Ireland, and that compete against international players (even in the domestic market).

The significance of transport costs to a firm depends on the value and volume of the product in question. For example, export costs are less of a concern for firms dealing with high value/low volume products such as pharmaceuticals than is the case for low value/high volume products, such as food. Many companies involved in the food sector in Ireland also incur the costs of transporting inputs from regionally dispersed firms, so that domestic fuel costs have a greater bearing on them.

²²⁹ LEIN is a voluntary grouping, facilitated by SEAI, of industrial companies from a range of sectors including food, chemicals, medical devices, ICT, engineering, etc

²³⁰ SEAI: http://www.seai.ie/Your_Business/Large_Energy_Users/LIEN/

²³¹ Available at: <http://www.forfas.ie/newsevents/news/title,8203,en.php>

In terms of transport costs, much of the focus by firms is on fuel costs, although the international price of oil is a key determining factor. Pressures have increased to reduce fuel taxes in light of significant increased fuel prices over the period since April 2009. Government taxes account for almost 51 per cent of diesel prices, compared with EU averages of 48 per cent²³². Budget 2013 saw the introduction of a fuel rebate for hauliers which is welcomed²³³. This move recognises hauliers as a separate category of road users and the key role they play as part of Ireland's competitive enterprise base²³⁴.

In general, for manufacturing firms the most substantial cost of exporting is shipping. Ireland is at a cost disadvantage in relation to all freight transport modes compared to other European countries²³⁵, although this is not surprising given Ireland's peripheral location.

Effective integrated internal and international transport links (including roads, rail, air and sea) can serve to mitigate the impact of Ireland's location in the eyes of potential investors and overseas customers. Although Ireland ranked 26 out of 59 countries in 2012 in terms of the perception of its distribution infrastructure²³⁶, there had been a significant improvement since 2005 when Ireland scored 4.5 out of 10 compared with 8.2 out of 10 in 2012.

Recognising that there has been much development of the transport infrastructure in Ireland, capital investment in major transport infrastructural projects has reduced significantly over recent years. Sustained investment in the upgrading and maintenance of Ireland's transport infrastructure is of vital importance to the manufacturing sector which relies heavily on efficient and adequate transport links in order to successfully do business.

Transport infrastructure must also be responsive to the changing needs of manufacturing firms. For example, the change in the composition of goods exports from higher volume, lower value to lower volume, higher value in sectors such as ICT and chemicals has resulted in an increasing demand for air freight services.

A range of policy priorities in relation to transport infrastructure have been set out in the recent Forfás publication *Overview of the Main Infrastructure Issues for Enterprise (2012)*. While capital resources are limited, it is critical that any prioritisation of investment will support economic recovery and the activities of manufacturing firms.

Advanced Broadband Infrastructures and Services - An Enterprise Development Agenda

The availability of competitively priced and advanced broadband services is acknowledged as being high on the agenda for internationally traded services activities. What is perhaps not as well understood is its critical importance for manufacturing firms. The use of ICTs is becoming more pervasive as companies engage in global supply chain networks, manage overseas locations, become more involved in integrated design and co-development of products and embrace new ways to manage customer relationships. The digital factory is becoming more of a reality where greater amounts of data are captured, analysed and shared across affiliate plants and/or suppliers. Earlier chapters have highlighted the increased pervasiveness of ICTs and the necessity for all

²³² Energy Statistics and Market Observatory, European Commission, August 2012

²³³ Hauliers will be able to recoup 7.5 cent on each litre of diesel purchased from 1 July 2013

²³⁴ Cost of Doing Business 2012, Forfás, sets out the potential for negative long term impacts that would result from reducing taxes across the board

²³⁵ Costs of Exporting, Forfás (forthcoming)

²³⁶ World Competitiveness Yearbook, IMD, 2012

manufacturing firms to embrace these technologies. While responsibility lies with the business to make the necessary changes in-firm, the government has a role to play in making that as easy as possible for them, particularly for SMEs.

The regional spread of manufacturing activity means that the availability of broadband is an important factor for manufacturing firms in both urban and rural locations. However, there is less choice and less access to good quality broadband services outside the main urban areas²³⁷, creating a significant issue for the continuing development of firms in these locations.

The cost of broadband remains an issue with prices in Ireland almost seven per cent higher than the OECD average, more than twice the cost in France, Sweden and the UK²³⁸. In addition, the VAT exclusive cost of the fastest broadband connection available to business in Ireland was the second highest among a number of benchmarked countries²³⁹.

There has been much debate over the past number of years regarding the extent of market failure in the private sector provision of resilient and advanced broadband infrastructures and services in Ireland. A positive development has been the recent publication of a National Broadband Plan by the Department of Communications, Energy and Natural Resources (DECNR)²⁴⁰ which commits to a €175 million investment, albeit this will not be expended until after August 2014. Absolutely crucial will be the completion of the proposed national mapping exercise in a timely manner, as this is the precursor to determining where State intervention is needed²⁴¹. We need also to consider if the changes to the EU state aid regime aimed at promoting broadband could accelerate this investment.

Property Related Costs

The availability of competitively priced, high quality industrial property is an essential element of the eco-system for attracting further investment in manufacturing in Ireland, whether by foreign or indigenous greenfield investment or expansion. There are different considerations for the existing cohort of companies, already established in Ireland. The aspect of occupancy costs (rent and rates) is considered firstly.

Rental costs have cumulatively declined by almost 37 per cent since they peaked in 2007. This has resulted in an improvement in Ireland's competitiveness ranking by 4 places²⁴², which is positive for companies establishing in Ireland for the first time, or expanding into new property. For enterprises already leasing property, it is unlikely to yield any benefit particularly for those that are operating in the regime of upward only rent reviews²⁴³. Initiatives such as the NAMA guidance note²⁴⁴ for dealing with tenants' difficulties and the progress being made on the Working Group on

²³⁷ Ireland's Advanced Broadband Performance and Policy Priorities, Forfás, 2011

²³⁸ This is based on average price of Mbit per second in 2011. Broadband Statistics, OECD, March 2012

²³⁹ Costs of Doing Business 2012, Forfás. Data reflects advertised business connections only and do not take into account connections that may be negotiated between business and service providers

²⁴⁰ Delivering a Connected Society, DCENR, 2012

²⁴¹ The outcome of the mapping exercise will inform a design and procurement process for State intervention. EU State Aid approval will also be required and will be informed by the mapping exercise. Source: DCENR

²⁴² Industrial Space Across the World 2007-2011, Cushman and Wakefield

²⁴³ The Land Conveyancing and Law reform Act 2009 was introduced in Ireland to ensure that all new leases signed from March 2010 contain a provision that rents can be reviewed both upwards and downwards on review

²⁴⁴ Portfolio Management Internal Guidance Note: Assessment of a debtor/receiver proposal for a reduction in rent on an upward-only commercial lease, National Asset Management Agency, December 2011

Transparency in Commercial Rent Reviews are welcome, particularly in light of the constraints facing government²⁴⁵.

In terms of commercial rates²⁴⁶, annual rateable valuations (ARVs) increased at an average annual rate of 5.2 per cent over the ten years 1998 to 2008²⁴⁷. The ARVs reduced by a relatively small 0.5 per cent between 2010 and 2012, and were reduced nationwide by an average of 0.34 per cent in 2013. The national average remains above the 2005 average rate (although the 2013 ARV is lower than it was in 2008) and significant regional differences remain. Rates are generally a relatively small proportion of business costs for many businesses. Nevertheless they can be burdensome for small business - and given that approximately 95 per cent of all manufacturing firms are small, this is an issue that should not be overlooked.

In terms of constructing a prime industrial unit, costs have fallen by over 23 per cent between 2007 and 2011²⁴⁸. However, reduced construction costs have in some cases been insufficient to make development viable in that the cost of replacement/expansion of existing premises remains expensive compared to the prevailing rents on existing buildings. This is a particularly challenging issue in the context of FDI attraction, where the availability of industrial property is an integral part of the marketing proposition. Over the past number of years IDA Ireland has operated on a partnership basis with the construction sector in the advance provision of prime industrial property, and this model is not operating effectively in the current economic climate.

The final aspect relates to development levies imposed by local authorities, which can constrain the attraction of FDI and indigenous manufacturing expansions. Any barriers to potential enterprise investment that will lead to job creation need to be addressed in light of the radical economic changes that have impacted manufacturing and in the context of the new statutory guidelines on development contributions issued in January 2013²⁴⁹. Some authorities have introduced reductions which are welcome. It is essential that the new guidelines result in a more robust and transparent charging mechanism that match levies with the (true) economic cost of providing development.

Regulatory Burden

Regulation is a necessity to ensure Irish manufacturing firms can operate successfully globally. It protects customers, assures quality and can help create a level playing field for firms to compete. Ireland has developed a good international track record in highly regulated sectors such as pharmaceuticals, medical technologies and food - a track record that is extremely important as an attractor for FDI and for Irish firms marketing overseas. Regulation can also play a role in

²⁴⁵ Despite extensive consideration, it has not proved possible to develop a target scheme to tackle upward only rent reviews in existing businesses leases which would not be vulnerable to a legal challenge or require compensation to be paid to landlords. Businesses can make use of the Rent review Arbitration Code, drawn up by the Working Group to help to resolve issues at a lower cost, in less time and in a less adversarial way

²⁴⁶ Rates are a property-based source of income that is levied by local authorities throughout Ireland on the occupiers of commercial and industrial properties. The annual commercial rate for each property is calculated by multiplying the annual rate of valuation (ARV) by the rateable valuation for the property which is determined by the Valuation Office

²⁴⁷ Analysis of Economic Templates, Report to the County and City Managers Association, Enterprise Strategy Steering Group, August 2012

²⁴⁸ Costs of Doing Business 2012, Forfás

²⁴⁹ Development Contributions, Guidelines for Planning Authorities, Department of Environment, Community and Local Government, January 2013

stimulating innovation – e.g. ‘smart’ and green products and services developed in response to environment protection regulations, and/or in driving standards that serve to authenticate quality.

For manufacturing in general there is a range of regulations to which firms must adhere (apart from labour related regulations), including: health and safety; trade-related regulations; standards and environmental regulations; etc.

Many regulations are driven by EU legislation, over which Ireland has little control. Through the participation of Government officials, Ireland can influence policy at EU level and provide input from the perspective of Irish firms. In terms of EU Directives, timely and well considered transposition into national legislation is critical to reduce uncertainty and to ensure that competitiveness is not inadvertently eroded. This is pertinent to the forthcoming Industrial Emissions Directive which is due to be transposed by 2013.

Manufacturing firms accept that there is a need for, and value in, regulations. On the other hand, there are issues pertaining to the burdens placed on them primarily with regard to reporting, audits and inspections carried out by a number of different bodies. Because of the sheer volume of licences and regulations and the range of bodies involved in monitoring compliance, companies find themselves faced with the burden of completing many different forms (often requiring the same information) and a range of uncoordinated inspections and audits. These demands are exacerbated in the case of small firms. Regulation is particularly onerous for the food and drink sector that faces a multiplicity of licences and inspections, managed by a range of authorities. Manufacturing firms, in general, cite environmental regulation and Integrated Pollution Prevention Control (IPPC) licences as being the most burdensome.

A comprehensive review of licences/regulations was published by Forfás in December 2012, which set out specific actions needed to reduce the cost burden for firms²⁵⁰. The Government has agreed to the development of integrated licensing processes for business.

It is critical that concerted efforts continue to be made by government departments to reduce by 25 per cent the administrative burden on business of requirements that stem from their own departments.

The Funding Environment

The process of ‘making things’ is capital intensive, with significant levels of up-front investment required in the machinery and equipment necessary to create a final product. Over time, the capital intensity of manufacturing has increased, and will continue to do so, not least due to increased levels of automation, enabled by advances in technology and the role of ICTs.

Investment in capital equipment and technology is an imperative for all manufacturing firms in a globally competitive environment²⁵¹. Capital intensity also presents a significant barrier to entry for new start-ups, especially in the more established sectors.

There are a number of elements, which when working effectively and in concert, create a favourable business environment conducive to the needs of enterprise. These include bank financing, various equity financing options, State Aid, and the tax framework. In Ireland, there are a range of products, schemes, supports and initiatives in place today (see Appendix IV - The

²⁵⁰ A Review and Audit of Licences Across Key Sectors of the Irish Economy, Forfás, 2012

²⁵¹ The Report of the High Level Group on Manufacturing, Forfás, 2009

Funding Environment for Manufacturing Firms)²⁵². While there has been good progress, a number of concerns have been raised by manufacturing firms, many of which have arisen as a result of the economic downturn. Manufacturing firms cite the lack of access to finance as being a significant constraint to future competitiveness and growth.

Banks

Banks have traditionally been the principal source of financing (both short and long-term) for the manufacturing sector in Ireland. What is transpiring in the context of the current financial and banking crisis has a direct bearing on manufacturing, in particular:

- Risk aversion, demonstrated by a reduction in longer-term lending durations and a continuing downward trend in medium term financing (1-5 years)²⁵³;
- The increasing cost of lending for enterprises;
- Increased (onerous) levels of security/guarantees required for loans and asset financing; and
- A perceived lack of engagement & understanding on the part of the banks in relation financing the growth and development of a manufacturing enterprise.

Equity

The equity landscape in Ireland has developed substantially over the past 10-15 years. Indeed, there is an unprecedented level of funding available today for start-up/early stage and fast growing segments of Irish business, helped by State and private sector joint initiatives such as the Seed and Venture Capital Scheme and the Employment and Investment Incentive Scheme (EIS - formerly the Business Expansion Scheme). The manufacturing sector has benefited from this to some degree, particularly technology intensive fast growth firms. However there are a number of issues hindering a greater role for equity in the financing of manufacturing in Ireland, and these come into sharp relief in the context of constrained bank financing:

- Many manufacturing firms (including manufacturing start-ups) do not fit the Venture Capital (VC) paradigm. VCs typically seek fast growth and returns on investment and a lower requirement for debt;
- Established manufacturing firms have (generally) demonstrated a reluctance to cede control or to dilute their shareholding to external interests;
- Food companies in particular find it difficult to secure equity investment without having established a route to market/scale;
- The attractiveness of the newly revamped EIS for potential investors is lessened due to its limitations regarding the higher earner restriction and the exclusion of medium-sized firms in non-assisted areas²⁵⁴; and

²⁵² The State's involvement in the funding environment is aimed at maximising economic development and where necessary to redress market failures, and drive competitiveness and innovation. The mainstream financing options via banks and equity investments are commercially motivated, although there is a co-dependent relationship involved

²⁵³ As indicated by statistics reported by the Central Bank of Ireland, 2012, Money and Banking Statistics, September 2012

²⁵⁴ A Review of the Equity Investment Landscape in Ireland, Forfás, 2013

- There is a lack of investors operating in the risk capital segment, i.e. taking equity in established manufacturing firms looking to grow their businesses.

Enterprise Ireland is due to launch a *Development Capital Fund* aimed at addressing the 'equity gap' relating to risk capital in early 2013. It is currently reviewing proposals from potential fund managers who will partner with the State in making investments. It is intended that investments of between €2 and €10 million will be made in 30 to 40 established companies that are seeking growth capital. It is anticipated that the Fund will accommodate a range of investment products including equity, quasi-equity and debt.

State Aid

Aid to business for manufacturing activities is available primarily through the enterprise development agencies. A range of funding programmes is in place to support the establishment, growth and innovation activities of enterprises in accordance with prevailing EU state aid rules²⁵⁵. Over time there has been a shift in policy at EU level towards support for capability building (including for example, RD&I and training) and sustainability with less emphasis on capacity building for employment creation through investments in greenfield operations or expansions. The state aid guidelines are based on the principles that aid should only be given where there is an incentive effect in order to avoid market distortions, used only where there are genuine market failures, and to redress regional disparities.

The overarching principle in the case of Regional Aid Guidelines (RAGs) is to target aid toward more disadvantaged regions within the EU-27 context. While Ireland had benefited in earlier years, successive reviews of the RAGs have resulted in a scaling back of aid intensities (reflecting the policy shift above) and also more limited spatial coverage. The reality is that certain more disadvantaged regions throughout the EU can offer greater levels of grant support to incentivise new investments in capacity building than can be offered here. This is a reality that is outside of the control of the Irish Government and its agencies, although it can have implications for enterprise in Ireland, given the increasing mobility of Irish owned firms.

Negotiations are underway at EU level as the current state aid regime expires at the end of 2013. There are a number of areas of concern from Ireland's perspective particularly in light of high unemployment levels, the relatively weak enterprise base in the regions and the need for industrial restructuring²⁵⁶. For example, continued availability of regional aid to large companies in Article 107 (3) (c) regions is one aspect that is under negotiation. Any significant changes in this regard will have implications for greenfield and expansion investments by *all* large companies (regardless of ownership) and for regional development in Ireland and in other Member States.

In 2012 the Commission set out an ambitious state aid modernisation programme, encompassing a range of guidelines and regulations²⁵⁷, with the objectives of fostering growth in a strengthened

²⁵⁵ State aid is generally considered to result in distortion of competition amongst Member States or amongst enterprises. Where state aid is permissible therefore, it is by exception only, and to promote economic development and other legitimate policy objectives where this benefit outweighs any distortion of competition

²⁵⁶ Industrial restructuring is the on-going process of change in composition of economic activities in terms of sectors and activities and a move toward higher value added output which is sustainable

²⁵⁷ The state aid modernisation programme aims to revise, streamline and possibly consolidate state aid guidelines to make them consistent with a set of common principles (for assessing the compatibility of aid with the internal market): RD&I, RAGs, Environmental Aid, Risk Capital and Broadband; and to revise the following regulations: Block Exemption Regulation, Enabling Regulation and de minimus Regulation
http://ec.europa.eu/competition/state_aid/modernisation/index_en.html

internal market; focusing enforcement on cases with the biggest impact on the internal market; and streamlining decision making. This work is taking place under the Irish presidency of the EU, and it is necessary that the Irish position is fully reflected in this modernisation agenda.

