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Internal Market and Consumer Protection

How can European industry contribute to growth and foster European competitiveness?

Study for the ITRE Committee

EN

2014

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DIRECTORATE GENERAL FOR INTERNAL POLICIES

POLICY DEPARTMENT A: ECONOMIC AND SCIENTIFIC POLICY

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STUDY

Abstract

This paper, produced by Policy Department A for the ITRE Committee, describes, analyses, and recommends options as to how European industry can contribute to sustainable growth and competitiveness in the EU. It reviews factors that influence growth and competitiveness, and links case studies from European industry to related barriers and enablers. It presents recommendations for framework conditions that public authorities can influence in order to promote European industry in repositioning itself globally. Finally, the paper then presents relevant case studies in full.

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CONTENTS

LIST OF ABBREVIATIONS

B2B	Business to Business
B2C	Business to Consumer
BRIC	Brazil, Russia, India, China
CAGR	Compound Annual Growth Rate
DoP	Declaration of Performance
CPR	Construction Products Regulation
DoP	Declaration of Performance
DMC	Domestic Material Consumption
EEE	Electrical and Electronic Equipment
EFFRA	European Factories of the Future Association
EIB	European Investment Bank
EIT	European Institute of Innovation and Technology
ESCO	Energy Service Company
ESF	European Social Fund
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
hEN	Harmonised European Standard
HLG	High Level Group
HRM	Human Resource Management
HRST	Human Resources for Science and Technology
ICT	Information and Communication Technology
IoE	Internet of Everything
IoT	Internet of Things

ITRE	Committee on Industry, Research and Energy
KETS	Key Enabling Technologies
KIC	Knowledge Innovation Communities
M2M	Machine to Machine
ME	Mechanical Engineering
MOOC	Massive Open Online Course
OEM	Original Equipment Manufacturer
PCT	Patent Cooperation Treaty
PPP	Public-Private Partnership
QR (code)	Quick Response (code)
R&D	Research & Development
RCA	Revealed Comparative Advantage
REFIT	Regulatory Fitness and Performance
RoHS	Restriction of Hazardous Substances
SCM	Supply Chain Management
SMEs	Small and Medium-sized Enterprises
STEM	Science, Technology, Engineering and Mathematics
TTIP	Transatlantic Trade and Partnership Act
UEAPME	European Association of Craft, Small & Medium-sized Enterprises
VET	Vocational Education and Training
WEEE	Waste Electrical and Electronic Equipment
WEF	World Economic Forum
WTO	World Trade Organisation

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EXECUTIVE SUMMARY

Background and objective

The economic crisis of 2008 has led both economists and policy makers in many EU countries to reconsider how manufacturing can drive growth, employment creation and competitiveness in the future. There is also a growing recognition of the connection between manufacturing and services in value added generation and in job creation.

This altered perception of the role of manufacturing has also urged policy makers to take an interest in the basis for a renewed industrial policy and whether additional and complementary measures are needed to ensure a viable long-term strategy for competitiveness in advanced manufacturing in Europe. This forms the background for this study requested by the European Parliament's Committee on Industry, Research and Energy (ITRE).

The study is intended to inform the debate about the current state of the European industry and how it can reposition itself and hereby contribute to growth, employment creation and competitiveness in the European Union. The paper mainly focuses on framework conditions that can be influenced by public authorities, particularly the European institutions, and in some cases at Member State level.

The paper is based on an extensive literature review, interviews with stakeholders, and case studies.

State of play of European industry

The subject of this paper is "industry", which in the context of this report is defined not only as manufacturing, but covering a broader set of activities including also mining and quarrying and energy activities.

European **growth** has lost momentum over time. In 2000, the Euro area demonstrated the same growth rates as the US and the OECD total, and a higher growth rate than Japan. This picture changed during the crisis. Though the European Commission was timely in launching economic recovery plans, the EU had a negative real GDP growth in 2012. It is estimated that the European recovery will remain slow compared to global competitors. There is no single factor that can explain why recovery in European industry is slow to regain momentum. A range of factors must be taken into account such as the aggregate demand, access to financing, barriers to restructuring including investments, and full exploitation of automation and digitalisation technologies for innovation purposes, which in turn has implications for future skills demands.

Human capital: Education and skills

The structural changes in manufacturing are likely to continue beyond the crisis. This will impact future skills demand in manufacturing. In particular advanced automation and digitalisation technologies offer new opportunities to improve productivity and resource efficiency, but could also enable the development of new business models and products with new functionalities and services embedded. This will require a dual skills strategy. It should on one hand focus on the skills of future engineers and scientists so that they can exploit technological advances made in for example material technologies and in nano- and microelectronics. On the other hand, it is necessary to ensure that the workers at the shop floor level have the skills and competences to exploit more intelligent manufacturing platforms fully.

Recommendations:
Comprehensive forward-looking anticipation mechanisms are needed to fully understand the employment and skills impact of the wider drivers of change across manufacturing value chains, and how skills demands and skills supply could play out in different scenarios, much like measures previously implemented within the e-skills action framework.

Access to finance

Due to the crisis, in particular SMEs have experienced difficulties in accessing finance and investment capital, including venture capital, although there are differences across Member States due to differences in national framework conditions and recovery measures implemented. There are also differences in capital markets, and difficulties are particularly evident in sectors where the return on investment is long and/or uncertain.

Recommendations:

More reliable and updated information about the financing situation of SMEs should be provided to relevant national stakeholders through relevant media channels and in collaboration with SME associations. There is a need to match national R&D programmes to ensure that delays in payment from the EU programmes do not become an obstacle to participation in European R&D; there is a need to ensure a European framework for long-term investment capital for SMEs, which must be widely communicated. Furthermore, monitoring mechanisms should be set up for the use, uptake and adequacy of EIB financing instruments.

Inputs and infrastructure

Increasingly, **digital infrastructures** will be the key driver of the next generation of advanced manufacturing. Developments in big data, analytics and use of sensor technologies to monitor production processes, and supply chain interactions and products could gradually transform European manufacturing to a highly information and knowledge intensive industry.

Recommendations:

The upcoming calls under the Factories of the Future initiative in Horizon 2020 includes substantial opportunities to build a strong research and innovation base for integrated digital infrastructures for manufacturing. Much can be done by Member States to ensure wider uptake of these research efforts. Structural funds can be strategically prioritised, and networking arrangements can be established between national and regional initiatives on promoting advanced manufacturing through digital infrastructures and the European Factories of the Future Research Association - which is a PPP aimed to promote an advanced manufacturing agenda for the EU.

Energy: It is a challenge for European policy making to ensure a transformation process towards a harmonised European energy market, which will not have too severe effects on energy intensive industries short term. Setting up a more coherent energy policy in Europe with a view to the creation of a real European energy market is an urgent priority.

Recommendations:

The European Commission can provide strong support to Member States through a range of mechanisms, which can pave the way for an innovative, efficient, and truly smart implementation of the smart grid. This could include a "grid modernisation indicator ranking" with an award structure similar to previous experiences on eGovernment awards. Actions regarding data ownership of consumer data from smart grids could enable consumer driven innovation. The Commission could also play a central role in promoting regulations which require utilities to develop and propose performance-based metrics, which could maximise the value of utility smart grid investments.

The availability and cost of **raw materials** is high on the European agenda. Recycling materials – especially those that are scarce – has the triple benefit of providing new opportunities for the recycling industry, bringing environmental benefits, and reducing scarcity and/or costs of input for the industries for which the materials are relevant.

Recommendations

Recommendations include the development of a long-term action plan for the realisation of a circular economy, including EU-funded initiatives that prioritise circular economy concepts in Smart City initiatives; reassessing current EU regulations on waste against strategies of a circular economy; placing raw material trade high on the agenda in upcoming European trade negotiations; and encouraging further integration of waste streams, their handling and recycling by supporting coordinated action across groups of Member States.

Technological progress and innovation

Technological innovation is critical to the competitiveness of European industry. The EU-27 is trailing behind the US in terms of innovation, and there are major differences in innovation performance among EU Member States. There is less investment in manufacturing R&D in the EU than in the US. However, after years of relative stagnation, the R&D intensity of the EU has been slowly progressing since 2007 to reach 2.03 % of GDP in 2011. This is mainly due to increased public R&D investment during the crisis period, but business expenditure on R&D has also continued to increase in the EU between 2007 and 2011, although at a much slower pace than in the preceding period.

Recommendations:

Recommendations include boosting innovation-oriented procurement in sectors such as health, public security, environment, waste, energy refurbishment of public buildings; and implementing various measures to promote industry-science relations, including encouraging PhDs to take up industrial careers as well as industrial PhD schemes. Schemes to promote small manufacturing companies' engagement on a regular and long-term basis with the formal knowledge system can boost R&D and innovation capacity in SMEs. **Production and value chains:** Lead firms in global value chains tend to concentrate their number of sub-suppliers to control quality. A strategic positioning of SMEs in the value chain as sub-suppliers to leading (global) firms can become a gateway to further internationalisation and opportunities to participate in collaborative R&D and innovation enabled by digital technologies.

Recommendations:

The European Commission and Eurostat could accelerate the potential impact of global value chains at the macro, meso and micro level by developing a comprehensive statistical monitoring framework in cooperation with national statistical offices, also taking into account skills and labour market implications.

Firm creation and growth

Europe is less effective at bringing research to the market compared to its main competitors such as the US, Japan, and South Korea. A lot of factors are at play such as institutional strategies, funding mechanisms and incentives, and profiles of professional staff, which all impact the entrepreneurial culture and the wider support mechanism and hence also the availability of financing for early-stage knowledge-driven companies. Another important issue, relating to the regulatory environment, is the ability for failed entrepreneurs to get a "second chance" and start again.

Recommendations:

More knowledge is needed regarding the role of policy in the development of eco-systems of innovation. To kick-start growth, the question is if SME innovation policies should to a larger extent prioritise growth-oriented SMEs in order to also obtain job creation effects. To do so tools and methods to assess operational and strategic barriers to growth at the firm level are needed to better target public support. The quality and excellence in the innovation support systems to SMEs is critical to spur their absorptive capacity.

Access to markets

Strengthening the effectiveness of the **internal market** for industrial products is a key pillar in European industrial policy towards the re-industrialisation of the EU. However, while substantial progress has been made towards implementing the Single Market, barriers still exist.

Recommendations:

Efforts to achieve correct implementation of existing rules and enforcement mechanisms relating to the Internal Market should be maintained, rather than introducing new regulation.

There are signals of protectionist behaviour and non-tariff trade barriers in a number of **external markets**.

EU trade policy should continue to identify existing market entry barriers in markets outside Europe and seek to ensure a level playing field for European companies vis-à-vis their counterparts in other parts of the world by reducing non-tariff barriers.

Administrative and regulatory framework conditions

Following a comprehensive programme to reduce regulatory burdens created by EU legislation, it is estimated that administrative burdens have been reduced by well above the 25 % target set out in the Administrative Burden Reduction programme. Between a third and half of administrative burdens in Europe are said to derive from EU legislation. Inefficient national implementation remains an issue. Regulatory stability and Furthermore, industry representatives point to the need for more regulatory stability. Frequent regulatory changes result in an uncertain environment for long-term investments.

Recommendations:

Impact Assessments of any new regulation or other EU initiatives in this area should consistently and in-depth consider both negative and positive consequences of new policy initiatives on both the overall policy objectives (e.g. environment/climate) and on European industry.

1. INTRODUCTION

1.1. Background

This document is a study requested by the European Parliament's Committee on Industry, Research and Energy (ITRE).

As highlighted in a recent publication from the European think tank Bruegel[1] a new and important debate on the future of manufacturing has recently emerged in Europe. Some of the factors driving this interest are that manufacturing is a driver of productivity in the European economy, and there is a growing recognition that high-value added knowledge intensive services are intrinsically linked to manufacturing.

The European Commission initiated an economic recovery plan already in 2008, but the response in terms of economic development has been slow. In 2012, the Commission proposed a new strategy - a vision for the industrial sector to create growth and jobs[2]. The Commission set a target that European industry should account for 20 % of GDP in 2020. This figure has already declined from 16 % in 2012 when the target was set, to 15.1 % in June 2013. In 2014, the Commission presented an updated strategy for "an industrial renaissance"[3]. The strategy outlines few new initiatives but tends to leave a margin of manoeuvre to the Member States.

Yet, the European economic recovery after the 2008 financial crisis has been slow compared to the US economy and the emerging economies. In particular the so-called BRIC countries and South Korea are catching up, putting the future competitiveness of European industry under pressure.

1.2. Scope and purpose of the study

This study is intended to feed into and enrich the debate about the current state of the European industry and how it can reposition itself by fully exploiting the opportunities offered through the European Union framework. The study should enable members of the Industry, Research and Energy Committee to establish an own view of the subject, in particular regarding the assessment of the barriers to and enablers of European industrial growth. The paper describes, analyses, and recommends options as to how European industry can contribute to growth and foster competitiveness.

The study focuses primarily on framework conditions that can be influenced by public authorities, particularly the European institutions.

1.3. Methodology

The paper is based on an extensive literature review, interviews with stakeholders, and the expert knowledge of the authors. A comprehensive literature list is included in the appendices to the paper.

In order to enrich the analysis and provide examples of barriers and enablers affecting the competitiveness of European industry, ten case studies have been carried out as part of the analysis:

1. The European Eco-industry – access to finance
2. Electronics waste recycling
3. Slovak Republic – "the European value-added leader"

[1] Veugelers, R. (ed.), *Manufacturing Europe's future,* Bruegel Blueprint Series, no. 21, 2013.

[2] European Commission, A stronger European industry for growth and Economic Recovery, COM(2012) 582, Brussels, 2012b.

[3] European Commission, *For a European Industrial Renaissance*, COM(2014) 14/2, 2014b.

4. Eindhoven – competitiveness through innovation
5. SMEs in Spain / Italy – access to capital
6. Changing dynamics of skills supply and demand
7. ICT – an enabler for closing the productivity gap
8. Construction products and the internal market
9. The mechanical engineering (ME) sector – a European productivity problem?
10. Technical textiles in Belgium– transition of a traditional industry

The case studies were selected on the basis of an initial literature review and deliberations with the European Parliament services, aiming to illuminate key opportunities and challenges emerging from different sectors and different Member States chapter. Examples and excerpts from the cases are used in the discussion of barriers and enablers in Chapter 5, and the full text of the 10 case studies can be found in Annex 1[4].

1.4. Structure of the paper

This introductory chapter is followed by definitions of key concepts and a brief overview of the "state of play" – the current situation of EU industry – in Chapter 3, followed by an overview of competitiveness and growth factors in Chapter 4. In Chapter 5 the competitiveness factors, barriers and enablers are discussed. Finally, chapter 6 sets out the conclusions and recommendations.

References and case study overview and texts are provided in the annexes.

[4] An overview of the cases and their pertinence to the identified factors of competitiveness and growth is provided in Annex 2.

2. STATE OF PLAY

2.1. Introduction and definitions

This chapter outlines the current situation of European industry and its competitiveness and contribution to growth, including how industry has managed the recent financial and economic crisis.

The subject of this paper is "industry". A definition of what is understood by industry in the context of this paper is provided in the box below.

Box 1: Definition - industry

The most recent industrial policy communication from the Commission, "For a European Industrial Renaissance[5]" defines "manufacturing" as referring to Section C and divisions 10 to 33 of NACE Rev. 2., while "industry refers to a broader set of activities including also mining and quarrying and energy activities"[6]. For the purposes of this paper, we have chosen to apply the same, broad understanding of industry – i.e. including the manufacturing industry and some primary activities, but excluding "classical" service sectors such as banking, insurance, etc.