The competition for winning mobile investment has intensified significantly, and it is important that Ireland continues to utilise the scope for supports that *are* allowable under EU state aid rules to achieve its enterprise policy objectives. For example, some Member States make strong use of environmental aid²⁵⁸ and may be optimising other instruments such as financial engineering (i.e. financing that is not a grant, and includes loans, guarantees, equity etc.) and risk capital to a greater extent. It is important that Ireland is not disadvantaged in this context.

Tax System

The tax system in Ireland is generally held to be pro-enterprise. Wear and tear capital allowances are available (accelerated for energy-efficient equipment), and the R&D tax credit is available for investment in innovation (including capital equipment and buildings related to R&D initiatives). The tax system has also been utilised to leverage private sector investment in enterprise, for example through the Employment and Investment Incentive Scheme (EIS). It is important that tax initiatives aimed at addressing market failures and promoting enterprise growth are fit for purpose. In this respect, the EIS 'high earner' restriction is seen as a constraining factor given that most potential (& larger scale) investors occupy this cohort.

Each of the four funding sources outlined here have been affected to some degree by current economic conditions, including the financial and banking crisis in Ireland and further afield, and until the broader challenges are overcome, constraints will continue to emerge. While initiatives in one area can help to address constraints in another it is a fact that a healthy funding environment for manufacturing will see all four elements playing complementary roles in facilitating the growth and development of manufacturing enterprises.

Capital investment in manufacturing is not a luxury; it is inextricably linked with business development and growth. A step change in the performance of the manufacturing sector in Ireland will require a responsive and supportive funding environment.

Education and Skills

Ireland is recognised for its well educated and highly skilled work-force. Manufacturing needs an engaged pool of people who are aware of the interesting and exciting opportunities offered by manufacturing; the fair pay and conditions and modern work practices and career development opportunities. Highly proficient leadership, with ambition, vision and strong management teams is fundamental if a firm is to respond to the disruptive changes in evidence, to interpret the implications of changing market dynamics for the way of working, and to fully understand existing and potential customer needs. Consultations with companies reinforced the fact that leadership and strong change management competences will be crucial as companies focus on transformation and harness peoples' commitment, attitude and capabilities.

²⁵⁸ For example, analysis indicates the proportion of environmental aid vs regional aid in: the Netherlands 55 per cent vs 0.6 per cent; Finland 40 per cent vs 6 per cent; UK 34.4 per cent vs 6.5 per cent; compared with Ireland 8.4 per cent vs 33.3 per cent

The consultations and analysis undertaken by the Expert Group on Future Skills Needs (EGFSN) for the complementary manufacturing skill study provides insights into the supply-demand issues facing manufacturing firms across all skills levels. This section draws on that in-depth analysis²⁵⁹.

Firstly we present a brief overview of what is currently available, and then set out the skills needs highlighted by manufacturing companies.

Looking to Higher Education, there has been a significant increase in total enrolments in science, technology, engineering and mathematics (STEM) programmes relevant to the manufacturing sectors over recent years. Enrolments now stand at just over 45,000. Although science/selected health programmes outnumber engineering enrolments by approximately 2 to 1, there have been strong increases at Level 6/7 enrolments, particularly in ICT related programmes, electrical engineering and mechanical engineering. At Level 8/9 the main enrolments relate to biological/biochem/chemical sciences; computing and electronics and engineering categories. What is also of interest is the increasing influence of the environmental agenda, reflected in strong enrolments in energy/environmental related programmes. The challenge for manufacturers, however, is that many of these graduates are sought after in other sectors such as health, education, software and research.

In terms of further education, many of the 18,000 FETAC²⁶⁰ awards in 2012 in the science, engineering manufacturing and computing fields are specific to manufacturing including those relating to pharmaceutical processing, materials manufacturing and injection moulding. These offer potential upskilling opportunities for those with lower formal levels of qualifications.

There has been a noticeable decline across most of the apprenticeships since 2007, particularly in the numbers of fitters, electricians, metal fabricators, toolmakers and sheet metal workers. The low levels of supply in areas critical to manufacturing were raised as a real concern by companies.

Development programmes for the manufacturing sector in Ireland are also provided by a number of stakeholders including, for example, Enterprise Ireland, Skillnets, Engineers Ireland and the Ideas Institute (SIPTU).

Although the education and training systems cater for the needs of the manufacturing sector, there were a number of areas identified that need to be addressed as they have the potential to constrain development and growth of the sector.

Manufacturing Skills Needs

In the first instance, companies cited the **negative perceptions of manufacturing** as a fundamental issue as it dissuades suitable people from seeking to make a career in manufacturing. Opportunities for career progression are not clearly structured or mapped out, as is the case in other countries (such as Germany for example) to prospective entrants to manufacturing mainly at operative, trade, technician and supervisory levels.

The following sets out the particular skills needs highlighted by firms through surveys and interviews:

Skills for Manufacturing Excellence: Lean manufacturing techniques and increasing automation are driving the need for upskilling across virtually all occupations. What was also identified as crucial for manufacturing firms today is the need for professionals (engineers/scientists) that

²⁵⁹ Refer to the complementary report for further detail The Future Skills Needs of Manufacturing, EGFSN, 2013

²⁶⁰ Further Education and Training Awards Council

already have a strong understanding of manufacturing processes to acquire skills in data analytics. The need for R&D skills for manufacturing processes was also highlighted. This includes engineering capabilities and operations management for production process optimisation, and chemical and biological science-based R&D skills in industries such as pharmaceuticals, chemicals, food, beverages and semiconductors.

Trade and Technician Skills: A significant number of engineering firms indicated a shortage of people with toolmaking and/or machinist skills. A shortage (or potential shortage) of polymer technicians, qualified to level 7 in the National Framework of Qualifications was highlighted as being of concern primarily (although not exclusively) by the Medical Devices sector. There were also more general concerns about the supply of technical workers at skilled trades or technician level capable of working on machinery that combines mechanical, electrical, electronic and IT/software technologies.

Engineering Skills: The need for core engineering skills was reflected across a broad spectrum of manufacturing firms consulted. There was a strong view that the demand for validation engineering, quality engineering, automation engineering, supply chain engineering and other professional level engineering specialisms that support manufacturing should be satisfied through qualified and experienced engineers undertaking further study. In addition, some firms report a shortage of engineers with strong skills in polymer engineering.

Researcher Skills and Key Persons: A number of manufacturing firms highlighted the high business and employment impact that a key person with industry-leading skills can have. They may drive improvements in business performance out of proportion to the cost of hiring them through driving product development, commercialisation, operational performance or marketing, and through improved decision-making. Researchers in product development are needed, which, at its most advanced level, requires people with research degrees at levels 9 and 10 in a relevant area.

Language and Customer Facing Skills: Many of the manufacturing firms interviewed identified difficulties in hiring people with skills in European languages for customer facing roles as an important challenge. A large part of the problem is with a lack of technologists with European language skills, needed to take on roles including technical selling, customer site engineering and customer support. Relatively few engineers or scientists see commercial roles, such as sales or marketing, as attractive career options. While many manufacturing firms need technically knowledgeable people to engage with customers, they often have difficulty in inducing their engineers and scientists to take on that role.

Generic Skills: Increasingly it is becoming necessary for individuals with technical skills at all levels to have strong generic skills, particularly in terms of people skills, communication skills, problem solving skills, planning skills and project management skills appropriate to the level of the work. These skills are essential enablers for manufacturing excellence and new ways of working and collaborating.

The Ideas Institute

The Ideas Institute was established in 2001 to meet a strategic need that had been identified by SIPTU members and conveyed to the National Executive Council of SIPTU.

The Ideas Institute identifies ways in which new thinking and new services can be introduced into the workplace for the benefit of employees and the enterprise as a whole.

Of interest for manufacturing firms is the project management service offered for managing change. The service involves a partnership approach that engages both employees and management to realise effective change in the ways of working.

<http://www.ideasinstitute.ie/development.html>
(adapted)

Research, Development and Innovation

Research and innovation plays an essential role in the productivity and success of manufacturing firms operating in a fiercely competitive global environment and in their contribution to Ireland's future economic growth. Although Ireland's research and innovation system is relatively nascent, considerable progress has been achieved over the past decade.

Priority Research Areas

Ireland's significant increase in investment in R&D since the late 90s is beginning to bear fruit with increasing international awareness of Ireland's excellence in certain fields of science and technology. Public expenditure on Research and Technologies was €912 million in 2011²⁶¹. The recently published *Report of the Research Prioritisation Steering Group* sets out a number of research areas, including both horizontal and sector specific areas, which will inform the priority areas around which future investment in publicly-performed research should be based. Table 1 sets out those most pertinent to manufacturing. Other priority areas include those relating to ICTs (software, networks etc.), Renewable Energy and Smart Grids/Smart Cities which although not focused on manufacturing per se, may in fact have an indirect relevance for many manufacturers operating here (Table 2).

Table 2 Priority Research Areas of Relevance to Manufacturing

Priority Area	Brief Description - Focus
Manufacturing Competitiveness	Development and application of technology and knowledge management systems to reduce costs, eliminate waste, drive resource efficiency and improve product quality
Processing Technologies and Novel Materials	Enabling the Irish manufacturing base to transition into one with enhanced capabilities in processing technologies and materials science and engineering
Medical Devices	Development and manufacture of next generation medical devices
Diagnostics	Emerging growth areas such as personalised medicine/companion diagnostics, nutrition related diagnostics, veterinary diagnostics and point-of-care devices
Therapeutics - Synthesis, Formulation, Processing and Drug Delivery	Developing competence in pre-manufacturing research, technology and development responding to industry needs in therapeutics/pharmaceuticals, (e.g. the manufacture and formulation of small molecules and bioprocessing research)
Food for Health	Development and production of functional foods or ingredients in Ireland

²⁶¹ The Science Budget 2010-2011, Forfás This includes programmes delivered by the HEA, Science Foundation Ireland, Health Research Board, Agriculture/Teagasc etc. and the enterprise development agencies

Priority Area	Brief Description - Focus
Sustainable Food Production and Processing	Agri-food production, marine fisheries and seafood and food processing including manufacture of safe, value added and innovative foods
Innovation in Services and Business Processes	Enabling both the manufacturing and services sectors to innovate their service offering, service delivery and business process <i>(Note: Directly relevant to manu-services as well as enhanced customer care and SCM)</i>
Data Analytics, Management Security and Privacy	Turning data into information that can be exploited for both economic and social benefit (Note: Increasingly relevant to manufacturing in the context of more complex production processes, PLM and real time information flows)

Source: Report of the Research Prioritisation Steering Group (Extract)

State Investment in Research and Technology Centres

The State's investments have served to provide an R&D infrastructure that is supportive of the needs of enterprise, thereby enhancing Ireland's attractiveness for investment in knowledge intensive activities by both foreign and Irish owned firms. The State has invested in establishing R&D centres including: Centres for Science, Engineering and Technologies (CSETs) and Strategic Research Centres (SRCs); Technology Centres and Technology Gateways. The R&D tax credit was introduced in 2004 and the enterprise agencies provide direct supports to companies for R&D activities.

The Centres each perform an important role within the overall National Innovation System (NIS). The SFI supported CSETs conduct high quality academic research *oriented to* applications and industry needs. They work in collaboration with companies, both MNEs and SMEs. The CSETs are an important element of Ireland's attractiveness for investment and, working with IDA Ireland and SFI, have played a role in encouraging major technology-based MNEs to establish R&D facilities here. Five of the nine CSETs are engaged in research that is relevant to manufacturing sectors operating in Ireland²⁶². The Strategic Research Clusters

I2E2 Energy Research Centreworking with companies to provide solutions for companies

I2E2 operates from Leixlip and involves collaboration with a number of companies (both foreign and Irish owned) to identify solutions to improve energy efficiencies and reduce costs within manufacturing firms.

Work in the area of HVAC systems (heating, ventilation and air conditioning) and Clean rooms covers:

- the optimisation of existing HVAC systems;
- R&D of technology to integrate with or supplement existing building controls;
- investigation of the key drivers of malfunctions; developing appropriate technology to eliminate energy waste from HVAC systems;
- research the constraints imposed by product manufacture in medical, pharmaceutical and semiconductor industries in order to identify possible reductions in energy needs while still achieving the necessary environmental quality standards.

Source: <http://www.i2e2.ie/>

²⁶² Alimentary Pharmabiotic Centre, UCC, Centre for Research on Adaptive NanoStructure and Nanodevice, CRANN, TCD, Biomedical Diagnostic Institute, DCU, Clarity, UCD (Sensor networks), Systems Biology, UCD

(SRCs) stimulate multi-disciplinary, multi-research institute collaboration on R&D and are generally of a smaller scale than the CSETs. These Centres/Clusters engage with industry in a range of activities including formal collaborative R&D partnerships, information dissemination, seminars etc.

A number of Technology Centres have been established over recent years (or are in the process of being established). The focus of the R&D undertaken by the Technology Centres has been set by industry, and a number of the Centres are involved in R&D that is of direct relevance to manufacturing activities and/or manufacturing related sectors. The enterprise development agencies have worked with groups of companies facilitating them in defining their research needs in the first instance. This definition of needs determined the R&D to be undertaken by the Centres in collaboration with industry. Of particular relevance for *all* manufacturing firms are: the Irish Centre for Manufacturing Research (University of Limerick) which is focused on productivity and competitiveness; and the i2E2 Energy Research Centre based in Leixlip. These Centres collaborate with a broad range of firms across manufacturing sectors including for example, pharma, ICT, medical technologies, and clean technologies. Companies involved include, for example Pfizer, Intel, Ceramicx, Cylon Controls and Aughinish Alumina²⁶³. Other Technology Centres have a sector specific focus, such as Food for Health Ireland, based in Cork. Others are currently in development focused on supporting sectors such as medical devices, pharmaceuticals (drug production) and connected health.

Addressing the Needs of Small Firms

Although the Centres set out above have been established with the specific objective of collaborating with firms on R&D, smaller firms in general face higher barriers to entry and difficulties in leveraging state funded R&D. A number of Centres are making efforts to address this issue. For example, the ICMR and i2E2 Centres have introduced a three tier model to stimulate interaction at different levels, including: Board level (significant input and access across the entire Centre); partner level (input and outputs based on specific projects); and subscriber level (basic access level, a first step)²⁶⁴.

In addition, Enterprise Ireland has recently launched its Technology Gateways initiative²⁶⁵ which aims to have a greater propensity to meet the needs of local industry - essentially providing a gateway or portal at regional levels that facilitates access for firms to a national network of research and technology capability. The Gateways will create a pathway for smaller companies in particular to gain experience in working with external partners. Depending on the firm's own capabilities, engagement may start with simple enquiries or Innovation Vouchers before moving on to collaborative RD&I projects. These early stage steps are of value, although more is needed to build the innovative capabilities and capacity across a broader base of manufacturing firms in Ireland.

For many SMEs their focus is more about identifying and adapting technologies that are 'new to them' for their specific needs - an area that is increasingly relevant in terms of advances in Lean, Clean and Digital technologies in the manufacturing environment.

²⁶³ This is not an exhaustive listing. Some firms are involved in collaborative R&D with both Centres

²⁶⁴ Technology Innovation for Irish Manufacturing and Energy Competitiveness, Issue 1, October 2012

²⁶⁵ The Gateways Centre initiative is a successor to the Advanced Research Enhancement Centres programme

Engineering and Applied R&D

Despite this investment, much of which is targeted toward the needs of the manufacturing sector, many companies cited the lack of emphasis on engineering for manufacturing and on applied R&D as being a gap in the R&D support system. For a number of firms the depletion of Ireland's past capabilities in areas such as plastics and toolmaking are considered a significant disadvantage. The lack of facilities that firms can avail of to trial and test new products and manufacturing processes has also been highlighted as a specific issue, particularly in the context of the capital intensity of the sector. Having said that, some firms cited the benefit of having been able to access equipment that had been funded by the State in the HEIs and suggested that such investments may be underutilised.

A recent study by the Advisory Council for Science, Technology and Innovation (ACSTI)²⁶⁶ points to the fact that compared with other countries, Ireland lacks centres that fully fit the characteristics of a Research Technology Organisation (RTO). Some well known examples of RTOs include the Fraunhofer Gesellschaft in Germany, VTT (the Technical Research Centre in Finland) and NTO (The Netherlands Organisation for Applied Scientific Research). RTOs are focused on applied research directed at medium term industry needs as well as shorter term technology development and technical services (problem solving) for industrial clients. RTOs rely to a greater extent on private revenues²⁶⁷ and the question arises as to whether the absorptive capacity of Irish based firms is sufficiently developed for an RTO model to be viable or sustainable in Ireland.

R&D Tax Credit

Ireland's R&D tax credit initiative is also supportive of the drive toward increasing firms' engagement in R&D activities and innovation. Its introduction in 2004 is regarded by companies as a positive and indeed, necessary development, in the context of global competition and other country offerings. However, companies operating from Ireland continue to be at a competitive disadvantage when compared with competing countries for investment such as France, Hungary and Canada that have a full volume based R&D tax credit system. It is also important that Ireland continues to monitor international developments in relation to the tax treatment of intangible assets and IP to ensure that Ireland's tax regime remains competitive²⁶⁸.

Firm Level Supports for RD&I

The enterprise development agencies (IDA Ireland and Enterprise Ireland) also provide direct grant aid to companies undertaking RD&I. Enterprise Ireland also delivers initiatives that are aimed at increasing collaboration between firms and HEIs including Innovation Vouchers, Innovation Partnerships; and at increasing commercialisation of State supported R&D in HEIs including the Commercialisation Fund and the Business Partners programme. The next section discusses the role of the enterprise development agencies in more detail.