Industry definition

As stated above, "industry" in the context of this report is defined not only as manufacturing, but as covering a broader set of activities including mining and quarrying and energy activities. Manufacturing, however, constitutes the key part of what we define as "industry". The industries covered by the concept of "manufacturing" are listed in Table 1 below.

Table 1: Manufacturing sub-sectors according to NACE Rev. 2

NACE Rev. 2	Manufacturing sub-sector
C10	Manufacture of food products
C11	Manufacture of beverages
C12	Manufacture of tobacco products
C13	Manufacture of textiles
C14	Manufacture of wearing apparel
C15	Manufacture of leather and related products
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
C17	Manufacture of paper and paper products

5 European Commission, *For a European Industrial Renaissance*, COM(2014) 14/2, 2014b.

6 European Commission, *A vision for the internal market for industrial products*, COM(2014) 25 /2, Brussels, 2014a.

NACE Rev. 2	Manufacturing sub-sector
C18	Printing and reproduction of recorded media
C19	Manufacture of coke and refined petroleum products
C20	Manufacture of chemicals and chemical products
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
C22	Manufacture of rubber and plastic products
C23	Manufacture of other non-metallic mineral products
C24	Manufacture of basic metals
C25	Manufacture of fabricated metal products, except machinery and equipment
C26	Manufacture of computer, electronic and optical products
C27	Manufacture of electrical equipment
C29	Manufacture of motor vehicles, trailers and semi-trailers
C30	Manufacture of other transport equipment
C31	Manufacture of furniture
C32	Other manufacturing
C33	Repair and installation of machinery and equipment

2.2. Definition of key terms

Concepts such as “growth”, “competitiveness” and “productivity” are commonly used, but not always clearly defined. They are to some extent interrelated. Before proceeding to the analysis, we shall therefore provide some definitions of these key concepts.

2.2.1. Growth

Growth, in its broadest sense, simply refers to a positive change in size, often over a period of time. From an economic perspective, growth is the **process by which a nation's wealth increases over time.** The most widely used measure of economic growth is the real rate of growth in a country's total output of goods and services (gauged by the gross domestic product adjusted for inflation, or real GDP) (Britannica Concise Encyclopaedia).

GDP is a measure of economic activity and is defined as "the value of all goods and services produced less the value of any goods or services used in their creation[7]".

This definition of growth has the advantage that it is simple, measurable, and commonly agreed, and this makes it possible to analytically distinguish and compare growth rates of for example countries or individual sectors. However, this strict definition does not take into account the notion of sustainability in terms of effects on employment creation and the environmental impact.

In the wake of the crisis, there has been a growing discussion on the appropriateness of growth measured as GDP. In France for example, the Ministry for Sustainable Development established a Commission to prepare a national conference on sustainable development indicators based on recommendations made. The aim has been to establish a draft list of indicators that can better measure progress made in achieving the national sustainable development strategy. A publication put forward by the European Trade Union Institute proposes the development of a broader set of indicators, which would also be more aligned to the European 2020 strategy for smart and inclusive growth[8]. It expands the growth concept by incorporating three additional growth dimensions - Smart Growth, Sustainable Growth and Inclusive Growth:

- *"Smart growth means strengthening knowledge and innovation as drivers of our future growth".*
- *"Sustainable growth means building a resource efficient, sustainable and competitive economy, exploiting Europe's leadership in the race to develop new processes and technologies, including green technologies, accelerating the roll out of smart grids using ICTs, exploiting EU-scale networks, and reinforcing the competitive advantages of our businesses, particularly in manufacturing and within our SMEs, as well through assisting consumers to value resource efficiency".*
- *"Inclusive growth means empowering people through high levels of employment, investing in skills, fighting poverty and modernising labour markets, training and social protection systems so as to help people anticipate and manage change, and build a cohesive society[9]".*

The concepts of Smart Growth, Sustainable Growth, and Inclusive Growth highlight the significance of characteristics that are not embodied in the narrow economic definition of growth and which are important in the further elaboration of innovation driven and sustainable strategies for competitiveness and growth for European industry. The notion of sustainable and smart are for example reflected in new initiatives on industrial symbiosis meant to reduce the carbon footprint of European industry, whilst finding new models to turn waste into a resource[10]. It is also linked to initiatives to promote youth employment, through initiatives such as the European Alliance for Apprenticeships[11].

Although a broader definition of growth is thus evolving, it still lacks robust indicators. In this report, *when speaking of "growth", we will thus generally be using the more traditional definition presented above: economic growth, i.e. the real rate of growth in the total output of goods and services (measured in real GDP growth)*, except where otherwise specified.

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[7] EUROSTAT, Glossary Productivity, 2013, http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Glossary:Productivity.

[8] Coats David (ed.), (2011) *Exciting from the crisis toward a model of more equitable and sustainable growth*. European Trade Union Institute http://www.tuac.org/en/public/e-docs/00/00/09/A2/document_doc.phtml.

[9] European Commission, EUROPE 2020: *A strategy for smart, sustainable and inclusive growth*, COM(2010) 2020, Brussels, 2010.

[10] http://www.climate-kic.org/themes/industrial-symbiosis/.

[11] http://ec.europa.eu/education/policy/vocational-policy/alliance_en.htm.

2.2.2. Competitiveness

Competitiveness relates to an economy's ability to compete with other economies: "*Competitiveness is a measure of a country's advantage or disadvantage in selling its products in international markets*"[12]. This definition also applies to industries and individual firms. The definition is quite broad, and a large number of factors can influence a country's (or a firm's) competitiveness - as the American Harvard Professor Michael Porter puts it: "*Almost everything matters for competitiveness*".

Competitiveness is closely linked to productivity. The two concepts are so interconnected that competitiveness is sometimes defined by productivity:

- "Competitiveness is defined by the productivity with which a nation utilizes its human, capital and natural resources[13]".
- "We define competitiveness as the set of institutions, policies, and factors that determine the level of productivity of a country. The level of productivity, in turn, sets the level of prosperity that can be reached by an economy. The productivity level also determines the rates of return obtained by investments in an economy, which in turn are the fundamental drivers of its growth rates. In other words, a more competitive economy is one that is likely to grow faster over time"[14].

The latter definition, underlining both the complexity of the concept of competitiveness as well as its link to productivity, is the one that will be applied in this report.

2.2.3. Productivity

Productivity concerns the relations between input and output: "*Productivity is the output produced from each unit of input*[15]"

Specific types of productivity are often referred to, for instance:

- *Labour productivity*, defined as output per unit of labour input, where the unit of input is labour measured for example by "no. of full time equivalent employees" or "no. of hours worked" per unit of time (e.g. a year).
- *Capital productivity*, where the unit of input is "the capital stock".
- *Total factor productivity/growth accounting*: basically a ratio between an "index for output" and an "index for inputs[16]".

Another concept sometimes referred to is *resource productivity,* which highlights the qualitative aspects of growth by incorporating the use of natural resources used in the economic activity. *"Resource productivity is a measure of the total amount of materials directly used by an economy (measured as domestic material consumption (DMC)) in relation to economic activity (GDP is typically used). (…) Resource productivity of the EU is expressed by the amount of GDP generated per unit of direct material consumed, i.e. GDP/ DMC in euros per kg*[17]*".*

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[12] http://stats.oecd.org/glossary/detail.asp?ID=399.

[13] Porter, M. E. *The Competitive Advantage of Nations*. 2nd ed. New York: Free Press, 1998. (1st ed. New York: Free Press, 1990.).

[14] World Economic Forum and Roland Berger Strategy Consultants, *Rebuilding Europe's Competitiveness*, Insight Report, World Economic Forum, Geneva, 2013.

[15] EUROSTAT, Real GDP growth rate – volume, 2014, http://publications.europa.eu/code/en/en-250500.htm.

[16] See e.g. Biagi, F. (2013): ICT and Productivity: A Review of the Literature; Institute for Prospective Technological Studies, Digital Economy Working Paper 2013/09; available at: http://ftp.jrc.es/EURdoc/JRC84470.pdf; chapter 3.

[17] EUROSTAT, *Real GDP growth rate* – volume, 2014, http://publications.europa.eu/code/en/en-250500.htm.

2.3. The current situation of European industry

This section provides an overview of the current state of play of European industry. It presents key indicators on growth, employment and productivity of industry, and on the competitiveness of subsectors. Finally, we look at some of the main European recovery measures and some possible explanations for why recovery remains sluggish in Europe.

2.3.1. Key economic indicators: growth, employment and productivity growth

European growth has lost momentum over time. In 2000, the Euro area[18] demonstrated the same growth rates as the US and the OECD total, and a higher growth rate than Japan. The economic crisis in 2008 affected the growth rates negatively in Europe as well as in comparable economies. However, the European economy did not recover as well as others, leading to a negative real GDP growth in 2012. The OECD estimates that European real GDP growth rates will become positive again, but Europe will not reach the same growth levels as Korea, the US or the OECD total. The global economy is projected to accelerate because of increases in wage levels and increases in long-term interest rates. These factors will boost domestic demand. Thereby, the economic activity is expected to increase and the unemployment level is expected to fall. However, the OECD identifies the possibility of renewed financial tension in the Euro area as a barrier for economic growth in Europe: "*The recovery remains hesitant, reflecting remaining fiscal pressures, high unemployment and the lingering effects of the euro area crisis on balance sheets and credit conditions*[19]".

Figure 1: Development in real GDP, 1989-2012

Source: OECD Economic Outlook 2013 (OECD 2013), *Estimates by OECD.

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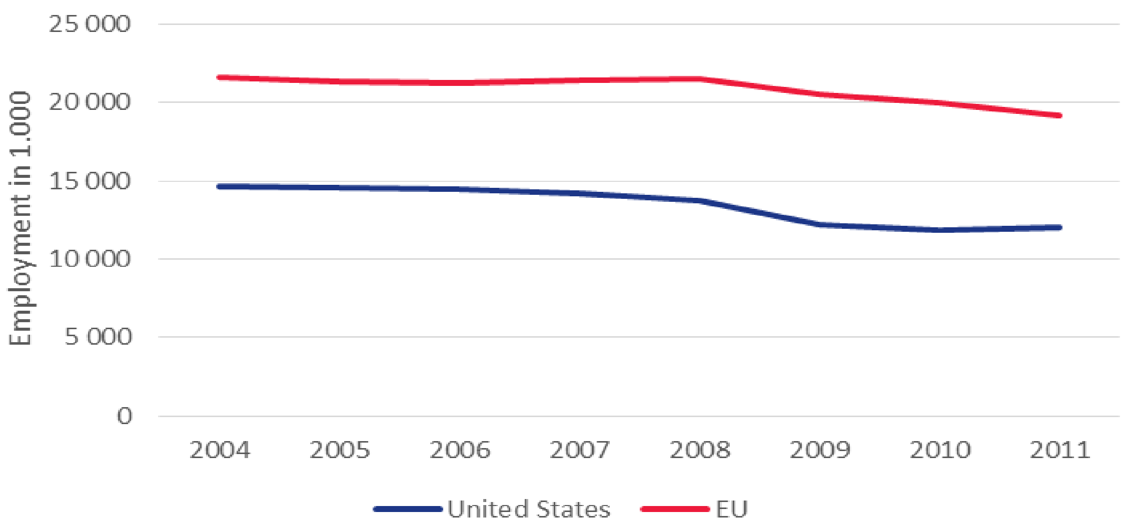
[18] The **eurozone** – formally called the **euro area**, is an economic and monetary union (EMU) of 18 European Union (EU) Member States that have adopted the euro (EUR) as their common currency and sole legal tender. OECD presents aggregates for certain country groupings, such as OECD-Total and the Euro area. The Euro area consists of the following Member States of the European Monetary Union (EMU): Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, the Netherlands, Portugal, Slovak Republic, Slovenia and Spain. Other EU states (except for the United Kingdom and Denmark) are obliged to join once they meet the criteria to do so.

[19] OECD, *OECD Economic Outlook.* vol. 2013/2, OECD Publishing, France, 2013a.

Employment

European industry employment decreased following the economic crisis in 2008. In comparison, the US had the same setback in 2008 but the US employment level stabilised in 2009 where the decline stopped. The employment in European industry has however continued to decline. There are many explanations for this. On factor is concerned with metrics. The international comparison of manufacturing employment is somewhat different if viewed in terms of hours worked rather than by the number of workers. If measured by number of hours worked, Germany experienced a decline in manufacturing work similar to that of the United States since 1990. Declines in France, Japan, and the United Kingdom were larger. Another factor could be that the US has seen a relatively more moderate development in hourly labour costs than in other advanced OECD economies due to the dollar exchange rate used in international trade [20]. The increase in hourly wage compensation in the US was 43 % from 2000-2012. For the same period, it was at 86 % in France and 80 % in Germany. Italy, which has seen a comparatively small drop in manufacturing employment, experienced by far the smallest increase in output per hour worked of any of the wealthy countries for which data are available, and saw an increase of 105 % in hourly compensation costs in the period 2000- 2012[21].

Figure 2: Total employment in manufacturing



Source: OECD Structural Analysis Statistics (database).

The role of manufacturing changes over time. As economies become richer the manufacturing share of GDP peaks at between 20-35 % when countries reach mid-income status. After that point, the economy shifts to consumption of services, and jobs in services replace job hiring in manufacturing. This development partially explains declines in manufacturing jobs in both the US and in Europe, while at the same time manufacturing has been growing in China[22].

[20] Source: Bureau of Labour Statistics "*International comparisons of hourly compensation costs in manufacturing 1996- 2012*", http://www.bls.gov/ilc/ichcc/htm#chart01.

[21] Levinson Marc (2014) U.S. Manufacturing in International Perspective Congressional Research Service.

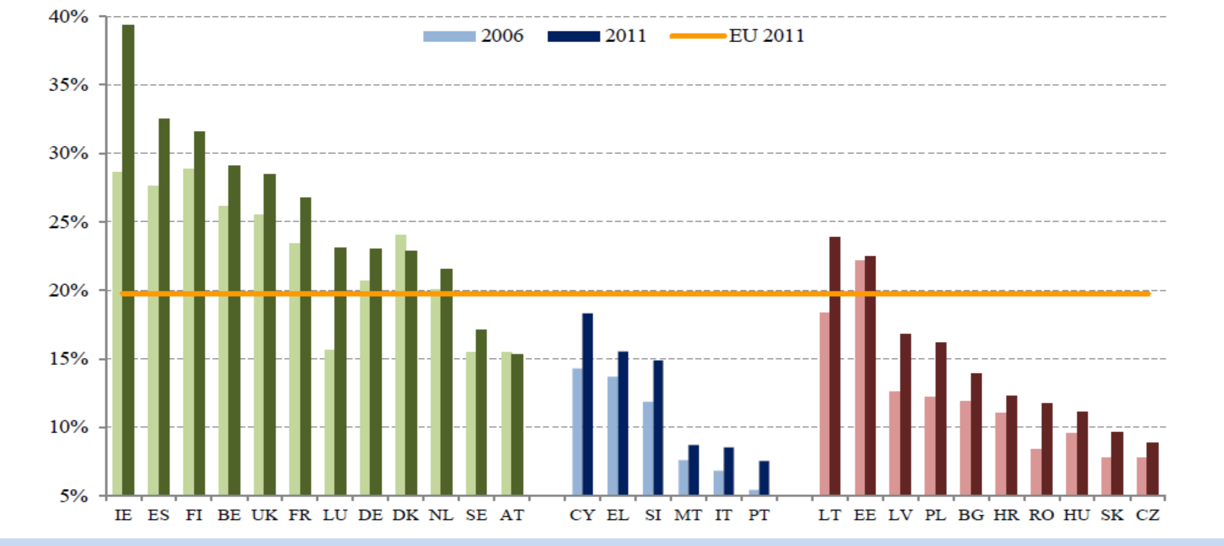
[22] Mckinsey (2012): Manufacturing the future. The next era of global growth and innovation.