²⁶⁶ Sustainability of Research Centres, ACSTI, June 2012

²⁶⁷ Fraunhofer institutes typically generate circa 60 per cent of revenues from privately funded contract R&D projects

²⁶⁸ Over the past two years, there has been an acceleration of the introduction / enhancement of regimes for attracting and retaining mobile intangible asset investment

The Enterprise Development Agencies - Supporting Firms

At the operational level, the enterprise development agencies, namely: IDA Ireland, Enterprise Ireland, the County Enterprise Boards (Local Enterprise Offices) and Science Foundation Ireland are responsible for enterprise promotion²⁶⁹. They each have a core area of focus, which enables them to build a depth of relevant expertise and understanding of the enterprise cohort for which they are responsible, and to focus their own resources to best effect²⁷⁰. It is intended that the newly formed Local Enterprise Offices will operate as a first port of call for companies, and will provide signposting to the relevant enterprise development agency and available supports and services.

The enterprise agencies operate within a wider business environment which has a strong bearing on the ultimate performance of enterprises and on the impact of firm level interventions.

For instance:

- Currently, the single most important issue for the Enterprise Ireland client base is access to finance. Without an improvement in this situation, the range of instruments available to Enterprise Ireland is likely to have a reduced impact.
- Maintaining relative cost competitiveness and consolidating Ireland's international reputation are fundamental to the future success in attracting FDI.
- Continuity in the Government's commitment to invest in Ireland's knowledge and research capabilities is critical to the realisation of SFI's strategic objectives.

The agencies support companies that are primarily exporting or have the capability to do so. In relative terms, activities in exporting sectors have proved to be resilient - particularly for firms that made efforts to enhance productivity and management capabilities.

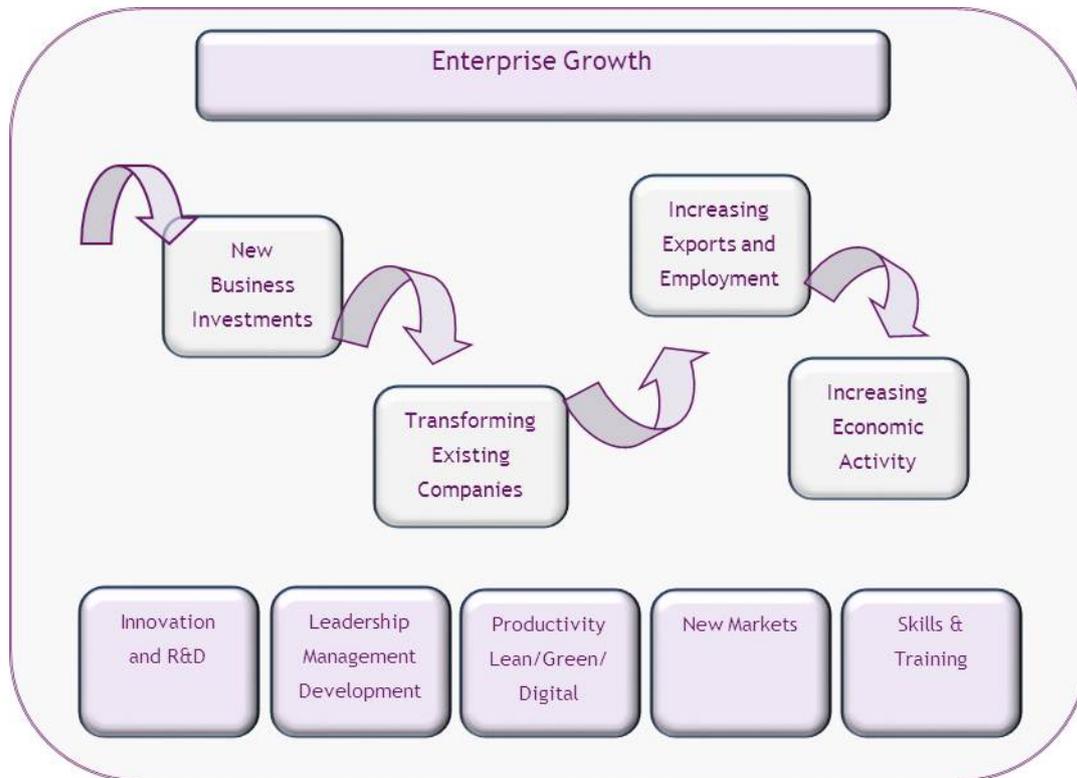
Supporting Productivity and Innovation at Firm Level

The enterprise development agencies provide direct supports at firm level - the nature and extent of which is informed by aspects such as market focus, maturity and stage of development of the sector and indeed, the capabilities and objectives of individual firms within sectors (Figure 24).

²⁶⁹ While the enterprise agencies under the remit of DJEI engage directly with a wide base of firms, certain segments of the enterprise base are either fully or partially serviced by a number of other bodies across different government departments (e.g. Fáilte Ireland, Marine Institute, Teagasc, Irish Film Board, Bord Bia, Bord Iascaigh Mhara, Údarás na Gaeltachta)

²⁷⁰ The agencies operate within the legislative context of the Industrial Development Acts and State Aid rules. The ownership and scale of a company determines the agency from which the company will receive enterprise supports. The CEBs/LEOs can also provide support to micro enterprises

Figure 24 The Role of the Enterprise Agencies in Supporting Enterprise Development



In recent years the agencies have strengthened their offerings to support firms in:

- Enhancing productivity through Lean and Transformational Change Programmes;
- Supporting Leadership and Management Development through programmes such as Leadership for Growth;
- Broadening access to new markets through targeted trade missions, training in International Selling, and establishing more structured trade relations;
- Broadening the potential client base through open calls for programmes such as the Competitive Fund and the establishment of the newly formed Potential Exporters Division;
- Widening international reach through overseas marketing and initiatives focused on attracting overseas entrepreneurs to invest in Ireland; and
- Stimulating increased collaboration and networking, particularly (although not exclusively) in the area of R&D through Technology Centre programmes, pooled innovation vouchers and the recently launched clustering initiative.

Strengthening the Focus on Manufacturing

Within the agency supported cohort, growth in internationally traded services activities has predominated over recent years as the digital world opened up new and exciting possibilities and barriers to international trade in services were addressed.

That is not to say that manufacturing has been overlooked - many of the supports (financial and advisory services) available through the agencies are directly relevant to manufacturing firms.

Recent investments point to the continuing attractiveness of Ireland as a location for manufacturing, including e.g. Intel, Kerry Group and Vistakon. More can be done by the agencies, however, in helping to redress the somewhat negative perception of manufacturing, both nationally and internationally.

This report serves to highlight the ongoing importance of manufacturing. It highlights the changes that manufacturing firms are facing, the capital intensive nature of the activities and the need for ongoing investments in automation and technology deepening. It is perhaps in this area - in supporting capital investment that most change will be required. However, the reality is that constraints do exist in terms of state aids (as set out above).

As is the case with firms, the agencies operate in a fast changing world - and their advisory services and interventions need to be continuously reviewed and adapted. In some instances, it is recommended that certain supports be extended and/or enhanced to strengthen the focus on the needs of manufacturing firms. In others, it is about broadening access to relevant supports currently available within Enterprise Ireland to foreign owned firms where this makes sense. Strengthening linkages between foreign and indigenous firms, raising the awareness of what is being produced by Irish firms and promoting the success of Ireland's internationalised firms are areas that require enhanced focus.

Strengthening Collaboration and Coordination

The fact that the nature of manufacturing and manufacturing related sectors is a constantly shifting dynamic has been highlighted in this report - informed primarily by global trends. New opportunities and challenges arise continuously. Many of the newer opportunities will arise at the 'blurring' of existing sectors and/or as a result of disruptive technologies. Through their in-depth understanding of sectors, strong relationships with client companies and in-market intelligence, the enterprise development agencies are well positioned to identify opportunities and obstacles to growth at an early stage. This report also highlights the increasing need for companies to collaborate to compete. The agencies, too, will be in a better position to support the changing dynamic in a collaborative way by building on the work of the recently established Cross Agency Group (APJ2012).

Conclusion

There are many positive aspects to Ireland's ecosystem that are supportive of manufacturing. Ireland is recognised as a 'good place to do business'. Ireland's attractiveness for investment includes access to a well-educated, young workforce, its competitive fiscal environment, developing reputation for excellence in certain fields of science and technology, international connectedness and track record. At the same time, there are identified gaps and/or aspects that need to be further developed. This is to be expected, as the business environment is not, nor should be, static. As industries evolve in response to global drivers of change, so too should the business environment that supports it.

In the next chapter, we provide a synopsis of Ireland's distinctive strengths and areas for improvement based on this chapter and preceding chapters before setting out what needs to be done in Chapter 9.

8 Ireland's Distinctive Strengthsbut...

Introduction

This chapter presents a brief synopsis of the analysis presented in the previous chapters. Data analysis has been complemented by wide consultation that captures the experiences of individuals who have worked in overseas locations and have first-hand evidence of what makes Ireland different.

Ireland has a number of distinctive strengths - strengths that are needed in the new manufacturing era and that can make a difference to Ireland's reputation for manufacturing.

However, these are strengths that need to be protected and further developed. Many of the strengths have a counter-point, so that although Ireland does have strengths - many come with a 'but'....

The recommendations in the following chapter aim to build upon strengths, address the challenges set out within each of the sections below as well as to enable the realisation of opportunities.

Good Business Environment

Ireland is well regarded as a 'good place to do business'. Ireland has the advantage of being a small country and firms have easy access to a pro-business government.

On the other hand, there are two critical issues that continue to constrain growth:

- Ireland's relative **cost competitiveness** remains *the* key issue for manufacturing firms across a number of elements, including employment, utilities, transport, property related costs and bureaucracy associated with regulations; and
- Irish owned companies cite considerable difficulties in **accessing finance** on reasonable terms - particularly for capital intensive investments and start-ups.

The Government's continued commitment to maintaining the current 12.5 per cent corporation tax rate is crucial to generate certainty, stability and predictability- all of which serve to restore confidence in Ireland as a good place to do business.

Strengths in Manufacturing Sectors

Ireland is internationally renowned for its track record and strengths in highly regulated manufacturing sectors such as Pharma, Bio-Pharma, Medical Devices and Food. ICT contributes significantly to exports and employment. Ireland also has strong engineering capabilities, and continues to demonstrate its ability to remain to the forefront of emerging areas of opportunity.

On the other hand:

- There appears to be a general **negative perception** of manufacturing nationally which permeates into the policy and support system and into individuals' education, training and career choices.

Ireland's manufacturing base is somewhat distinctive from other countries given the high proportion of foreign multinationals based here. Employment numbers in agency supported firms based in Ireland is similar for foreign and Irish owned entities, although in general:

- Irish owned firms are considerably smaller in terms of scale; and
- The higher proportion of exports is delivered by foreign firms.

This provides both a challenge and an opportunity to grow the contribution from the indigenous base. There is also potential to improve how we 'tell the story' and recognise the success of many Irish internationalised companies.

Although many of the firms based in Ireland are highly productive and a number operate at the leading edge of advanced manufacturing:

- A **greater step change** is needed by firms at *all* stages of their development to realise increased productivity and sustainable competitiveness.

Export Oriented and Globalised

Ireland is a small open economy and benefits from its openness to trade. Exports have generally proved to be resilient during the economic downturn, and certainly form the basis for recovery.

However:

- Ireland's **capabilities in international sales**, in understanding markets and cultures, in connecting to the customer and in developing stronger internal feed-back loops to inform new product and/or services development as well as strategic partnership management need to be enhanced.

Workforce Quality and Expertise

Ireland has successfully attracted investment from business on the basis of the quality of its workforce and expertise - offering a highly skilled workforce. Companies operating here continue to cite Ireland's workforce as a strength.

On the other hand:

- There are a number of **skills gaps**, which although not necessarily of significant scale are in critical roles that will become even more in demand as manufacturing continues to evolve, including, for example engineering, electronics, software, tool design, robotics, analytics²⁷¹;
- **Capabilities** need to be enhanced particularly with regard to technology deepening, product and process RD&I, design and new product introduction;
- **Management capabilities and leadership skills** need to be enhanced across a broader cohort of firms to drive international business growth for the innovative firm and to realise the step change needed to compete successfully in the 'new' era of manufacturing.

Flexibility and Problem Solving

Internationally, Ireland has a reputation for people with a can do attitude, an ability to identify and to solve problems and a high degree of flexibility in the workforce. Ireland ranks first out of 59 countries in terms of adaptability and flexibility of the workforce when faced with new

²⁷¹ See Chapter 7 for further details, also Future Skills Need for Manufacturing, EGFSN, 2013

challenges²⁷². These distinctive strengths need to be further nurtured through from the education system to the workforce. A number of firms are taking the necessary steps to respond effectively to the disruptive changes in manufacturing.

On the other hand:

- Firms cite a degree of **inflexibility and embedded work practices** that constrain the step change needed; and
- Capabilities in **change management processes** need to be further developed. An enhanced understanding is needed of the pervasive nature and end-to-end business implications for productivity enhancement initiatives such as Lean, Shingo, Six Sigma that ultimately rely on peoples' commitment, attitude and skills.

Collaborative and Internationally Connected

The analysis for this report reinforces the need for companies to collaborate to compete effectively in this increasingly competitive global environment. There is a degree of collaboration and networking in evidence across a number of areas particularly in the area of RD&I and industry associations²⁷³.

On the other hand, there is also a perception that **collaboration remains somewhat fragmented** which means that the synergistic potential is not being fully realised:

- As manufacturing evolves it is apparent that new opportunities present themselves at the **blurring of the edges of existing sectors**. A more proactive role should be taken in breaking down existing silos and in facilitating cross sectoral engagement;
- The connections between foreign firms based here and Irish firms have weakened in terms of **sub-supply**;
- Companies do not tend to collaborate or partner to the extent possible to capture market opportunities by working with others that have complementary products and/or services.

Building an International Reputation in RD&I

Ireland's investment in RD&I over the past decade is beginning to bear fruit with increasing international awareness of Ireland's excellence in certain fields of science and technology.

On the other hand:

- There is a perception that investments have not been directed sufficiently toward engineering for manufacturing;
- There is a lack of facilities that firms can avail of to trial and test new products and manufacturing processes;
- Smaller firms face higher barriers to entry and difficulties in leveraging state funded R&D;

²⁷² Source: IMD WCY Executive Opinion Survey based on 4,200 responses received from the countries examined

²⁷³ Business Networks on the Island of Ireland, Intertrade Ireland, 2010

- For SMEs there is a need to continue to help firms to identify and adapt 'new to them' technologies for their specific needs - an area that is increasingly important in terms of advances in Lean, Clean and Digital technologies in the manufacturing environment.

A Depth of Natural Resources

Many of Ireland's successful sectors rely on its natural resources - including, for example food, renewable energy and construction related sectors. Ireland can benefit from its green image in its international promotion of what makes it (somewhat) distinctive. As all companies need to have regard for sustainability, the efficient use of natural resources becomes a concern and a responsibility for all sectors.

For manufacturing firms, access to high quality water is paramount. On the other hand, firms cite concerns regarding the continued availability of high quality water over the longer term (and waste-water treatment).

Infrastructures

Ireland has invested significantly over the past decade to address its physical infrastructure deficits in terms of its road network and access to international markets. Investments have slowed as exchequer finances are constrained.

On the other hand, there remain a number of aspects that are of concern for manufacturing firms, particularly in relation to Waste policies, water and waste-water, energy sustainability and security of supply, and availability of high quality broadband.

Conclusion

Ireland has a number of strengths that makes it different and that offers a good environment in which to do business. Perhaps the most important message arising from our analysis is that action is needed to remove immediate barriers to growth and to ensure that our international messages are in fact based on reality.

Ireland's strengths, while providing a strong basis for future growth in the manufacturing sector, will be insufficient if they are not continuously refreshed and updated to meet the disruptive changes ahead. The fact is that these disruptive changes are imminent - not something in the (relatively) distant future of 2020 - and have implications for most (if not all) manufacturing firms operating in Ireland today.

The next chapter sets out what actions need to be taken - both at the level of the business environment and at the level of the firm.

9 Taking Action

The suite of actions set out below under 4 headline areas encompasses the level of the business environment and the level of the firm. The strategic aim has been set out underpinned by a number of more specific actions. Although each action has a particular focus, there is a strong inter-play between them. Strengthening capabilities at the level of the firm is highly dependent on peoples' capabilities, skills and attitude. You will note, therefore, e.g. that skills related actions pervade many of the areas set out - and at both the business environment level (education) and at the level of the firm. Likewise the concept of collaboration, partnering and peer-learning is reflected in many instances.

	Area of Focus
Redressing Perceptions	
1	Redressing Perceptions of Manufacturing
Addressing Barriers to Growth	
2	Delivering Structural Improvements for Cost Competitiveness
3	Retaining a Competitive and Pro-Business Tax Regime
4	Addressing Funding Issues for Capital Intensive Manufacturing Activities
A National Step Change Initiative	
	<i>A National Step Change Initiative: Strengthening Ireland's Manufacturing Base</i>
	Pillar A Enhancing Productivity and Competitiveness
5	Pillar B Connecting to the Customer & Extending International Reach
	Pillar C Broadening and Deepening Innovative Capabilities
	Pillar D Strengthening Collaborative Actions for Economic Growth
6	Strengthening Ireland's Own - a focus on indigenous potential: start-ups and scaling
7	Developing Ireland's People for Manufacturing - Making the Difference
Infrastructures	
8	Prioritising investment in Infrastructures for Manufacturing

Perceptions of Manufacturing

In Ireland, industry cites a lack of awareness of how manufacturing has evolved as a sector - in terms of its complexity and sophistication. There appears to be a general negative perception in terms of manufacturing nationally which permeates into the policy and support system. There is a sense that the 'newer' activities in internationally traded services sectors have grabbed the attention of policy makers and educationalists, to the detriment of manufacturing over the past number of years. It is not a case of either/or - but more a case of redressing the imbalance of recent years.