Manufacturing now accounts for 16 % of total employment in the EU-15 (down from over 21 % in 1995). Jobs are primarily lost in old companies (6 years old or more). A third of the total manufacturing job destruction took place in small and old companies, and 28 % of the manufacturing job loss occurred in large companies more than 6 years old.

Both small and large firms contribute to job creation. SMEs account for more than 40 % of new manufacturing jobs, and large, well-established industry firms account for more than a fifth of the total manufacturing jobs created.

Within manufacturing, the restoration of employment has favoured white-collar (especially high-skill) occupations. This is reflected in a small top quintile employment growth in manufacturing. The countries in which top quintile manufacturing employment growth was relatively strongest were Austria, the Czech Republic and Germany. In Germany, three out of the top six categories of top-paid jobs demonstrating growth were science/engineering professions in hi-tech or heavy manufacturing sectors (machinery, automobile and fabricated metals).

Figure 3: % of people with high qualifications employed in manufacturing



Source: EU Commission Industrial Performance Scoreboard 2013[23]

The structural changes that have occurred in the manufacturing labour force are seen in the table above. In the small manufacturing firms, vocationally educated employees constitute their core workforce. This is for example the case in German *Mittelstand* firms, which due to their overall innovation capacity and profitability have created global interest. In these firms, the manufacturing shop floor and the workers are seen as a strategic knowledge asset and not as a cost[24]. Reasons are that these firms produce small series highly tailored products, which typically involves a close iteration and proximity between development and manufacturing. Products may be more crafts based or very technological in nature[25].

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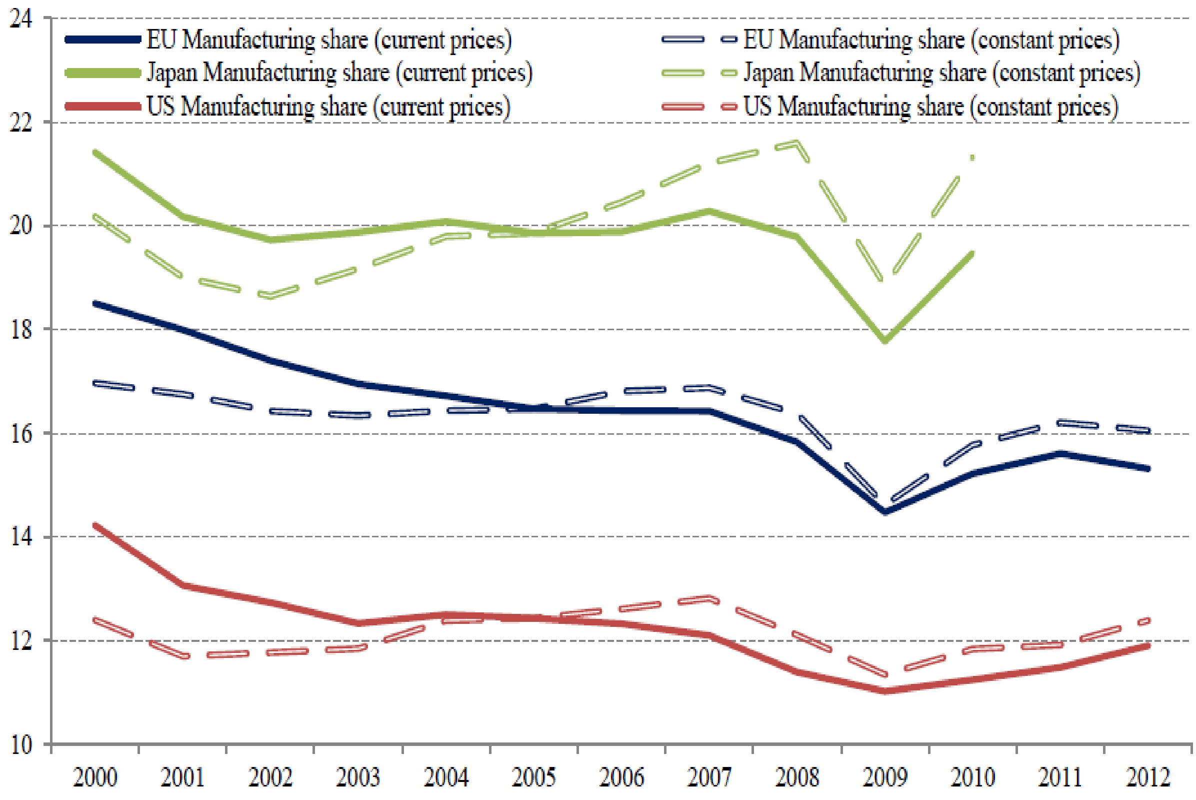
23 EU Commission Staff working Paper (20139 Industrial Performance Scoreboard 2013 Ref Ares (2013) 37771189- 19/12-2013.

24 Davis Jim (2013) *The Three Camps of Manufacturing*. Coalition for Smart Manufacturing, USA http://smartmanufacturing.com/who/jim-davis/.

25 Kidmose Rytz Benita, Shapiro Hanne, Jakobsen Leif, Damgaard Kasper Johansen (2014) *Produktionsvirksomheder i globale værdikæder, Indspil til IKT Vækst Team* Erhvervsstyrelsen (in Danish).

The decline in employment in manufacturing in the EU has occurred across low-tech, medium tech and high-tech manufacturing. Job losses have primarily affected the low-skilled workforce. Apart from the financial crisis, structural changes have been driven by off-shoring as well as automation. Manufacturing has therefore become more skills-intensive also in low-tech sectors such as textile and food[26]. As the economy begins to pick up, it will be important to recognise that those jobs lost in manufacturing in terms of skills requirements will not come back, even when the economy has fully recovered. In Denmark for example, there are emerging signals of skills mismatches also in those regions where there is a pool of labour with many years of manufacturing experience to draw from. However, many of these are semi-skilled, and they have typically not been trained in the mix of skills the new advanced manufacturing technology platforms require[27]. High-tech and medium tech companies account for an increasingly smaller share of employment in 2011 compared to 2000, except in the new Member States such as Czech Republic, Hungary, Slovakia, Poland and Estonia. In all other European countries, total employment has dropped in high and medium-high technology manufacturing, and in particular in Spain and the United Kingdom.

Figure 4: Manufacturing Gross Value Added (GVA) as percentage of total GVA generated by the private sector



Source: European Commission -Industrial Scoreboard 2013[28].

In Europe, total industrial production dropped by almost 20 percentage points between the first quarter of 2008 and the second quarter of 2009. Afterwards the index increased until 2011 when it had returned to the 2005 level. For high-technology industries, the decline

26 Veugelers, R. (ed.), *Manufacturing Europe's future,* Bruegel Blueprint Series, no. 21, 2013.

27 Shapiro Hanne, *Baggrundsanalyse til 3Fs indspil til den danske industristrategi*, Danish Technological Institute, 2014 (in Danish).

28 European Commission staff Working document Industrial Scoreboard 2013.

during the crisis was less pronounced (less than 10 percentage points) and the recovery quicker. For low-technology industries, the general development has been different. Growth between 2005 and 2008 was much slower than for industry overall, but the decline during the crisis was comparatively moderate. Since then however, no low-technology industry has yet regained its 2005 level If we look at the share of manufacturing in gross value added generated by the private sector in the EU, the share of manufacturing growth value added remained stable at around 20 pct. until 2008, where it dropped considerably. The same applied also to Japan and to the US. After 2009, there have been considerable differences between the US and Europe. The US has seen a recovery back to pre-crisis levels. In the EU, there was a recovery followed by a second dip in 2012. This development underlines the urgency of policy action.

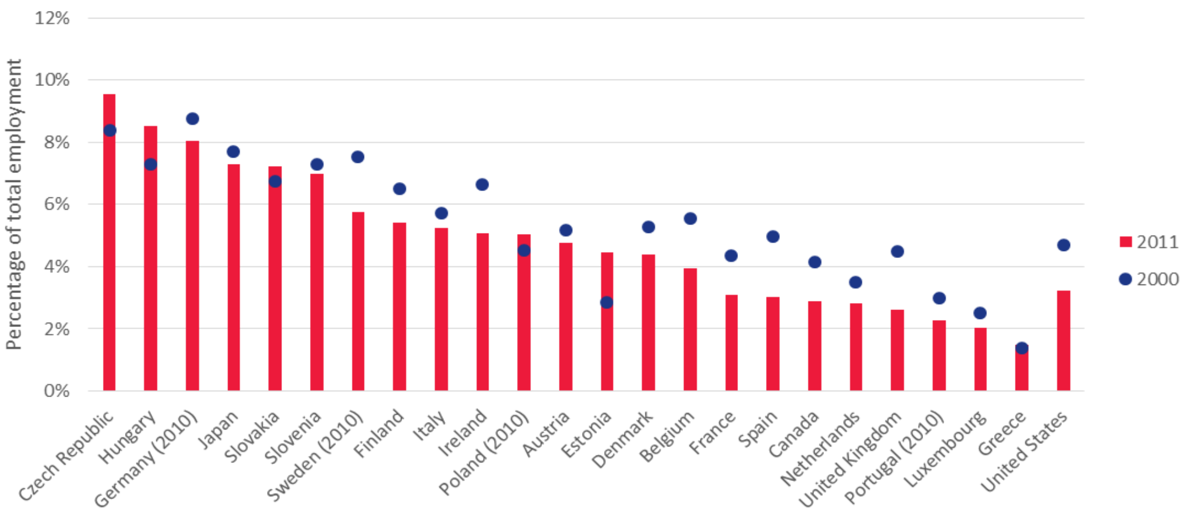
Developments in low-technology industries are a particular challenge. Growth between 2005 and 2008 was much slower than for total industry, but the decline during the crisis was comparatively moderate. Since then however, no low-technology industry has yet regained its 2005 level[29].

From an overall growth perspective, investments in low-tech sectors where Europe has long-standing crafts traditions could be a way to invigorate these industries. If complemented by coherent up-skilling and redesign of business processes it can lead to employment creation in the medium term, and a more sustainable model of competitiveness, which does not primarily rely on cost efficiencies. Technology upgrading is not merely a way to increase productivity. It is also a way to improve resource efficiency. Automation and digital technologies can be an additional way whereby companies with proud crafts traditions can find new ways to create highly tailored products to different market segments at almost the same price as mass manufactured products. Such investments cannot stand alone. They must be complemented by substantial skills upgrading in those firms, particularly at the shop floor level, if substantial productivity gains are to be made[30].

[29] Ibid.

[30] Jakobsen Leif, Yding Sørensen Stig, Shapiro Hanne Damgaard Kasper (2013), *De Skjulte Helte- Danske produktivitetssucceser*. For Forsknings- og Innovationsstyrelsen. An English summary of the study is available from Danish Technological Institute, Centre for Policy and Business Analysis.

Figure 5: Employment in high- and medium-high technology manufacturing



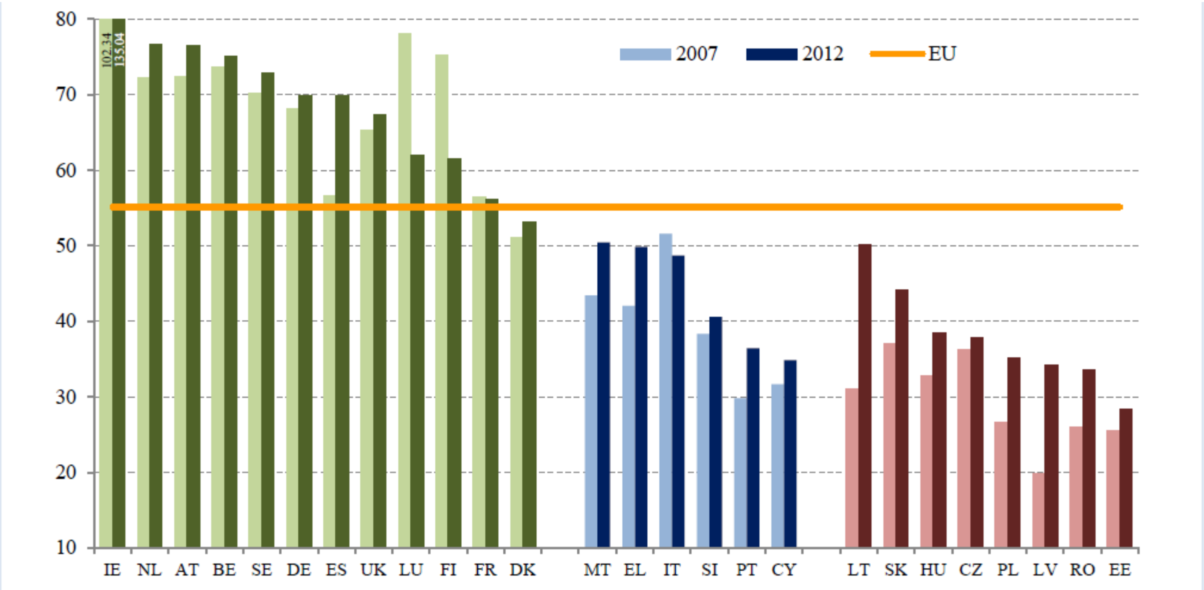
Source: OECD, Structural Analysis (STAN) Database, ISIC Rev. 4, May 2013.

Productivity

The productivity level is a relevant measure for European industrial competitiveness.

One of the key measures of productivity is labour productivity. Figure 5 shows the labour productivity development change from previous years, in other words the relative growth in labour productivity. European manufacturing does not have the same level of productivity as the US and Korea, though there are marked differences across the EU Member States as the figure below shows:

Figure 6: Labour productivity in manufacturing

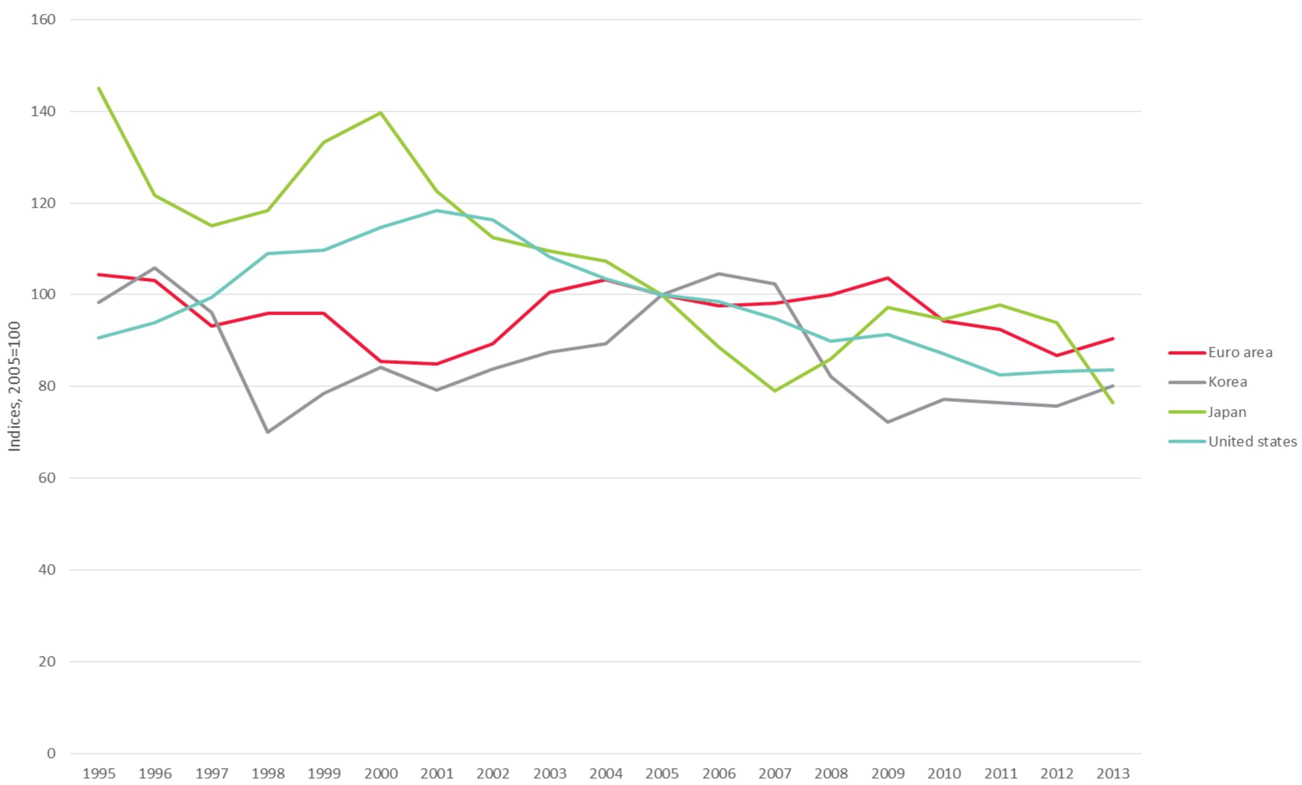


Source: Eurostat.

Labour productivity has grown since 2007 in the majority of Member States. However, in most of them this development is explained by the fact that the labour force shrank faster than manufacturing declined. In countries such as Luxemburg, Finland and France, productivity did not increase due to rising average unit labour costs.

The development in relative unit labour cost partly determines European industrial competitiveness. Unit labour cost is defined as "*the average cost of labour per unit of output and are calculated as the ratio of total labour costs to real output*[31]". From 2006 until 2009, the relative unit labour cost in the euro area gradually increased. Since then euro area unit costs have dropped, but not to the same degree as in Korea, Japan and the US. Their unit labour costs are now considerably lower than in 2005. In recent years, wages in China have been rising and the Yuan has appreciated, potentially eroding China's cost advantage in manufactures. Between 1998 and 2003 China's unit labour costs fell, but since 2003 they have increased both absolutely and relative to US unit labour costs. Much of the rise in China's relative unit labour costs can be traced to a real appreciation of the Yuan against the dollar. China's unit labour costs remain low relative to other manufacturing economies[32, 33].

Figure 7: Development in relative unit labour cost



Source: OECD, Structural Analysis (STAN) Database, ISIC Rev. 4, May 2013.

A recent European Commission staff working paper[34] shows marked differences between Japan, the US, and Europe in terms of how the crisis has impacted production, employment and access to credit. When it comes to bank credits for example, there was a sharp

[31] http://stats.oecd.org/mei/default.asp?lang=e&subject=19.

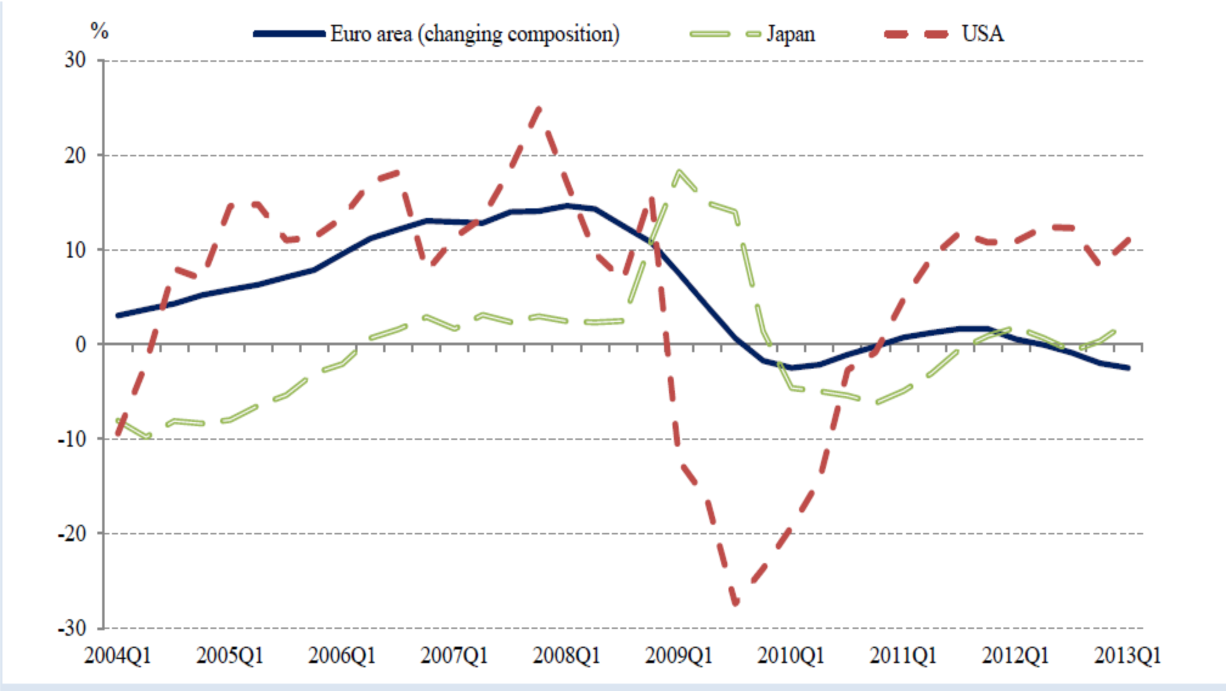
[32] Ceglowski Janet, Golub Stephen S., *Does China Still Have a Labor Cost Advantage?* Bryn Mawr College Scholarship, Research, and Creative Work at Bryn Mawr College, 2012.

[33] For a detailed global overview from 2010 see http://www.bls.gov/fls/chartbook/2012/section3a.htm.

[34] European Commission, *Industrial performance scoreboard - A Europe 2020 initiative*, Commission Staff Working Document, Brussels, 2013e.

decrease in 2009. In the US, the situation was quickly reversed, while that has not been the case in the EU. Whilst the crisis affected bank loans in Japan, the recently implemented monetary policy can be seen in loan growth.

Figure 8: Year-on-year growth of loans to non-financial corporations, EUR



Source: European Commission, *Industrial performance scoreboard - A Europe 2020 initiative*, Commission Staff Working Document, Brussels, 2013.

There is no single factor that can explain why recovery in European industry is slow to regain momentum. The most recent survey on SMEs from the European Central Bank shows that a lack of customers is now seen as the most important barrier to recovery across the Member States[35]. When it comes to access to financing, including development capital, the situation varies considerably among Member States, and in some Member States small manufacturing firms in particular continue to be very negatively impacted from lack of finance. Small firms are known to be more hesitant to invest in new manufacturing platforms, and lack of access to investment capital including expensive loans can aggravate the situation with a negative impact on productivity and strategic opportunities to be positioned in global value chains. Therefore, it is necessary to take into account the multitude of factors, which influence the performance of manufacturing firms, and which furthermore vary across Member States depending upon enabling framework conditions. Some of these factors will therefore be discussed further in the following chapters of this study.