There *are* opportunities for manufacturing in Ireland over the years to 2020 - which can be realised.

As a priority it is important to redress public and political perception about the potential for manufacturing in Ireland, about the changing nature of manufacturing, its potential to offer job and career opportunities across a range of skills levels and across all regions, and about its valuable contribution to Ireland's recovery.

Ireland *is* in manufacturing and will continue to be in manufacturing in the future.

1	Strategic Action Undertake a strategic campaign of coordinated actions over 2013 to promote <i>Making it in Ireland - Manufacturing 2020</i> nationally and internationally.	DJEI, MDF/ Agencies
1.1	Develop a suite of key messages based on the evidence in this report to inform a coordinated programme of national and international (media, electronic etc.) communications for <i>Making it in Ireland - Manufacturing 2020</i> that would be used consistently by politicians, government department and agencies. Build on the existing agencies 'blackboard' campaign (<i>Innovation Ireland</i>).	DJEI and Agency Communications Managers
1.2	Identify and 'recruit' a small cohort of manufacturing champions who would become the faces of manufacturing in Ireland, and who would be supported in promoting manufacturing in Ireland at various relevant events and in various journals and articles over 2013.	DJEI
1.3	Deepen engagement of the Manufacturing Development Forum across Government to maintain a continued focus on the concerns and opportunities facing the sector in the context of significant change.	DJEI
1.4	Undertake an initiative to promote careers in manufacturing. In doing so, Discover Science and Engineering (DSE) should collaborate with manufacturing industry sectoral representative organisations, higher education institutions, SOLAS and relevant professional and trade organisations to deliver this initiative.	DSE/ Industry Assoc

Delivering Structural Improvements for Cost Competitiveness

Consultations with managers of manufacturing firms cite Ireland's relative cost competitiveness as being *the* most significant challenge facing them. Although Irish firms are affected to a greater degree than foreign firms by the domestic cost environment, it would be remiss to interpret this as a non-issue for foreign firms. The fact is that relative costs feature strongly in the Foreign Direct Investment (FDI) decision making process²⁷⁴ and that Ireland could potentially reposition itself in the market place for greater levels of investment from FDI (greenfield and expansions) across a broader range of activities if cost competitiveness were improved. For Irish firms trading on international markets, cost inputs determine their pricing structures and affect their ability to compete. For start-ups, a cost competitive environment in Ireland could positively influence their decisions with regards to where to establish production in the first instance.

Of particular relevance to manufacturing firms are: Costs of Employment; Utilities; Transport; Regulatory Burdens and Property Costs. In a number of circumstances, there is a strong interplay between costs, market structure and/or availability of infrastructures - and this is apparent in the analysis in Chapter 7 and the actions below. For further analysis and recommendations see recently published reports by Forfás²⁷⁵.

Although much may be outside of the control of government, it is important that actions are taken to address those aspects of costs where government *can* play a role. Equally important is for government to ensure that modifications to existing policies or the introduction of new measures do not (inadvertently) increase the costs for business. In some instances, firms can take a proactive role in reducing costs, e.g. through initiatives to improve energy efficiencies or minimise waste. Much of the control of labour costs (above the minimum wage) falls to firms - although cost of living and inflation are factors that impact on the real wage for individuals and the potential to effectively negotiate wage reductions. Other factors such as the tax wedge (i.e. the gap between what the employer pays and what the employee receives) and replacement rates (i.e. the proportion of out-of-work benefits received when unemployed against take home pay if in work) are also relevant.

2	<p>Strategic Action</p> <p>Make concerted efforts during 2013 to address the step change needed to realise structural reform to improve Ireland's relative cost competitiveness in support of manufacturing and enterprise development, growth and job creation.</p>	DJEI / Whole of Govt
2.1	<p>Costs of Employment</p> <ul style="list-style-type: none"> ▪ Continue the measures included in recent Budgets²⁷⁶ to ensure that all replacement rates move below the 100 per cent mark and ultimately move toward the 70 per cent benchmark; 	DoF

²⁷⁴ Location assessment and decision making is a complex process and depending on the nature of the investment other factors come into play, such as knowledge infrastructures, access to markets etc

²⁷⁵ Costs of Doing Business 2012, Overview of the Main Infrastructure Issues for Enterprise, etc <http://www.forfas.ie/>

²⁷⁶ Actions taken in recent budgets include e.g. reductions in social welfare payments (2010), changes to tax credits and tax bands along with the introduction of the USC (2011), entitlement to jobseekers benefit based on a five day rather than six day week where a person is working for part of a week (2012)

	<ul style="list-style-type: none"> ▪ Ensure that proposed policy changes do not result in increases to the costs of employment (e.g. pension auto-enrolment); and ▪ Ensure that there are no further increases in the labour tax wedge and provide an indication of when it will be feasible to reduce marginal rates below 50 per cent, by broadening the tax base (e.g. property tax, user charges etc.). 	DoF
2.2	<p>Energy Make concerted efforts to remove additional cost burdens to firms resulting from domestic policy and to enhance competition in the energy market.</p> <ul style="list-style-type: none"> ▪ Continue to raise awareness and to support firms in undertaking initiatives to increase energy efficiencies and reduce use; ▪ In the context of the significant additional costs for consumers arising from the peat PSO, unless there is a clear economic rationale for maintaining them, subsidies for peat generated electricity should be discontinued; ▪ Prior to converting peat plants to biomass, a full cost benefit analysis of the implications for Irish electricity prices and energy security and sustainability should be undertaken; and ▪ As a maturing technology, the price support scheme for onshore wind should be revised so that the price support levels for new onshore wind projects are phased out over time. 	<p>Agencies/ SEAI, Ind Assoc/ Gov Depts</p> <p>DCENR</p> <p>DCENR</p> <p>DCENR</p>
2.3	<p>Waste Prioritise the implementation of the key commitments made in the new waste policy, <i>A Resource Opportunity - Waste Management Policy in Ireland</i>, that will lead to improved competitiveness - in particular there is a need to accelerate progress on:</p> <ul style="list-style-type: none"> ▪ Reducing the number of waste regions from ten to three; ▪ Developing waste plans for the three new waste regions that will provide confidence and facilitate private investment in cost effective recycling and energy recovery infrastructures; ▪ Ensuring that Ireland's negotiating position at EU level on the new, more ambitious waste targets to be put in place by 2017 is informed by national competitiveness and environmental considerations; and on ▪ Ensuring continued and enhanced efforts by Government departments, agencies, business representative associations and businesses themselves to grow awareness among all SMEs of how best to exploit waste management reduction processes and technologies. <p><i>See also Action area 5 - Lead and Transformational Change</i></p>	<p>DECLG</p> <p>Gov Depts / Ind Assoc / Agencies</p>

2.4	<p>Water We need to ensure that moving from the current regime (where water services are provided by 34 local authorities) to Irish Water, leads to greater efficiencies and reduced capital and operational costs as potential economies of scale are exploited and the burden on business is reduced. Key actions required in this area include:</p> <ul style="list-style-type: none"> ▪ Prioritise reducing the high leakage levels in urban centres to improve efficiencies and reduce the need for new capital investment; and ▪ Develop a water regulatory framework that reduces inefficiencies in the capital and operational costs of water services infrastructure and ensures that water services charges are fully cost reflective and passed on to all customers in a fair and transparent manner. 	DECLG
2.5	<p>Regulation</p> <ul style="list-style-type: none"> ▪ Continue to review the decision making processes for environmental and IPPC²⁷⁷ licensing, taking account of the need to meet the State's obligations under the relevant EU Directives, with a view to: <ul style="list-style-type: none"> enhancing the process in terms of consistency and time lines; reducing uncertainties in relation to new investments or plant expansions that create jobs; and to reviewing costs of compliance in line with a risk based approach. 	DECLG/ EPA
2.6	<p>Property Related Costs</p> <ul style="list-style-type: none"> ▪ Accelerate the revaluation processes for Rates through the introduction of self-assessment or the outsourcing of valuations [the enactment and implementation of the Valuations Bill is critical to expedite the process]. ▪ Encourage Local Authorities to continue to exercise restraint in setting commercial rates in 2013 (a reserved function of elected members) and, where possible, to reduce rates. ▪ Introduce waivers/50 per cent reduction in Local Authority development levies for a period of 2 years, in the context of the changed economic circumstances, the need to remain internationally competitive for investment, and the reduced cost of delivery of the required infrastructure for which levies are charged²⁷⁸. ▪ Develop more robust and transparent charging mechanisms that match levies with the economic cost of providing development arising from the new draft guidelines on development contributions. 	<p>Valuation Office</p> <p>Local Authorities</p> <p>Local Authorities/DECLG</p> <p>Local Authorities</p>

²⁷⁷ Integrated Pollution Prevention Control

²⁷⁸ New Development Contribution Guidelines were published by DECLG in January 2013, available at <http://www.environ.ie/en/Publications/DevelopmentandHousing/Planning/>

Retaining a Competitive and Pro-Enterprise Tax Regime

It is important that Ireland continues to strengthen its rankings as a good place to do business, with a particular focus on maintaining its pro-enterprise competitive tax regime. The measures in Budget 2013 for manufacturing and SMEs, and in particular, the reaffirmation of the commitment to a tax regime supportive of investment, is welcome. *Actions 2.1 and 5C.10 are also relevant.*

3	<p>Strategic Action</p> <p>Maintain a pro-business environment with regard to Ireland's tax regime, ensuring that the enterprise perspective remains central to decision making processes.</p>	DoF
3.1	Continue strong coordinated reassertion of Ireland's commitment to maintaining the current 12.5 per cent corporation tax regime and monitoring the competitiveness of Ireland's tax offering.	DoF

Addressing Funding Issues

Irish owned companies cite significant difficulties in accessing finance on reasonable terms - particularly for capital intensive investments and start-ups. Together with relative cost competitiveness, manufacturing CEOs /managers state that these are genuine constraints to the future development of the manufacturing sector in Ireland and to employment creation. For manufacturing, the fact is that capital investment is not a luxury; it is inextricably linked with business development and growth.

Funding sources include bank financing, equity financing options, agency supports which operate under state aid guidelines, and the tax framework. Each of the four funding sources has been affected to some degree by current economic conditions. Actions have been taken in response, including the recently commenced Enterprise Ireland *Development Capital Fund Scheme* which will contribute to alleviating the shortage of risk/growth capital available to more established companies. While initiatives in one area can help to address constraints in another it is a fact that a healthy funding environment for manufacturing will see all four elements playing complementary roles in facilitating the growth and development of manufacturing enterprises.

Industrial restructuring is the on-going process of change in composition of economic activities in terms of sectors and activities and a move toward higher value added output that is sustainable. It presents a particular challenge for Ireland in the current period of high unemployment and fiscal adjustment. Policies and interventions need to be directed toward supporting the attraction of investment in new sectors and activities throughout the country, and in supporting the application of new technologies and new knowledge to enhance the competitiveness and productivity of existing activities. Utilising the full scope for support allowable under EU state aid rules and ensuring that existing initiatives are fit for purpose is important in this context. For example, in relation to the availability of equity, the new Employment and Investment Incentive Scheme (EIS) has potential for enhancement. The use of alternative sources of EU funding is becoming increasingly important in the current constrained environment. There are also enduring issues in relation to bank financing indicating that the required cultural shift in lending practices is not yet complete.

On a different note, some firms have queried the different approaches taken by the agencies when providing supports (whether equity or direct grant aid). The equity approach facilitates cash flow, whereas state held equity would not be a viable proposition for foreign owned subsidiaries. Given the increased mobility of indigenous firms, global competition for investment and the changing economic circumstances, it is timely to review what mechanisms are most appropriate. There are also additional avenues to EU funding that need to be explored further.

4	<p>Strategic Action</p> <p>Ensure that the funding environment is supportive of the needs of the capital intensive manufacturing sector, with all of the elements working effectively, to support the delivery of the step change needed to enhance productivity and innovation.</p>	DJEI/ Agencies
4.1	Develop and implement new <i>Capability Funds</i> for manufacturing to run for a period of 2 years, aimed specifically at supporting capital investment by firms as part of a defined strategic business development initiative to drive increased productivity and competitiveness, consistent with the objectives of the strategy for Manufacturing.	EI/IDA/DJEI
4.2	Ensure that, in the ongoing negotiations with the EU Commission on the state aid modernisation programme, the importance of state support in securing enterprise investment from SMEs and large firms (with a particular emphasis on the needs of manufacturing firms - such as capital investment and technology deepening) is fully reflected to secure the best regime for Ireland and other European regions.	DJEI
4.3	Develop further proposals to make full use of the potential for state support for productive investment under EU state aid rules.	DJEI, Forfás, EI, IDA
4.4	Consider alternative sources of EU funding, building on assessments already undertaken, and maximise the opportunities under EU programmes (including, for example the upcoming Competitiveness of Enterprise and SMEs (COSME) 2014-2020 and Key Enabling Technologies (KETs)).	DJEI, Forfás, EI, IDA
4.5	<p>To provide certainty and enhance the potential of the Employment and Investment Incentive Scheme (EII) to encourage investment in Irish manufacturing:</p> <ul style="list-style-type: none"> ▪ Extend the EII scheme to 2020 as outlined in Budget 2013, with early application to the EU Commission to enable approval before the end of Q2, 2013; ▪ Fully exclude the EII relief from the high income earner restriction; and ▪ Seek an expansion of the EU guidelines in the current EU negotiations so that all medium sized companies, including those in non-assisted areas, can qualify for investment under the EII scheme. 	DoF, DJEI

4.6	Continue to work with the banking sector to assist them in a cultural shift in lending practices, and ensuring that relevant lending personnel are sufficiently equipped with an understanding of the strategic business development objectives of manufacturing operations and range of lending options in order to make informed lending decisions.	EI/ CRO
4.7	Undertake an analysis of the rationale for the different approaches taken to support indigenous and foreign owned firms and consider what models are most appropriate in the current economic climate (taking into account approaches taken in other EU member states and state aid guidelines).	Forfás, DJEI, EI, IDA

A National Step Change Initiative - Strengthening Ireland's Manufacturing

In light of the disruptive changes underway in manufacturing, a concerted effort is needed to realise the step change required to position Ireland's manufacturing sector for growth. We need to develop and deliver a *National Step Change Initiative*. The proposed initiative builds on a number of interventions already in place to provide a coordinated and cohesive approach across all relevant actors. Actions will be required both at the level of the firm and in terms of enhancing the business environment across four main pillars:

- **Productivity:** driving Lean principles, energy efficiencies and sustainable practices throughout the operation, and adopting technologies new to the firm (including ICTs) and engaging with employees through change processes;
- **Innovation:** enhancing level of engagement and capabilities in R&D and innovation in product, process, business models and organisational change;
- **International marketing and selling capabilities:** building stronger connections with customers and expanding market reach; and
- **Collaborating to compete** more effectively on international markets.

The initiative (and elements of it) will resonate differently for different firms. For example, for firms that are seeking new market opportunities (e.g sub-supply for the Medical Devices market) - advisory services and supports for accreditation will be directly relevant; for some it may be about obtaining supports and/or funding for investment in capital equipment and automation to enhance productivity; and for others supports such as the Innovation Vouchers will assist in stimulating early engagement in R&D. Firms should be facilitated to engage in the way that is most relevant and appropriate to their stage of development. As well as the enterprise development agencies, others have a role to play in helping to deliver on a *National Step Change Initiative*, whether by way of providing direct assistance or in terms of enhancing the business environment - including for example, banks, fund managers, training providers, standards bodies and utilities providers.

It will require time and commitment by firms themselves and an ambition to deliver more than might otherwise be achieved without support.

Actions are set out across each of the four pillars (designated A to D), and involve actions at the level of the firm and at the level of the business environment.

5	<p>Strategic Action : Overarching</p> <p>Deliver a <i>National Step Change Initiative</i> to strengthen Ireland’s manufacturing base, focused on capability building and enabling companies to: drive enhanced productivity and competitiveness; to internationalise; to deepen engagement in innovation and to collaborate to compete. <i>Specific actions are set out across 4 key pillars.</i></p>	DJEI / IDA/EI through the existing Cross Agency Senior Mgt Team
5.1	<p>Raise awareness of the imperative to engage in a National Step Change Initiative and of the commitment required by managers and employees in the first instance to realise significant benefits to deliver profitable sales, exports and jobs.</p>	DJEI/ MDF, Agencies/ Ind Assoc & Union Reps

Pillar A: Enhancing Productivity & Competitiveness - Lean, Green and ICTs

The nature and extent of change will be specific to a company’s scale and stage of development - in some instances it will be about companies identifying and adopting technologies that are new to them, in others it will be at the leading edge of the *Factory of the Future* spectrum. Technologies encompass those used in the production process (including analytics, simulation, modelling, Lean techniques, CNC²⁷⁹, Computer Integrated Manufacturing etc.) as well as Information and Communications Technologies (Tracking & Tracing, Customer Relationship Management, Open Innovation, etc). In many instances it will require considerable capital investment, restructuring and training to realise full potential.

Over the past number of years, Enterprise Ireland introduced supports for companies through its Lean Business Offer and IDA Ireland works with its client base on a transformational change agenda. Often these initiatives are interpreted as (only) being about ‘cutting costs’ or ‘eliminating waste’. However an enhanced understanding is developing of the pervasive nature and end-to-end business implications of these initiatives that require change management expertise to harness peoples’ commitment, attitude and capabilities.

Transformation is ultimately about changing a way of working - about developing competences, problem solving skills and innovative capacities and about delivering on the responsiveness and flexibility needed to deliver increased sales in a highly competitive global market. Leadership and change management capabilities are critical in this regard.

During consultations a number of foreign owned firms expressed a desire to engage in the structured Lean Business Offer that is delivered by Enterprise Ireland and highlighted that this initiative is not currently available in IDA Ireland.

Through their ManagementWorks initiative, Skillnets offers a number of programmes to SMEs. Initial engagements with firms tend to be in the area of strategy and actions which can be taken to improve their current performance. Of particular interest is the potential to encourage some firms to participate in Lean style programmes as drivers of continuous change and improvement.

²⁷⁹ Machine tools that use programs to automatically execute machining operations - CNC (computer numerical control) machines offer increased productivity, flexibility, consistency and reliability

From a national perspective, building a more comprehensive data set through a benchmarking process would allow for an increased evidence based understanding of the qualitative capabilities of firms²⁸⁰. Such a database would facilitate the delineation of cohorts of firms, monitoring progress and the evaluation of the effectiveness of a more tailored suite of interventions.

5 A	<p>Strategic Action National Step Change Initiative: Pillar A</p> <p>Build on existing Lean and Transformational change initiatives to deliver a single <i>National Initiative</i> to drive enhanced productivity and change, by facilitating access to a <i>common suite</i> of advisory services, benchmarking tools, peer networks and in-firm training to companies (regardless of ownership).</p>	IDA/EI Cross Agency Senior Mgt Team
5A.1	<p>Develop and make available a <i>national</i> benchmarking tool that:</p> <ul style="list-style-type: none"> ▪ Enables companies to measure performance against international norms (sector specific) and which can be accessed in a way that is appropriate to a company’s needs and stage of development ranging from on-line diagnostic self-help tools to facilitate data gathering and workshops; and ▪ Builds a comprehensive dataset over time which will facilitate aggregated qualitative analysis, monitoring of progress at a programme level and the development of more tailored and customised suite of interventions. 	EI/IDA/DJEI
5A.2	<p>Review and enhance, as required, the existing Enterprise Ireland Lean Business Programme to deliver to the needs of foreign owned firms, as appropriate, taking into account aspects that may be particular to a foreign subsidiary operating as part of a global corporation.</p>	DJEI/EI/IDA
5A.3	<p>Continue to build and enhance Enterprise Ireland’s ‘approved’ panel of change management specialists and mentors with expertise of dealing with companies across a broad spectrum of capability, sector, scale, ownership and international reach²⁸¹.</p>	EI
5A.4	<p>Facilitate peer-to-peer learning across companies, sectors and ownership through a semi-structured model of site visits, case study dissemination and on-line fora (e.g. via LinkedIn).</p>	Ind Assoc & Employee Rep Groups MDF/Agencies

²⁸⁰ A database PROBE is utilised by Enterprise Ireland in its Lean Initiative that facilitates benchmarking against international norms/sectors etc. Although data held relates to indigenous firms only, and to those that have undertaken benchmarking as part of a Lean process, it does capture circa 1,000 benchmarks and could form the basis for the development of the national dataset proposed. It is not, however, a longitudinal dataset

²⁸¹ Currently available on Enterprise Ireland’s website and includes some international consultancies. This may need to be expanded further to support the proposed cross agency National Step Change Initiative

5A.5	Continue to promote the Becoming Lean initiative and Lean training programme introduced in 2012 by Skillnets that would cater to the needs of micro and small manufacturing firms. The newly formed LEOs should be equipped to provide signposting/referrals of the programme to potential client companies.	Skillnets CEB/LEOs
5A.6	Building on existing initiatives employee representative groups should continue to engage with their members to raise awareness of the challenges facing the sector, of its potential, and of the need for adaptability and flexibility. They should encourage high levels of employee participation in opportunities for continuous learning and contributing to a <i>workplace of the future</i> that will provide sustainable and rewarding employment. Effective participation also requires collaborative engagement by management.	Ideas Institute Employee Representative Groups
5A.7	Continue to deliver the Leadership4Growth and management development programmes, and facilitate leaders of Irish based foreign multinationals who would benefit ²⁸² modifying the content (only if necessary) to their needs and also in the context of the <i>workplace of the future</i> .	EI/IDA

Pillar B: Strengthening International Reach - Connecting to the Customer

Ireland's Foreign Trade Council continues to focus on strengthening Ireland's economic links and on building the capabilities of firms to target a greater number of international markets²⁸³. Building international trade relations requires continued focused and coordinated efforts to identify and address barriers.

At the firm level, Irish based firms are engaging more directly in marketing and sales, in connecting into and/or managing global supplier networks. The sales cycle for more customised and solutions based products is longer than a 'price for standardised product' which requires strong cash flow management, commitment and confidence. The connection to the customer has become increasingly important for all firms - even those multinational firms that may not have direct responsibility for sales but are involved in RD&I need to find ways to tap into market intelligence, customer trends and preferences.

Ireland's capabilities in international sales, in understanding markets and cultures, in connecting to the customer and in developing stronger internal feed-back loops to inform new product and/or services development as well as strategic partnership management need to be further enhanced.

²⁸² The L4G programme may be of particular benefit, for example, to smaller scale subsidiaries based here

²⁸³ Trading and Investing in a Smart Economy, DJEI, 2010 sets out the actions required to enhance Ireland's exports and trade

5B	<p>Strategic Action National Step Change Initiative: Pillar B</p> <p>Support firms to expand into international markets and deepen customer connections through targeted skills development, peer learning and collaboration; enabled by continued focus on developing strategic trade relations; and coordinated in-market support.</p>	ExportTrade Council Agencies
5B.1	<p>Enhance sales skills and capabilities to address more complex solutions based selling, Customer Relationship Management and Partnership Management - capabilities which would serve to expand into international markets and global supply networks²⁸⁴.</p> <p>Include aspects relating to cultural awareness and knowledge of market specific regulations and requirements.</p>	Private Sector providers / HEIs / EI
5B.2	<p>Establish a Peer Learning Group on International Selling that could serve to encourage exporting firms to initiate a step change to broaden their market reach to new territories.</p>	EI
5B.3	<p>Encourage and facilitate manufacturing companies to <i>collaborate to compete</i> - to work together to bring complementary products, services and/or capabilities together to address market opportunities that could not be served by one company and/or to take advantage of a manu-services model.</p> <p><i>Building on Enterprise Ireland's recently launched clustering initiative (October 2012).</i></p>	EI/IDA
5B.4	<p>Develop new (and restore) direct air links with key existing markets (e.g. US West Coast) and high growth markets and maintain air links with key European markets.</p>	DAA/DoT
5B.5	<p>Align the Foreign Earnings Deduction with Ireland's Trade, Tourism & Investment Strategy, recent trade missions and the enterprise development agencies' strategic markets, by including all of the following countries: the Kingdom of Saudi Arabia, the United Arab Emirates and Qatar in the Middle East; and South Korea, Japan, Singapore and Malaysia in Asia.</p>	DoF

Pillar C: Strengthening Innovative Capabilities

For companies to be successful on international markets it is essential that they continuously innovate to meet the changing needs of existing customers, and to develop new products and solutions to respond to unmet demand, to capture new markets and customers. The significant change underway in manufacturing has placed an increased emphasis on the importance of process R&D and, at a minimum, of technology adoption.

²⁸⁴ See also Key Skills for Enterprise to Trade Internationally, EGFSN, June 2012

From a manufacturing perspective, although BERD has increased over recent years in terms of amounts spend on R&D, the number of firms has remained relatively static. The engineering cohort appears to be less engaged in RD&I than other sectors and underrepresented in terms of overall State investment in RD&I. The agencies have worked with industry representatives to define the research agenda for Medical Devices, ICT, Food, Pharma/Biopharma, or are in the process of doing so, to inform HEI industry-led R&D through Technology Centres. There has been minimal engagement in defining the research needs of engineering firms including those that serve the industrial products markets (e.g. Agricultural Machinery, Equipment, Automotive, Aeronautics and Construction) and those engaged in Print & Packaging.

Despite significant investments by the State in developing Ireland’s research infrastructures and capabilities, there is also a perception that investments have not been directed sufficiently toward manufacturing. It is also difficult for companies to navigate their way to the most appropriate resource. It has also been more challenging for SMEs to engage in the existing Technology Centres that are relevant to manufacturing, although some new initiatives introduced by i2E2 (Energy Research Centre) and ICMR (Irish Centre for Manufacturing Research) could point the way for others to emulate. Enterprise Ireland’s Gateways Programme (that replaces the Applied Research Enhancement Centres) should also serve as a point of entry for SMEs in particular to the available research capabilities in HEIs.

It is important too, that Ireland’s IP regime remains competitive and attractive in the international context. Developments of international regimes regarding the treatment of IP and intangible assets need to be monitored on a continuous basis.

Where relevant, the actions align with the work of the Research Prioritisation Action Group (for manufacturing) that was established to progress the implementation of the *Report of the Research Prioritisation Steering Group*.

5C	<p>Strategic Action National Step Change Initiative: Pillar C</p> <p>Reorient State Investments toward enhancing Ireland’s RD&I capacity in Manufacturing, targeted toward specified industry needs (including an emphasis on mechanical and other engineering disciplines relevant to manufacturing) and increase firm level engagement in RD&I.</p>	<p>Agencies/ Research Institutes Gov Depts</p>
5C.1	<p>Undertake a concerted effort to encourage more manufacturing companies to engage in RD&I (with a particular focus on the cohorts with relatively lower take-up to date)²⁸⁵, building on existing work to raise awareness of initiatives and applicability to firms at different stages of capability and to encourage collaborative approaches (e.g. pooling innovation vouchers).</p>	<p>IDA/EI</p>
5C.2	<p>Facilitate technology adoption by firms that is ‘new to them’, including micro firms, as part of structural upgrading of the manufacturing base.</p>	<p>EI/CEBs/LEOs</p>
5C.3	<p>Establish a Strategic Technology Officer Group to assist companies with the potential to scale to address growth inhibitors through peer learning.</p>	<p>EI</p>

²⁸⁵ And utilising existing instruments/incentives to the maximum possible to effect the change needed (e.g. IDA R&D Fund, and EI R&D Fund etc.)

5C.4	Stimulate increased engagement and reduce barriers to engagement by SMEs in collaborating in state funded Technology Centres, by tailoring input, costs and opportunity to suit size and ambition of the firm. The recently introduced model by ICMR and i2E2 should be considered by other Technology Centres ²⁸⁶ .	Tech Centres EI/IDA
5C.5	Complete the ongoing audit of State funded equipment in HEI research facilities and assess the potential to provide access to firms on a pay-for-use basis to undertake pre-production trial and test, particularly where equipment may be underutilised.	HEA
5C.6	Raise awareness amongst manufacturing firms of the importance and value of innovation in services (particularly in the context of manu-services), including behavioural analysis, real time analytics and monetisation models.	EI/IDA
5C.7	R&D Infrastructures and Collaboration: Engage with manufacturing firms, particularly within sectors that have been relatively underrepresented to date (such as engineering) to determine and define specific needs at a research programme level (spanning through from basic, to applied to experimental development). <ul style="list-style-type: none"> ▪ Draw on existing capabilities/resources and initiatives to deliver to industry specified needs and increase collaboration between HEIs and industry; and ▪ Establish strategic collaborations with international research institutes and Research Technology Organisations (RTOs)²⁸⁷. 	IDA/EI/SFI/ DAFM
5C.8	Following on from action 5C.7 above if an infrastructure deficit has been identified in <i>applied research/experimental development</i> (for testing, prototyping etc.) carry out a feasibility study to assess the potential for establishing a Research Technology Organisation in Ireland.	DJEI (TI) ²⁸⁸
5C.9	Develop a consolidated marketing brand and message for the various Research, Technology Centres and Principal Investigators to facilitate easier access by industry to relevant knowledge & expertise and to strengthen Ireland's R&D message overseas in terms of critical mass.	DJEI (TI)
5C.10	Retain and enhance the potential of the R&D tax credit for enterprise as part of the review of the R&D tax credit which was announced in Budget 2013.	DOF/DJEI/Forfás

²⁸⁶ The ICMR, i2E2 have introduced a three tier model to stimulate interaction at different levels, including: Board level (significant input and access across the entire Centre); partner level (input and outputs based on specific projects); and subscriber level (basic access level, a first step). See *Technology Innovation for Irish Manufacturing and Energy Competitiveness, Issue 1*, October 2012

²⁸⁷ Including, for example the Fraunhofer Institute - which should also inform action 5C.8

²⁸⁸ Technology Ireland

Pillar D: Strengthening Connections and Collaboration

5D	<p>Strategic Action National Step Change Initiative: Pillar D</p> <p>Strengthen effective collaboration to deliver enhanced growth and job creation, by stimulating sub-supply connections, facilitating companies to collaborate to compete and by developing further cross sectoral / cross ownership connections.</p>	EI/IDA/SFI / Ind Assoc
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The following sections look at sub-supply connections; followed by cross sectoral collaboration.

Strengthening the Sub-supply Connections - Building the Eco-system for Manufacturing

The connections between foreign subsidiaries based here and Irish firms have weakened in terms of sub-supply over the past decade. While acknowledging that much is now about engaging in *global* supply networks where procurement decisions are made outside of Ireland, there is potential to strengthen linkages and to strengthen the supplier eco-system for Manufacturing in Ireland to address identified gaps currently and as the manufacturing sector evolves. Procurement includes goods, services and licensing of technologies and IP. Enterprise Ireland and IDA Ireland have recently launched a Global Sourcing Strategy²⁸⁹ to help strengthen business connections between foreign MNCs and Irish firms.

The agencies will continue to work with indigenous firms - to build up their knowledge, intelligence and understanding of the MNC procurement process and to facilitate peer to peer coaching/learning from companies that are successfully engaging with the foreign multi-national subsidiary. Relevant indigenous firms should continue to be included in FDI itineraries where appropriate, aligned with the systematic approach being taken to broker introductions between MNCs based here and potential suppliers.

For some indigenous firms, there is a basic requirement to acquire accreditation relevant to specific sectors to enable them to reposition their own strategies and target market. The analysis undertaken by the agencies should also lead to greater understanding of gaps in Ireland's market place that could be filled either by attracting FDI and/or stimulating start-ups to address a market need.

Both the foreign subsidiaries and Irish firms would realise benefits which would also result in economic return for Ireland. For foreign subsidiaries it would reduce the risks and hidden costs in longer supply chains, result in closer supplier partnerships and further embed their activities in Ireland. For indigenous supplier companies it would introduce a new customer base, strengthen their capabilities in selling, product development and customer relationship management and equip them to expand into overseas markets.

Much of the analysis undertaken by the agencies in developing the sourcing initiative will also serve to identify existing and/or emerging gaps in Ireland's eco-system to support manufacturing firms and future investment.

²⁸⁹ Delivering on Actions 5.11 and 3.3 in the Action Plan for Jobs 2012 that requires that Enterprise Ireland and IDA Ireland establish a senior management team to deliver on key priorities such as maximising procurement opportunities for Irish business with MNCs. <http://www.djei.ie/press/2012/20121130.htm>

	<i>Connections and Collaboration</i>	
	Strengthening the eco-system for Manufacturing	
5D.1	Continue to drive implementation of the actions set out in the Global Sourcing initiative to raise awareness of what is available on the Irish market and to optimise the proportion of goods and services procured by MNCs from Irish sources.	IDA/EI
5D.2	Support the work of the enterprise development agencies and help to raise awareness and signpost companies to advisory supports and services for accreditation, raise awareness with regard to the importance of Standards and sector specific needs and facilitate firms' engagement (as appropriate) on International Standards Development Groups	NSAI
5D.3	Continue to engage in a targeted approach to fill existing or emerging gaps in Ireland's eco-system for manufacturing to include: <ul style="list-style-type: none"> ▪ Targeting investments from mid-tier and/or early stage foreign owned companies (e.g. engineering service houses, equipment providers, and sector specific contract manufacturers); ▪ Fostering start-ups that aim to address identified gaps and that have the potential to export over time; and ▪ Assisting existing Irish firms to re-orient their strategies building on existing competences to serve market needs. 	IDA/EI
5D.4	Promote and facilitate industry-led initiatives such as FUSE, and identify ways in which such initiatives could be replicated without over-engineering them or losing the 'ground-up' commitment.	EI/IDA

Strengthening Cross Sectoral Collaboration to Realise New Opportunities

Although there are many opportunities arising as a result of changes within sectors, it is increasingly apparent that as manufacturing evolves new opportunities present themselves at the blurring of the edges of existing sectors. Some progress has been made in relation to combination products in particular and areas of adjacent possibilities - although such examples are not necessarily well known.

If Ireland is to realise future opportunities, a more proactive role should be taken in breaking down existing silos and in facilitating cross sectoral engagement. This requires a different approach to be taken by government departments, agencies and companies. It necessitates a strong cluster development approach (both within and across sectors), distinguishing between geographic colocation and genuine clustering activities that deliver synergies and higher growth potential than might otherwise be realised.

For manufacturing activities there are aspects of the business and challenges that are common to all - regardless of sector or ownership. This includes aspects such as enhancing energy efficiencies, Product Lifecycle Management and adopting Lean principles all of which provide an excellent 'safe space' in which companies can share experiences and exchange information and knowledge. The Leadership for Growth initiative has also stimulated peer networks that have continued on since

individuals engaged in the programme. These opportunities and networks should continue to be identified and stimulated.

Initiatives such as Ideagen could be broadened to cater to established firms, bringing individuals together from across different sectors and disciplines. The existing Ideagen initiative (launched 2009) targets entrepreneurs, innovators and researchers in the higher education sector. It involves facilitated three hour networking and information sessions. They are organised on a regional basis, focused on a specific sector, and serve to share knowledge on sectoral trends and research activities and to generate innovative ideas.

	<p><i>Connections and Collaboration</i></p> <p>Embed a more structured cross agency and cross sectoral collaborative approach to stimulate the potential for identifying and realising 'new' areas of opportunity at an early stage.</p>	
5D.5	<p>Establish focused working groups <i>across</i> the agencies and across existing sectoral departments that would strengthen knowledge sharing and solidify the opportunities in new convergent areas.</p> <p>A more structured process would allow for new areas to be identified at an early stage. It would also help to identify the specific actions needed to remove barriers and/or to support cross sectoral opportunities in areas such as regulation, IP and skills [e.g. green, nutraceuticals, combination products].</p>	EI/IDA/SFI
5D.6	<p>Develop and disseminate a series of case studies to demonstrate Adjacent Possibilities and Convergence, detailing challenges and how they were overcome.</p>	EI/IDA/SFI
5D.7	<p>Launch an <i>Ideagen Adjacent Possibilities</i> initiative to target established companies from different sectors to stimulate new and cross 'boundary' thinking.</p>	EI/IDA

Strengthening Ireland's Own - A Focus on Indigenous Potential

Start-ups provide the feedstock for future exports and employment. They can be the means by which new and emerging sectors and activities take root in Ireland. Start-ups have a key role to play in creative destruction²⁹⁰. They increase levels of innovation in the market place, increase productivity and improve competitiveness. Manufacturing start-ups face greater challenges than their counterparts engaged in services, not least because of the capital intensity of the business, the complexity of the production process and supply chain. Start-ups face challenges in

²⁹⁰ Joseph Schumpeter, *Capitalism, Socialism and Democracy* "a process of industrial mutation that incessantly revolutionises the economic structure from within, incessantly destroying the old one, incessantly creating a new one"

prototyping, material selection and the economics of manufacturing as well as a broader range of regulations that apply to manufacturing (including e.g. IPPC licenses).

There are a number of strong Irish owned firms operating on international markets and Enterprise Ireland continues to stimulate more companies to export and to build scale and capabilities. However Ireland does not appear to take the same pride in its SMEs that is evident in other countries such as Germany's Mittelstand. Much of the analysis of indigenous firms is based on data that reflects economic activity *in* the State. While this is a valid perspective to take in terms of documenting the return to the State from its investment in supporting enterprises, it falls short in terms of telling the full story of the extent of internationalised activities and the success of Irish companies.

The actions above relating to addressing the negative perception of manufacturing, of promoting career path potential, of cost competitiveness, and enabling access to State-funded equipment for pre-production, trial and test are all relevant to start-ups. In addition, further action can be taken to reduce barriers to entry.

	Strategic Action	Agencies/ CEBs(LEOs) / DoF/CSO
6	Nurture, strengthen and develop Irish owned manufacturing firms, creating a dynamic in start-ups, scaling and in taking pride in achievements to capture opportunities and generate jobs.	CEBs(LEOs) / DoF/CSO
6.1	Introduce a targeted <i>Start Fund</i> for indigenous manufacturing start-ups modelled on the existing Enterprise Ireland Competitive Start Fund which would facilitate feasibility, prototype development and market testing.	EI
6.2	Assess the feasibility of establishing a facility that provides access to entrepreneurs and early stage start-ups to equipment and expertise to facilitate proto-type development of new products/solutions. Consideration should be given to the possibility of private sector provision, and/or equipment being donated by vendors as part of the solution.	EI
6.3	Raise awareness of the contract manufacturing services that are currently available in Ireland, and of the potential of 3D printing (additive manufacturing) as a low cost option for prototyping and home based production at the initial consultation stage with start-ups and through Start Your Own Business courses etc.	EI/IDA
6.4	Develop and promote additional modules catering to the particular needs of manufacturing firms as part of the Start Your Own Business programme, and using manufacturing champions as guest speakers to demonstrate real life examples of overcoming hurdles.	CEBs/LEOs
6.5	To remove a barrier to entrepreneurship, introduce an additional voluntary opt-in PRSI contribution to enable the self-employed (Class S) to qualify for the full range of benefits, including Jobs Seekers Benefit, which is not means-tested.	DoF

6.6	Ascertain the benefits arising to the state from Outward Direct Investment and the extent of activities in overseas markets (sales, employment etc), in order to better inform policy and to enhance the 'Irish story' ²⁹¹ . Identify the additional metrics required (if any) for collection by CSO and the agencies.	Forfás/CSO
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Developing Ireland’s People for Manufacturing - Making the Difference

People make the difference. It is people who solve problems, who come up with creative ideas, who share learnings, who close the sale, who build relationships. A highly effective workforce is one of the most difficult to replicate - and an area in which Ireland could genuinely differentiate its manufacturing offering. An effective workforce is one that includes well educated and skilled individuals, bringing a can do attitude to bear in the workplace, and who can work effectively as part of a multi-disciplinary and multi-cultural team. Important too, are effective industry leaders, those with vision, ambition and who lead in a way that is inclusive.

Education and training are fundamental building blocks to ensuring that individuals have the technical skills and competencies to address the current and future needs of manufacturing firms. Actions required include: the need to establish a clear career path framework, to address specific skills gaps, to ensure course content is aligned with today’s and future manufacturing needs, and to strengthen capabilities in innovation, design and new product introduction. The manufacturing sector would benefit greatly from a more structured dialogue between industry and education providers, particularly in relation to skills issues such as project-based work placements, curriculum design and upskilling employees to Masters and PhD levels.

For more in-depth analysis and broader suite of actions refer to the *Future Skills Requirements of the Manufacturing Sector* (EGFSN) published to complement this strategy. This complementary skills report has assessed the future occupational profiles and skills needs of the sector based on the employment scenarios set out here in Chapter 5. A number of the key actions are highlighted below. The Actions above relating to promoting manufacturing as career (1.4), international selling (5B.1), Leadership for Growth (5A.7) and workplace of the future (5A.6) are also relevant.

7	<p>Strategic Action</p> <p>Drive implementation of the manufacturing skills study in a timely manner, to reenergise interest in manufacturing as a career, to address skills gaps, to ensure course content is aligned with manufacturing industry needs and to enhance capabilities in design and new product introduction.</p>	
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²⁹¹ Building on previous analysis undertaken by Forfás : Statement on Outward Direct Investment, 2007

7.1	Review and set out career paths in manufacturing, engaging industry, employee representatives and relevant providers of education and training and the qualifications bodies including industry representative bodies, SOLAS, Skillnets and Higher Education representatives.	MDF/Industry /Employee Reps/ Educ & training providers
7.2	Use the accelerated apprenticeship scheme to augment the number of apprentices qualifying as toolmakers every year. FÁS (and subsequently SOLAS) should endeavour to ensure that at least 55-60 apprentices qualify as toolmakers each year over the period to 2016. Update the toolmaking apprenticeship syllabus to reflect recent advances in manufacturing materials and processes. Assess the potential for increasing the supply of polymer technicians, including pooling resources for the associated equipment requirements. Providers should also investigate the possibility of funding equipment costs through leasing arrangements or sponsorship by clusters of companies or equipment manufacturers.	FÁS/SOLAS IOTs/Skillnets/Plastics Ireland/ IMDA
7.3	Examine the potential for formal learning opportunities for machinists, particularly for CNC machining and programming, including the potential for the development of a Machinist Traineeship or Apprenticeship	FÁS/SOLAS
7.4	Target mechanical engineering Level 8 programmes within the next Springboard call with a particular focus on automation, development and design and strongly emphasise enterprise collaboration and work placements. Review course content in mechanical engineering and other engineering disciplines relevant to manufacturing to include a practical grounding in the process improvement techniques currently in use in industry, including Lean and Six Sigma, modules in polymer science & engineering, data analytics and substantial work placement periods.	HEA, HEIs, HEA, HEIs, Engineers Ire
7.5	Identify ways in which a structured work placement programme could operate more effectively to deliver to the needs of the graduate/ undergraduate <i>and</i> to the firm, taking into account the resource commitment required by SMEs in particular.	MDF, Industry Assocs HEIs
7.6	Address the current small scale but critical shortages in Validation engineering, Quality engineering, Polymer engineering, Automation engineering and Supply chain engineering (primarily at NFQ level 9) through upskilling employees and the unemployed (Springboard) in partnership with industry. Focus on Manufacturing SMEs in future Irish Research Council calls for the Employment-Based Postgraduate Programme and Enterprise Partnership Scheme. Enterprise Ireland should seek to promote engagement by client companies within these programmes.	HEA, Skillnets, Trade Assocs Irish Research Council, HEA, EI

Infrastructures

The availability of suitable property at the right price and in the right place has long been an essential contributory factor in Ireland's success in attracting FDI. In terms of Gateway locations, ability to deliver property solutions to cater for the next wave of investment in advanced manufacturing (including e.g. Pharma/Bio-Pharma) will also be a requirement in the medium term.

Continued and prioritised investment is needed to ensure that Ireland's infrastructure remain world class and facilitate the efficient movement of people and both physical and electronic products. What is not necessarily readily understood, is that ICTs are increasingly critical for manufacturing firms, many of which are globally connected with suppliers, partners, researchers and customers and operate with increased volumes of real time rich data and graphics. *Note some infrastructure actions have been set out within the Cost section because of the direct implications for costs.*

8	Strategic Action Prioritise investment in infrastructures necessary to support manufacturing firms operating in a connected global environment - enabling the efficient movement of people and goods (physical and electronic).	
8.1	Industrial Property Ensure that appropriate financing mechanisms are available so that the building requirements associated with anticipated FDI investments are adequately catered for in Gateway locations, particularly in relation to attracting the next wave of manufacturing investment.	DJEI/IDA
8.2	Advanced Broadband Local Authorities should work with private sector and semi-states to accelerate roll-out where possible. It is critical that the State investments committed to for post August 2014 in the new national broadband strategy for Ireland (€175 million) are delivered according to the timelines set out and that opportunities to bring forward investment should be explored ²⁹² .	DCENR
8.3	Transport Infrastructures While capital resources are limited, it is critical that investment in physical infrastructures and routes to international markets that support economic recovery and the activities of manufacturing firms (roads, ports) are prioritised (See Appendix VI).	DoT

²⁹² Delivering a Connected Society - A National Broadband Strategy for Ireland, Department of Communications, Energy and Natural Resources, August 2012

Appendix I

Methodologies and Consultations

The Terms of Reference for the study were approved by the Forfás Board in May 2012. They set out the objective to determine:

What (new) policy actions are needed to support a competitive manufacturing sector in Ireland over the period to 2020 in the context of global trends and the ongoing transformation of the sector, and the issues facing manufacturing in Ireland today.

- Forfás has consulted extensively with industry, academia and key stakeholders over the past months, including:
 - Facilitated industry workshops (engaging with circa 80 firms);
 - One-to-one consultations with company representatives, academics and institutions;
 - Drawing from survey and interviews undertaken for the complementary Manufacturing Skills Study;
 - Presentations to and/or consultations with industry organisations and professional bodies including IMDA, FDII, IBEC Industrial Products, and the Academy of Engineering.
- Forfás undertook research and analysis of Ireland’s manufacturing activities, sector specific and cross sectoral areas of opportunities, global drivers of change and developed recommendations for consultation.
- Forfás collaborated closely and has drawn from the research undertaken in the complementary Manufacturing Skills Study (EGFSN)²⁹³, and the project lead for each study participated on relevant steering committees and working groups to ensure consistency.
- Research consultants, SQW were appointed to develop discussion papers on the Factory of the Future, assist in facilitating workshops, bringing the global dimension to bear on discussions, and to develop more in-depth case studies. RSM McClure Watters were appointed to undertake research and to provide on-the-ground insights for a number of countries.
- An Interagency Group, comprised of representatives from IDA Ireland, Enterprise Ireland and Science Foundation Ireland contributed throughout the development of the strategy.
- A Manufacturing Development Forum (MDF) was also established by the Department of Jobs, Enterprise and Innovation (DJEI) as required by the APJ 2012. The MDF is chaired by Patrick Miskelly (Kraft Foods) and comprises representatives from industry, the enterprise development agencies, DJEI and the Department of Agriculture, Fisheries and Food. The MDF was a valuable source of insights throughout the process. The MDF will play a critical industry role over the coming years in helping to promote manufacturing and to make the step change necessary to realise the potential of manufacturing here in Ireland.
- Forfás research, analysis and reporting: Maria Ginnity, Céline McHugh and Adrienne Costello

²⁹³ This strategy has also drawn from Forfás’ research in the area of costs, infrastructures, tax and regulation as well as the work of the Research Prioritisation Action Group (Manufacturing) and recently published sector strategies

Appendix II

Employment Scenarios

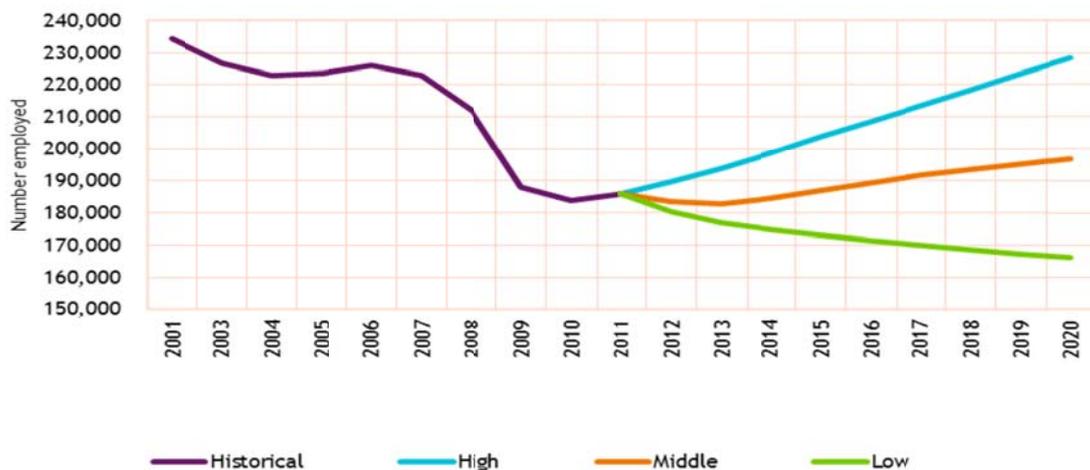
A set of three scenarios for possible future employment was developed to inform the occupational analysis and future skills needs of the sector, and to inform this strategy²⁹⁴:

- High is the “Competitive Manufacturing” scenario, which represents the Action Plan for Jobs 2012 (APJ 2012) projections up to 2016 and continues the APJ 2012 trend to 2020. It sees a potential increase in direct net employment of 43,000;
- Low represents a “Continuing Loss of Manufacturing” scenario and a potential loss in direct net jobs of 20,000. Gross Job Gains are 85 per cent of APJ, and job losses are (averaged across subsectors) 7.5 per cent of previous year employment; and
- Middle has Gross Job Gains at 92.5 per cent of APJ, and job losses at 5.75 per cent of previous year employment and estimates approximately 11,000 net job growth.

In developing the scenarios, the model disaggregated manufacturing into seven sectors. In summary:

- The assumed future employment is positive for Medical Technologies, Food and Drink, Engineering and better than the manufacturing sector average;
- ICT and Pharmachem are assumed to be around the manufacturing average in terms of future employment potential; and
- Consumer Products and ‘other’ are assumed to be below the manufacturing average.

Manufacturing Employment Scenarios to 2020



Source: Analysis Based on Forfás Annual Survey Manufacturing Employment Data

²⁹⁴ See also complementary report Future Skills Requirements of the Manufacturing Sector to 2020, EGFSN, 2013

Appendix III

Employment Data Sources

There are many sectors involved in manufacturing activities and there is also a number of different data sources for employment and output. In terms of employment, the CSO reports on manufacturing activity in the **whole economy**. CSO generally classifies a firm as *manufacturing* based on the output of the firm. Manufacturing is a sub-category within Industry. Industry includes activities such as mining and quarrying as well as utilities (energy, water, waste). The Forfás Annual Employment Survey (AES) reports on manufacturing companies that are **assisted by the enterprise development agencies** (IDA Ireland, Enterprise Ireland and Údarás na Gaeltachta).

The following table sets out the main sources of employment numbers used in this report. Firms that employ less than ten people, that are locally trading are not categorised within agency supported firms, although they may have received either advisory and/or grant aid as a start-up through the City and County Enterprise Boards.

	Employment
CSO QNHS Q3 2012 - economy wide employment in Manufacturing	
Total Industry (<i>Q3 2012</i>)	231,100
Manufacturing plus mining and quarrying, plus energy, water & waste	
Of which, Manufacturing	205,700
Agency Assisted Firms (Forfás, Annual Employment Survey 2012)	
Total Industry (<i>2012</i>)	197,100
Of which, Manufacturing	186,000
Manufacturing, of which:	
Irish-owned firms	51 per cent
Foreign-owned firms	49 per cent
Number of manufacturing plants, of which:	4,042
Irish-owned	3,515
Foreign-owned	527
Non-Agency Assisted Firms	
Manufacturing (using CSO Q3 2012 minus AES 2012 - derived by Forfás)	19,700

Note: to calculate the employment for non-agency assisted firms, the latest employment figure for agency-assisted firms was deducted (for the year 2012, 186,000) from the 2012 total manufacturing employment figure from the CSO QNHS Q3 2012 (205,700).

Appendix IV

Funding Environment for Manufacturing Firms

Available Source of Financing &/or Support/Initiative	Applicable to	Comment
Tax Environment		
Corporation Tax Rate 12.5%	All companies ²⁹⁵	Transparent headline rate - internationally competitive
Corporation Tax Relief - Start-ups	Companies for first 3 years trading (after 1/1/09)	Since 2011, linked to amount of employers' PRSI paid and carry forward beyond first 3 years of trading introduced in Budget 2013
Tax depreciation (wear & tear capital) allowances: Plant & Machinery, Certain intangible assets and Industrial Buildings	All enterprises	Generally over an 8 year period at 12.5% of the capital expenditure incurred
R&D Tax Credit : includes R&D related buildings, Plant & Machinery	All enterprises	Additional 25% tax credit on eligible R&D expenditure
Accelerated Tax depreciation for Energy-Efficient Equipment	All companies	Entire allowance can be claimed in the first year Subject to claw-back - resale/ceased use
Exemptions thresholds for VAT at €75,000 goods and €37,500 for services	Start-ups and micro firms	
Seed Capital Scheme (SCS): Refund of income tax for individual on taking up employment (1yr+) with newly incorporated company and acquires 15%+ share capital	Newly incorporated companies	Subject to State Aid rules
Employment & Investment Incentive Scheme (EIS): Income tax relief for investors in companies involved in certain corporate trades.	Companies involved in certain corporate trades	Subject to State Aid rules
Debt Financing		
Banks : Overdraft - agreed limit on a current account, supports day-to-day cash flow	All firms	Bank lending is a central element of the funding environment

²⁹⁵ That is, a Limited company or PLC. In 2010 about 63 per cent of manufacturing firms in Ireland were either Ltd companies or PLCs, of the remainder, 32 per cent are individual proprietorships and 5 per cent other legal forms of ownership (CSO, *Business Demography*)

Available Source of Financing &/or Support/Initiative	Applicable to	Comment
<p>demands</p> <ul style="list-style-type: none"> ▪ Business Loans: repaid by the business by way of regular repayments with interest over an agreed term - typically between 3-15 yrs ▪ Leasing & Hire Purchase (Asset Finance): lender purchases asset and hires it out for a fixed time (3-5 yrs) at an agreed rental rate - means no full payment up-front. ▪ Invoice Discounting: helps overcome cash flow issues by giving immediate access to a pre-determined percentage of invoiced debt ▪ EIB Loan Scheme: provides competitively priced medium term funding for SME business expansion projects - available from some Irish Banks 		<p>There was a strong reliance on debt funding from banks prior to financial crisis. Now equity financing is growing in importance with 'shares and other equity' the main source of funds for Irish non-financial corporations (SMEs) since Q3 2009 (SAFE Survey and Central Bank Research)</p> <p>Consultations have highlighted the increasing level of security/guarantees required of companies when entering leasing agreements with banks e.g. Debenture + Life Assurance + Asset itself.</p> <p>Banks considered to be overly risk averse in relation to leasing, cash-flow lending and business loans</p>
<p>Micro Finance Fund : €40million in additional lending over the next five years to firms <10, (an additional €50million of lending over a further five years at that point).</p>	<p>Companies with 10 employees or less (micro-enterprises)</p>	<p>The Microfinance Scheme will only be available to microenterprises who have been refused bank credit</p>
<p>Partial Loan Guarantee Scheme</p>		<p>The maximum guaranteed part of the underlying loan does not exceed €1.5 million, to comply with the €200k de minimis threshold</p>
<p>EI supports indigenous companies by means of redeemable preference shares (effectively a repayable loan)</p>	<p>Established EI clients undergoing expansion</p>	<p>Governed by Regional Aid Guidelines</p>
<p>Equity²⁹⁶</p>		
<p>Friends, Family & Founders: EIS Scheme above relevant on incorporation of the business</p>	<p>Companies at pre-seed - proof of concept /beyond</p>	<p>Most often informal, very important for firms <5yrs old</p> <p>Current financial/economic crisis has increased aversion to risk</p>

²⁹⁶ Equity refers to both 'private equity' provided to private companies whose shares are not freely tradable in any public stock market; and 'public equity' which relates to investments in companies whose shares are quoted on some form of stock exchange. The State has played a role as investor/co-investor in private equity investments

Available Source of Financing &/or Support/Initiative	Applicable to	Comment
<p>Business Angel: Halo Business Angel Partnership Programme - joint initiative of ITI and EI, plus the BICs - invested in 33 companies/€10m in 2011</p>	<p>Mainly companies at pre-seed to first round</p>	<p>Ireland has a small angel network in international terms but compares well to other small countries. It ranks highly in terms of no. of deals per Group/Syndicate</p> <p>Early stage start-ups are often unwilling to access equity based on fears of losing control of the business</p> <p>Current financial/economic crisis has increased aversion to risk</p> <p>High degree of co-investment with EI, Seed Funds and HBA investors</p>
<p>Seed Funds & Venture Capital:</p> <ul style="list-style-type: none"> ▪ EI Competitive Start Fund - max State investment available is €50,000 for a 10% equity stake. Requires €5k investment by promoter. Focused addressing a critical early stage funding gap for young start-ups. ▪ EI HPSU offers State equity investment on a co-funded basis to innovative high growth potential start-ups ▪ EI Seed & VC Funds - EI investment to stimulate the VC industry in Ireland. Under 2007-12 Seed & VC Scheme EI commitment is €175m in 7 VC and 4 Seed Funds. Over 40 investments made in 2011 and similar expected in 2012 ▪ Innovation Fund Ireland - est in 2008 with EI and NPRF each committing €125m to attract high calibre global VCs to est a presence in Irish VC market. Three VCs attracted to date - involving EI investment of €25m and equivalent by the VCs ▪ The NPRF is developing a SME Equity fund to support private equity investment (Non-VC) in Ireland 	<p>Mainly companies from seed stage onwards (seed and first round)</p>	<p>HPSU investment ceiling applies: up to €1m (Dublin & MidEast) and €1.25m (BMW, SE & MW)</p> <p>Since 1994 EI has committed over €300m to leverage a further €900 in Seed and VC funds</p> <p>Although Irish VC market is relatively well developed it faces a funding challenge in the near term. Given weak returns and turbulence in financial markets, encouraging investors to invest in VC funds is likely to remain a challenge. Continued State involvement post 2012 will require review of market failure justification (Forfás)</p>
<p>Growth/Risk Capital (VCs, Private Equity, State Investment):</p> <p>EI Development Capital Fund - seeking to</p>	<p>Developing & expanding companies post Second and</p>	<p>The Development Capital Fund aims to increase availability of risk capital and close the 'equity gap' experienced by SMEs seeking risk capital in excess of €2m. Regeneration of</p>

Available Source of Financing &/or Support/Initiative	Applicable to	Comment
make commitments to fund managers willing to provide equity, quasi equity or debt of between €2m and €10m to established investee companies	subsequent rounds	existing businesses, including family businesses also falls within the scope of the initiative
Corporate Venture Capital: <ul style="list-style-type: none"> ▪ Generally a minority stake by non-financial corporations for financial return and strategic business development reasons (innovation). Some operating in Irish environment: Intel Capital, J&J, IBM, Abbott, Shire 	Mainly from seed-stage through to second round	<p>State has not intervened in this sector.</p> <p>CV could be encouraged into the deal-flow environment of the EI supported S&VC funds - to increase funding, facilitate scaling and provide a potential exit mechanism for the State.</p>
Initial Public Offering: Sale or distribution of a company's shares to the public - used to raise growth or expansion capital	Developing & expanding companies post Second and subsequent rounds	<p>The Irish Stock Exchange provides a market for companies to raise capital in Ireland.</p> <p>The level of IPO activity in Ireland is relatively low</p> <p>The Irish Stock Exchange experienced a significant drop in market capitalisation since 2007 (Forfás equity paper)</p>
Trade Sale: Sale of company shares to industrial investors (also referred to as mergers and acquisitions)	Developing & expanding companies post Second and subsequent rounds	Trade sales play an important role in the development/growth of a company - can also be used as an exit strategy for investors (VCs etc.). The majority of VC exits in Europe are through trade sales (41.2% in 2010). 12% of the HPSUs supported over the 1989 to 2011 period were acquired (trade sale).
IDA Regional Aid: Regional Aid is used to support an investment in capacity building - capital and employment grant aids	Foreign owned firms (ITS and manufacturing)	Operates under EU Regional Aid Guidelines
Enterprise Ireland - Regional Aid: <ul style="list-style-type: none"> ▪ EI supports expansion of established companies via 'Job Creation', 'Capital Assets', 'Tech Acquisition' and 'Environmental capital projects' by means of Redeemable Preference Shares or Grants. 	Indigenous established companies	Operates under EU Regional Aid Guidelines
County Enterprise Boards (LEOs) Financial grant aid - employment and capital	Start-ups and micro firms	

Available Source of Financing &/or Support/Initiative	Applicable to	Comment
Research and Development Funds includes eligible expenditure on relevant R&D buildings, plant and machinery (EI, IDA and CEBs)	Manufacturing and ITS	Subject to certain limits governed by the EU RD&I Guidelines. Grant intensities are determined by the nature of R&D being undertaken as well as scale of the global entity

Source: The Irish Enterprise Funding Environment, Forfás, 2012; A Review of the Equity Investment Landscape in Ireland, Forfás, 2013; company and enterprise agency consultations

Appendix V

State Investments in R&D to Support Innovation in Industry

The following tables set out the existing Centres supported by the agencies of the Department of Jobs, Enterprise and Innovation - many of which are involved in R&D that is of direct relevance to manufacturing (or to firms based in Ireland that are currently involved primarily in manufacturing) whether in terms of the platform technologies and/or sector specific focus. The Centres differ in terms of scale, focus and proximity to market of their research activities.

The Centres for Science, Engineering and Technology (CSETs) are supported by SFI and are engaged in R&D that is oriented toward user needs. The Strategic Research Clusters (SRCs) stimulate multi-disciplinary, multi-research institute collaboration on R&D and are generally of a smaller scale than the CSETs. These Centres/Clusters engage with industry in a range of activities including formal collaborative R&D partnerships, information dissemination, seminars etc.

The Technology Centres programme (formerly Competence Centre) is a joint agency supported initiative. The Centres undertake R&D that has been defined by industry - the agencies facilitate companies to come together and collaborate to identify the areas/industry problems which can be addressed through the R&D Technology Centres.

Enterprise Ireland has supported Applied Research Enhancement Centres and is in the process of launching a call for its successor programme, Gateway Centres. These regionally based Centres aim to collaborate with industrial partners to introduce innovative technological solutions through a dedicated applied research strategy.

CSET	Acronym	Lead
Alimentary Pharmabiotic Centre	APC	UCC
Biomedical Diagnostic Institute	BDI	DCU
CLARITY (Sensor Web Technologies)	CLARITY	UCD
Next Generation Localisation (Software)	CNGL	DCU
Centre for Research on Adaptive Nanostructure & Nanodevices	CRANN	TCD
Telecommunications Research Centre (Software focused)	CTVR	TCD
Digital Enterprise Research Institute (Semantec Web)	DERI	NUIG
Irish Software Engineering Research Centre	LERO	UL
Systems Biology Ireland	SBI	UCD
Regenerative Medicine Institute	REMEDI	NUIG

Strategic Research Cluster	Acronym	Host Institute
Advanced Biomimetics for Solar Energy Conversion		UCD
Functional Oxides and Related Materials for Electronics	FORME	Tyndall
ICT for Sustainable and Optimised Building Operation	ITOBO	UCC
Irish Drug Delivery Research Network	IDDN	UCD
Network of Excellence for Functional Biomaterials (NFB)	NFB	NUIG
Photonics - Integration "From Atoms to Systems" (PiFAS)	PIFAS	Tyndall
Reproductive Biology Research Cluster		UCD
Solid State Pharmaceuticals Cluster	SSPC	UL
Immunology Research Centre	IRC	TCD
Alimentary Glycoscience Research Cluster	AGRC	NUIG
Clique (Graph and Network Analysis)		UCD
Federated, Autonomic Management of End-to-end Communication Services	FAME	WIT
Financial Mathematics Computation Cluster	FMC ²	UCD
Irish Separation Science Cluster		DCU
Molecular Therapeutics for Cancer Ireland	MTCI	DCU
Precision (manufacturing applications using plasmas)		DCU
Regenerative Medicine Institute	REMEDI	NUIG
Sustainable Electrical Energy Systems (SEES)	SEES	UCD

Technology Centres (Industry-Led R&D)	Acronym	Host
Irish Centre of Manufacturing Research	ICMR	UL
I2E2 Centre - Energy Efficiency in Manufacturing	I2E2	Intel
Applied Nanotechnology (focused on ICT and biomedical industries)	CCAN	
Materials Surface Science Institute (Composites)	MSSI	UL
Microelectronics Competence Centre Ireland (Radio Frequency System on	MCCI	Tyndall

Technology Centres (Industry-Led R&D)	Acronym	Host
a Chip)		
Competence Centre for Biorefining and Bioenergy	TCBB	NUIG/UL/UCD
Food for Health Ireland	FHI	UCC
International Energy Research Centre	IERC	Tyndall
IT Innovation Competence Centre		NUIM

Technology Centres currently in development include those focused on: Medical Device Manufacturing; Drug Production; Learning Technologies; Connected Health, Data Analytics, Cloud and Financial Services. The development agencies work with firms who collaborate to define specific research needs.

A new call is being issued by Enterprise Ireland for Gateway Centres that will succeed the existing AREs, and will strengthen regional connections into a national network of R&D capabilities.

Applied Research Enhancement Centres	Acronym	IoT
Ion Channel Biotechnology Centre	ICDC	Dundalk
Shannon Applied Biotechnology Centre	Shannon ABC	Limerick / Tralee
Pharmaceutical & molecular Biotechnology Research Centre	PMBRC	WIT
Centre for Research in Engineering Surface Technology	CREST	DIT
Micro Sensors for Clinical Analysis	MICRA	Tallaght
South Eastern Applied Materials Research Centre	SEAM	WIT
Centre for Advanced Photonics and Process Control	CAPPA	Cork IT
Medical Engineering Design and Innovation Centre	MEDIC	Cork IT
Wireless Sensor Applied Research	WiSAR Lab	Letterkenny IT
Centre for Affective Solutions for Ambient Living Awareness	CASALA	Dundalk IT
TSSG Innovation and Commercialisation Centre	TSSG	WIT
Technologies for Embedded Computing	TEC	Cork IT
Seamless Use through Network Abstraction Technologies	SUNAT	Athlone

Appendix VI

Priority Investments in Infrastructures for Manufacturing Companies

Roads

There are a number of bottlenecks around the country that if addressed in the immediate term will allow the full benefits of the significant investment in road and other infrastructures already made to be fully captured. Priorities are:

- Cork-Galway ring roads;
- Atlantic Corridor; (Gort-Tuam and Croom/Mallow);
- N28 Cork-Ringaskiddy upgrade;
- N22 Macroom/Ballyvourney bypass.

Source: Overview of Main Infrastructure Issues for Enterprise, Forfás 2012

Ports

The review of ports policy (2012) is of paramount importance. In particular, the strategy which emerges from this review must (i) ensure that Irish ports are market focused; (ii) encourage and facilitate investment; and (iii) promote competition²⁹⁷.

In the long term, deep water facilities at Irish ports need to be developed to accommodate the international trend toward larger shipping vessels and ensure that Irish importers and exporters continue to have access to a wide range and frequency of port services at competitive prices. Consideration should also be given to creating the regulatory environment to develop Ireland's potential as an entrepot port (e.g. setting out a clear framework ensuring port companies are autonomous and commercial companies).

Responsibility: Department of Transport

Source: Costs of Doing Business 2012, Forfás & Overview of Main Infrastructure Issues for Enterprise, Forfás 2012

Energy

A reliable and competitively priced supply of energy is vital for business and its ability to compete successfully in international markets. From a national competitiveness perspective, the challenge facing Ireland is to reduce energy costs while delivering on our security of supply and environmental sustainability objectives.

Following much debate on whether high tension cables should be placed underground or overhead, Government recently issued a policy statement which reiterates the strategic importance of

²⁹⁷ The Minister for Jobs, Enterprise and Innovation has requested that the Competition Authority carry out a study of the ports sector in Ireland. Amongst the objectives of the study, the Competition Authority has been tasked with examining: the level of competition between ports in the State and the effect of specialisation; the impact of competition from ports in Northern Ireland; how competition works within the State's major ports; the impact of competition of developments in other transport modes in Ireland and developments in shipping internationally; and the likely impact of changes in port ownership and structures

energy infrastructure investment to meet future economic and social goals²⁹⁸. There is a need to assess the effectiveness of the Government statement on the strategic importance of energy infrastructure in delivering key projects in a timely fashion. Delays in completing the North-South electricity interconnector are negatively affecting the efficient functioning of the Single Energy Market and are estimated to be costing approximately €20-30 million per annum, which means higher costs for Irish electricity consumers²⁹⁹. Placing high-tension transmission lines overhead, as opposed to underground, provides a technically superior solution at a fraction of the cost to all energy users³⁰⁰.

The policy statement provides clarity for planning authorities to ensure the timely delivery of that infrastructure while also addressing social acceptance issues. It is critical that the effectiveness of the provisions set out in the Government statement are assessed in due course to ensure that the significant energy infrastructure investment (e.g. north-south interconnector, proposed Grid Link project) needed to support future growth and competitiveness is being delivered in a timely and cost allocative fashion.

Responsibility: Department of Communications, Energy and Natural Resources

In spite of Ireland's ambitious plans to increase the use of renewable energy sources, Ireland's reliance on gas as a primary fuel source for electricity generation is likely to continue in the medium to longer term.

It is critical that the new energy policy framework to be developed by the Department of Communications, Energy and Natural Resources later this year facilitates the development of gas storage and new and diverse sources of gas (e.g. fracking) to ensure that Ireland has a cost-effective, secure and diverse electricity fuel mix in the future.

Responsibility: Department of Communications, Energy and Natural Resources

Source: Costs of Doing Business 2012, Forfás

²⁹⁸ Government Policy Statement on the Strategic Importance of Transmission and Other Energy Infrastructure, Department of Communications, Energy and Natural Resources, July 2012

²⁹⁹ The Action Plan for Jobs 2012 required Government to develop an awareness campaign by Q2 2012 to highlight the implications of delays in rolling out infrastructure for regional development and local job creation. According to the progress report for Q2, this has been completed. In July, the Government published a statement communicating the vital importance of the timely delivery of network investment and other energy infrastructure for national energy security, economic competitiveness, regional development and job creation. The awareness campaign will be largely based on the public confidence building measures already devised by EirGrid in relation to progressing GridLink and GridWest

³⁰⁰ See Section 3.1 of Forfás, Review of Energy Competitiveness Issues and Priorities for Enterprise, December 2011

Appendix VII

Country Comparators - A Brief Review

Many other developed countries are reassessing the importance of manufacturing within their economies in light of global drivers of change and in the context of the global economic crisis. An increasing number of countries have introduced programmes and policy instruments to support the competitiveness, productivity and innovation capacity of their manufacturers. In order to inform this manufacturing strategy for Ireland, a review was undertaken of a small number of countries³⁰¹. The countries selected included a number of EU countries (where interventions are informed by the same EU State Aid guidelines) as well as the US and China (See table 2 overleaf).

Common Challenges for Manufacturing

Although the five comparator countries diverge in terms of scale, geography, technological intensity, productivity and the levels of affluence, it is interesting that a number of common challenges were identified, including:

- The need to encourage greater value add in manufacturing through investment in RD&I to enhance productivity - indicating that this remains a challenge even for the more technologically advanced countries/manufacturing sectors, and that the pace of change requires a continuous focus on this area;
- SME manufacturers are less likely than larger ones to implement new technology, to adopt modern manufacturing processes, to invest in worker training, to adopt new forms of work organisation or to deploy improved business practices. However, Germany's Mittelstand appear to be somewhat distinctive, having come from a long tradition of engineering with embedded skills sets in Lean principles and processes improvements³⁰²; and
- A reticence on the part of recent graduates to go into manufacturing, which exacerbates current skills gaps. This reticence appears to exist even in cases where the Government has restated its commitment to, and its acknowledgement of, the importance of manufacturing to its economy.

It is likely that each of these is experienced in different ways and to a different extent in one country when compared to another - nevertheless the common themes prevail. The analysis also reinforces that the challenges facing the manufacturing sector in Ireland are not peculiar to it. However, in Ireland's case they are perhaps exacerbated in the face of high levels of unemployment, the relative high costs of doing business and challenges in accessing finance.

³⁰¹ Manufacturing Sector, Country Comparators Analysis, RSM MCCLure Watters, 2012 (unpublished, commissioned by Forfás)

³⁰² Technische Hochschulen deliver advanced technical and engineering apprenticeship programmes, demonstrating (and enhancing) the absorptive capacity within firms to identify, develop and embed relevant research and development

Table 2 Country Comparators - A Brief Synopsis

Country	Characteristics	Areas/Sectors of Strength
Germany (Bavaria)	<p>The largest manufacturing power in Europe with distinctive engineering capabilities (mechanical, electrical and chemical) and strong Mittelstand (Mid-tier) companies supported by a well-developed and mature national innovation/support system (<i>including Fraunhofer Institutes and Steinbeis - see detail on next page</i>).</p> <p>Bavaria's regional innovation policy is based around thematic areas of funding focused on traditional industries and on cross sectoral technologies such as laser, microsystems, mechatronics and new materials, as well as nano-technologies, ICTs and biotechnology.</p>	<p>Automotive</p> <p>Electrical Engineering</p> <p>Machinery</p> <p>Chemical/Pharmachem</p>
UK (Wales and Scotland)	<p>Focused on transforming their manufacturing sectors and with a long tradition in Food and Drink. Core competences in light engineering and chemical engineering are being applied to 'newer' areas in which, until recently, both countries had primarily academic expertise.</p> <p>The main challenge to the sector is the low level of productivity which affects the majority of UK manufacturing.</p> <p>Parts of Wales have an advantage in terms of its ability to provide grant aid at higher intensity levels than many more developed EU regions (including Ireland) as they are designated 'disadvantaged' regions in the context of EU State Aid guidelines.</p> <p>Scotland has recently successfully attracted a Fraunhofer Institute which will provide support to the photonics sector.</p>	<p>Food & Drink</p> <p>Photonics</p> <p>LifeSciences</p> <p>Renewable Energy</p> <p>Advanced Materials and Manufacturing Technologies</p>
Finland	<p>Highly innovative, with a population size similar to Irelands with many examples of companies from the high tech and other manufacturing related sectors that have experienced high growth.</p> <p>Until the '90s was dominated by chemical engineering and wood/timber production. Developed expertise in ICT/mobile telephony. Now building on core production methods and strengths in newer areas such as clean tech and energy efficiencies.</p> <p>A key challenge is to encourage manufacturing</p>	<p>ICT infrastructures, products/ services</p> <p>Food</p> <p>Cleantech</p> <p>Efficient utilisation of energy and raw materials</p> <p>Chemicals</p>

Country	Characteristics	Areas/Sectors of Strength
	businesses to export more, and this is supported by continued investment in innovation and a number of export support initiatives.	
US (Massachusetts)	<p>Distinctive capabilities in heavy engineering and the chemical industry - 'traditional' strengths that are being applied to smaller scale emerging sectors such as renewables. Massachusetts has long had a history of innovative approaches to economic development, which have more in common with European industrial policy rather than the generally more laissez faire approach common to other US States.</p> <p>The US has recently restated its commitment to manufacturing.</p>	<p>Fabricated Metal Products</p> <p>Machinery</p> <p>Electrical Equipment</p> <p>Chemicals</p> <p>Plastics</p> <p>Textile Mill Products</p>
China	<p>Large scale manufacturing operations and has developed preliminary capabilities in key high growth sectors. Much of its previous cost advantages are being eroded due to increased labour, energy and transportation costs.</p> <p>China adopts an all-encompassing State Plan - the National S&T Development Plan 2011-2015. It supports manufacturing through direct financial assistance and procurement. The Chinese Government has developed a number of sectoral clusters. These are still at a formative stage and are mainly concerned with dispersing best practice and the promotion of imitative technologies.</p> <p>China is of interest as a competitor that is advancing in terms of the aim to move into high technology/innovative sectors, as a potential FDI source and as a key emerging market.</p>	<p>IT - new generation</p> <p>Biotechnology</p> <p>Energy/environmental efficiencies</p> <p>High end equipment manufacturing</p> <p>New materials</p> <p>New energy vehicles</p>

Key Findings - Policy Approaches

There are a number of overarching findings of interest arising from the review of other countries' strategies and policies - in general:

- The areas of strengths set out in the comparator countries strategies and/or policy documents encompass both vertical sectors as well as horizontal enabling technologies which address constraints in the wider manufacturing sector in the relevant country (e.g. novel materials, ICTs). The analysis also indicates that assistance provided to manufacturing is not limited to the key sectors identified;
- There is a growing awareness of the need to move away from a siloed or sectoral approach which traditional clusters typically involve and toward more cross sectoral working. Cross

sectoral collaboration and linkages are supported by way of a light touch facilitative approach (as is the case in the UK and US) or a more formalised and structured approach (as is the case in Germany);

- What is also interesting is that countries build upon core skills and capabilities to capture opportunities in 'newer' sectors including, for example, environmental products and technologies; At the same time, Wales manufacturing sector appears to have suffered from a lack of continuity in government strategies over the years since 2002 that each set out different areas of sectoral focus³⁰³;
- Countries are increasingly focused on stimulating collaboration between firms and their HEI research institutes. Germany is an excellent example of a mature national innovation system that offers a range of basic and applied research capabilities to serve the needs of industry and firms of all sizes - although it is also true to say that the absorptive capacity in German firms is well developed; and
- Innovation is a core element and a recurring theme for enterprise and manufacturing policies and strategies - involving product, process, organisational innovation and technology adoption.

Interventions of Interest

In common with other European countries, Ireland offers a full range of comparable interventions to support manufacturing. Neither China nor the US offer the full range of interventions delivered in European countries. This reflects both the American laissez faire tradition and the evolving nature of Chinese economic development (Table 3).

However, although each of the areas for intervention appears to be well covered, there are a number of interventions that would be of interest to Ireland, particularly in terms of technology deepening in what may be regarded as more traditional manufacturing sectors, and in terms of engaging SMEs in RD&I activities. Not surprising is that Germany features high as an exemplar:

- The **Industrielle Gemeinschaftsforschung** programme brings together consortia of companies from the same industry to perform pre-competitive research relevant to specific industry problems. This appears to be similar to the approach being taken here to develop a Definition of Needs to inform the R&D focus of Technology Centres such as Food for Health Ireland (FHI), Microelectronics Circuit Centre Ireland (MCCI) or the Medical Device Manufacturing Centre that is in development. However, the success of the German programme has been on applying high technology solutions to the emerging needs of what is termed the lower technology sectors - a strategy that has sustained Mittelstand companies through continuous productivity improvements.
- Germany also operates a number of **Steinbeis Centres**. These represent a technology extension programme that seeks to transfer existing know-how in education and industry and helps SMEs to access expertise and new technology through cooperative projects, consulting, technical assistance and training. Technical services are delivered through semi-autonomous technology centres located primarily at polytechnic universities of applied sciences. The Steinbeis Centres are aimed at those companies which have the lowest absorptive capacity and need to embed basic process innovation in the first instance.
- Germany's 58 **Fraunhofer Institutes** bring businesses and universities together to conduct industrially relevant translational research in a specific advanced technology area. They

³⁰³ A Winning Wales, 2002: Wales: A Vibrant Economy, 2005: Economic Renewal : A New Direction, 2010

perform applied research that translates technologies into commercial products. The Fraunhofer Institutes use structured processes to identify areas of technology of relevance to industry³⁰⁴ and the short and longer term demands of the contract research market. Circa 60 per cent of their funding is achieved through contract research earnings. They conduct trials in demonstration centres equipped with state-of-the-art test facilities.

Table 3 An Overview of Interventions Provided in Other Countries

Category	Service	US	UK	China	Finland	Germany	Ire
Technology Acceleration Programmes and Practice	Promote technology Adoption by SMEs	X	X		X	X	X
	Provide Audits of SMEs' Lean Manufacturing and Innovation, Processes and Skills	X	X	X	X	X	X
	Business Advisers work Hands on with SMEs to Improve Manufacturing and Process Techniques	X	X		X	X	X
	Support Technology Transfer and Commercialisation	X	X	X	X	X	X
	Promote Technology/Knowledge Diffusion from Universities	X	X		X	X	X
	Perform R&D in direct partnership with SMEs	X	X		X	X	X
	Provide access to research labs/prototyping facilities	X	X		X	X	X
	Get SMEs into Manufacturing/Technology Consortiums		X		X	X	X
	Provide SMEs Direct R&D Funding grants		X	X	X	X	X
Technology Acceleration: Funding Mechanisms	Provide SMEs Loans to Scale/Grow Business		X	X	X	X	
	Use Innovation Vouchers		X		X	X	X
	Fund Joint Pre-Competitive Research Programmes		X		X	X	X
	Teach Innovation and New Product Development Skills	X	X		X	X	
Next generation: Manufacturing Technical Assistance	Provide SMEs Export Assistance and Training	X	X	X	X	X	X
	Promote Energy Efficient Manufacturing Skills	X	X		X	X	X
	Provide Assistance with standards	X	X		X	X	X

³⁰⁴ Fraunhofer Institutes operate in seven working alliances including ICTs, Materials and components, Nanotechnology, Surface Technology and Photonics, Defence and Security, LifeSciences and Microelectronics

	Teach Role of Design in Manufacturing ³⁰⁵		X		X	X	
Connect SMEs	Act as Broker to Other SME Support Services	X	X		X	X	X
	Host Best Practice Events	X	X	X	X	X	X

Source: Manufacturing Sector, Country Comparator Analysis, RSM McClure Watters, 2012 (Unpublished)

³⁰⁵ With the exception of BioInnovate, NUIG, focused on the medical devices sector

Appendix VIII

Forfás Board Members

Eoin O'Driscoll (Chairman)

Managing Director, Aderra

Martin Shanahan

Chief Executive, Forfás

Mark Ferguson

Director General, Science Foundation Ireland

John Murphy

Secretary General, Department of Jobs, Enterprise and Innovation

Barry O'Leary

Chief Executive, IDA Ireland

Frank Ryan

Chief Executive Officer, Enterprise Ireland

Michael O'Leary

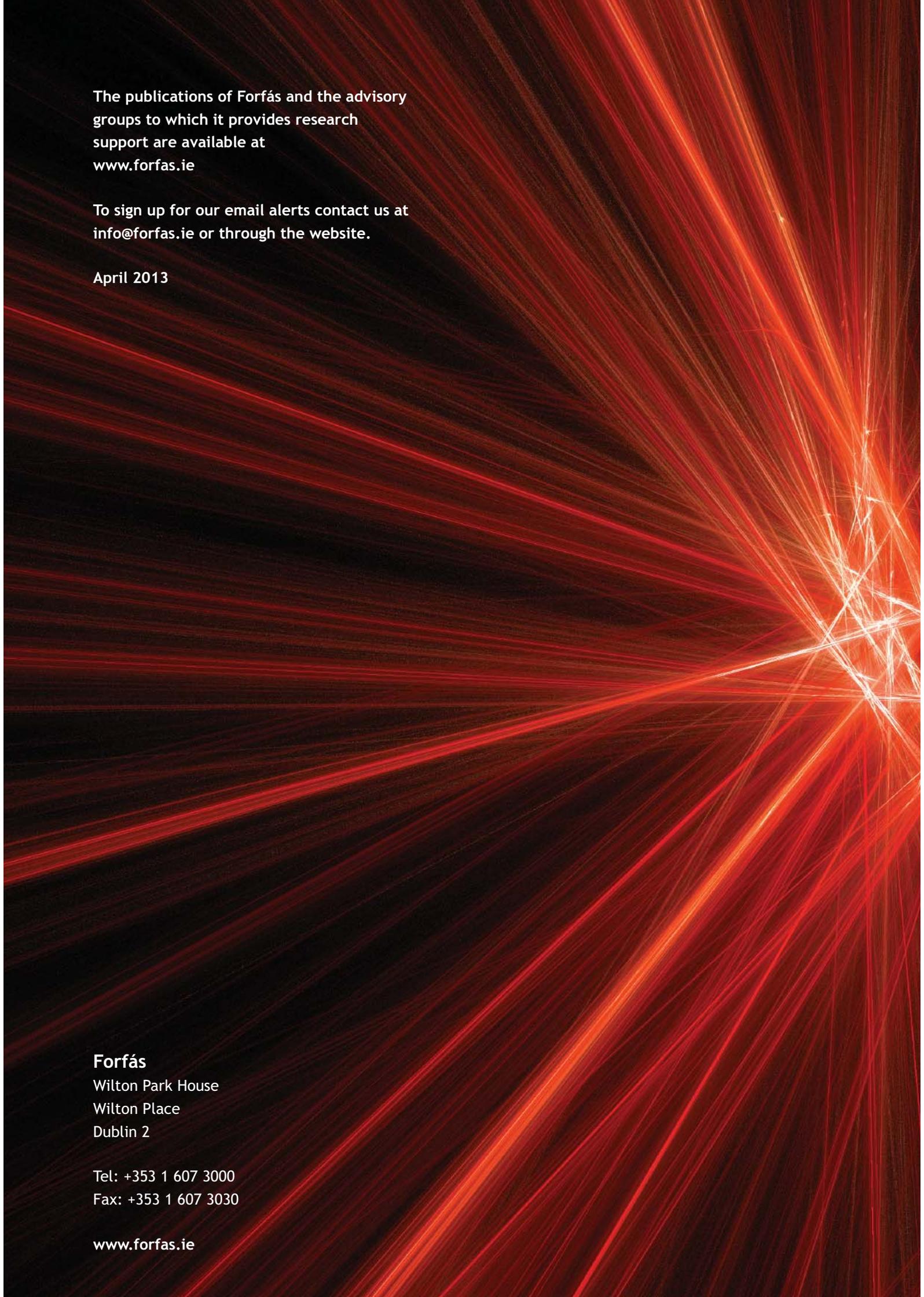
Secretary to the Board, Forfás

Appendix IX

Recent Forfás Publications

Sectoral Regulation: Study to Identify Changes to Sectoral Regulation to Enhance Cost Competitiveness Forfás	April 2013
EGFSN Statement of Activity EGFSN	March 2013
Costs of Doing Business in Ireland 2012 Forfás	March 2013
Vacancy Overview 2012 EGFSN	February 2013
Action Plan for Jobs 2013 Forfás, DJEI	February 2013
A Review of the Equity Investment Landscape In Ireland Forfás	January 2013
Regional Labour Markets Bulletin 2012 EGFSN	January 2013
A Review and Audit of Licences Across Key Sectors of the Irish Economy Forfás	December 2012
Global Entrepreneurship Monitor (GEM) 2011 Global Entrepreneurship Monitor	September 2012
Annual Employment Survey 2011 Forfás	August 2012
National Skills Bulletin 2012 NCC	July 2012
Monitoring Ireland's Skills Supply - Trends in Education and Training Outputs 2012 EGFSN	July 2012
Ireland's Competitiveness Scorecard 2012 NCC	July 2012

Forfás Annual Report 2011 Forfás	July 2012
Key Skills for Enterprise to Trade Internationally EGFSN	June 2010
Sustainability of Research Centres ACSTI	June 2012
The Science Budget 2010-2011 Forfás	June 2012
Annual Business Survey of Economic Impact 2010 Forfás	June 2012
Overview of the Main Infrastructure Issues for Enterprise Forfás	May 2012
Ireland's Productivity Performance, 1980 - 2011 NCC	May 2012
Community Innovation Survey 2008-2010 Forfás, CSO	April 2012
The Irish Enterprise Funding Environment Forfás	April 2012
EGFSN Statement of Activity 2011 EGFSN	April 2012
Playing our Part: Statement on Horizon 2020 ACSTI	March 2012
Report of the Research Prioritisation Steering Group Research Prioritisation Steering Group, DJEI, Forfás	March 2012
Vacancy Overview 2011 EGFSN	February 2012
Guidance for Higher Education Providers on Current and Future Skills Needs of Enterprise Forfás	February 2012



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