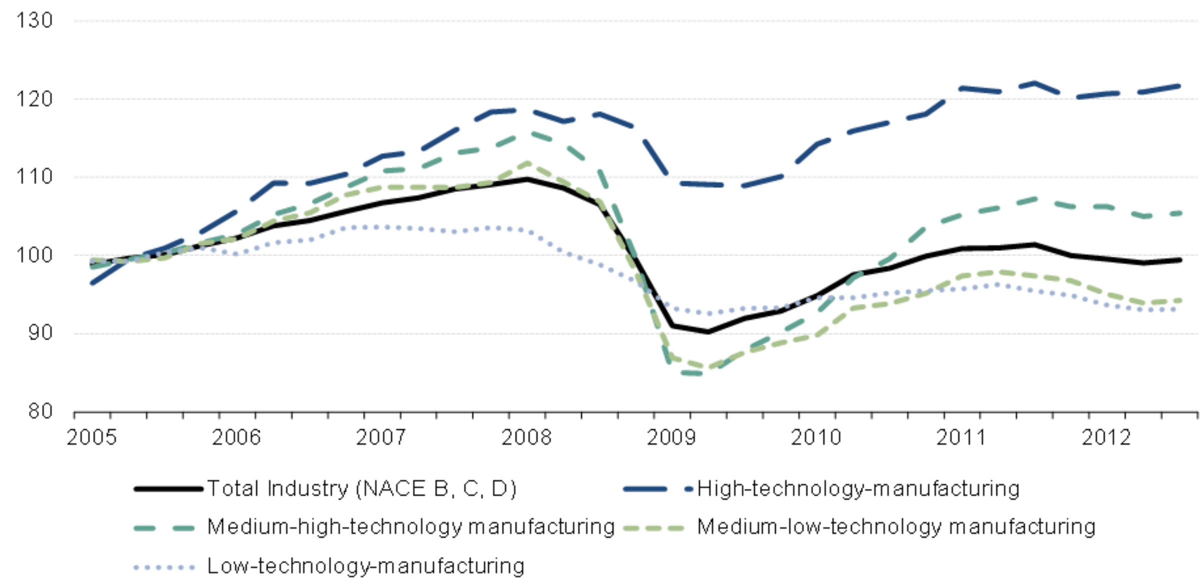
[35] https://www.ecb.europa.eu/press/pr/date/2014/html/pr140430_1.en.html.

2.3.2. Subsectors

This section takes a more detailed look at competitiveness from a sector perspective.

Figure 8 below looks at how different subsectors have recovered after the crisis in 2008. Only a few manufacturing sub-sectors have recovered to their pre-crisis level of output, such as pharmaceuticals and "other transport equipment". High-technology sectors in general have managed to recover, whereas the output from medium-technology, low to medium technology and low-technology sectors declined by 12-14 % between 2008 and 2013[36].

Figure 9: Index of production for total industry and main technology groups in manufacturing, EU-27, 2005 to 2012.



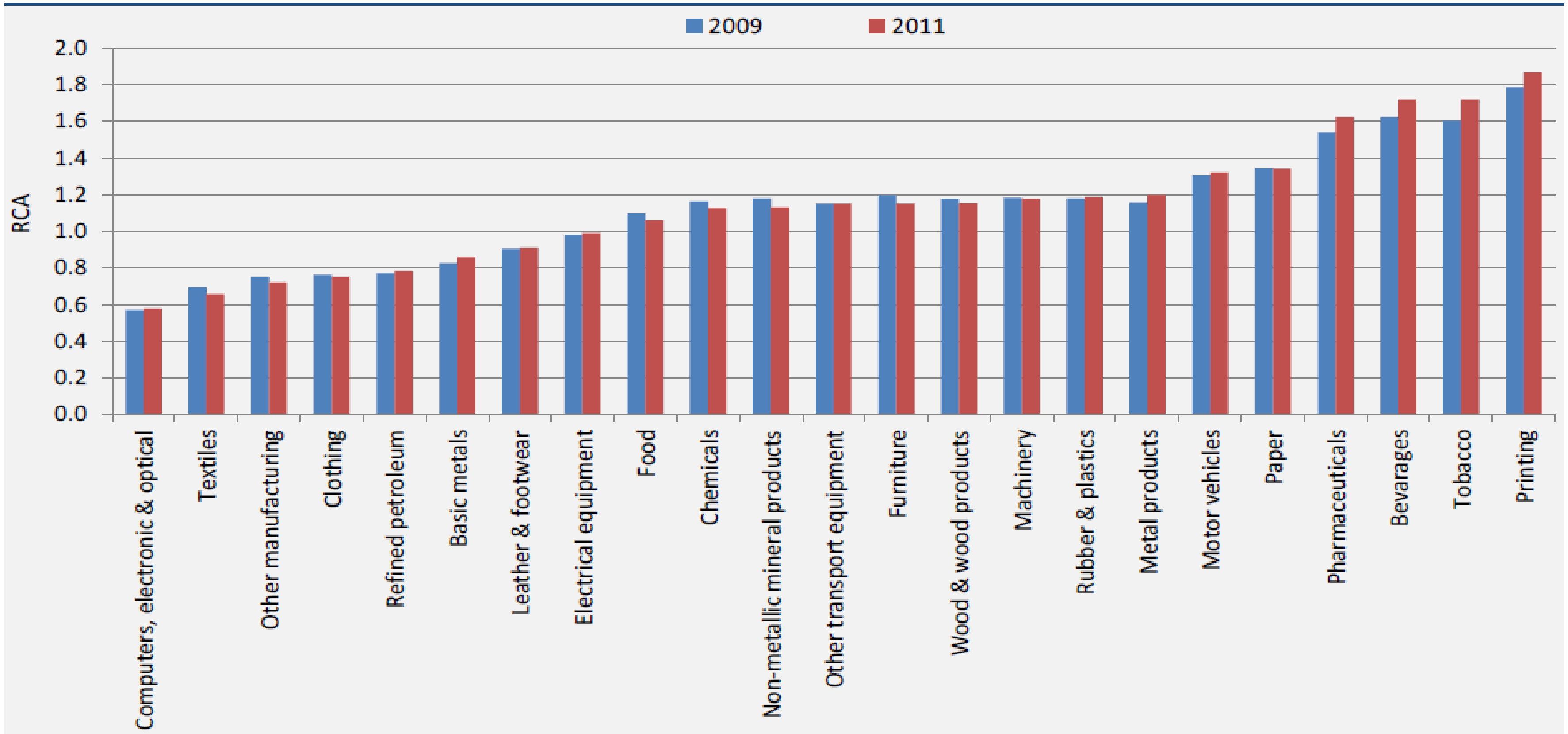
Source: Eurostat online data

Comparative advantage of industries can be compared using the RCA (Relative Comparative Advantage) indicator which compares the share of an EU sector's exports in the total EU manufacturing exports with the share of the same sector's exports in the total manufacturing exports of a reference group (see also note to Figure 9 below).

Generally, comparative advantages changed only marginally between 2009 and 2011. In 2011, four manufacturing sub-sectors stand out with a comparative advantage: Pharmaceuticals, Beverages, Tobacco, and Printing. Their comparative advantage increased from 2009 to 2011. Computers, Electronics & optical, Textiles, Clothing, and Other manufacturing are the manufacturing sub-sectors that had the largest comparative disadvantage.

[36] European Commission, DG Enterprise and Industry, *European Competitiveness Report 2013:Towards Knowledge Driven Reindustrialisation*, Commission Staff Working Document SWD(2013)347 final, Publications Office of the European Union, Luxembourg, 2013c.

Figure 10: EU comparative advantage in 2009 and 2011



Source: European Commission, *European Competitiveness Report. Towards knowledge driven reindustrialisation*, Commission Staff Working Document, Luxembourg: Publications Office of the European Union, 2013.

Note: An RCA (revealed comparative advantage) value higher than 1 means that a given industry performs better than the reference group and has comparative advantage, while a value lower than unity indicates comparative disadvantage.

Table 2 shows that Brazil, India and China have a competitive advantage in low-tech manufacturing. China is the only country/region with a relative comparative advantage in high-tech manufacturing. EU, Japan and the US have relative comparative advantages in medium-high-tech manufacturing.

Table 2: Revealed comparative advantages by technology intensities in manufacturing, 2011

	High Tech	Medium High Tech	Medium Low Tech	Low Tech
EU	0.85	1.14	0.89	1.01
Japan	0.73	1.59	0.86	0.16
US	0.88	1.22	0.96	0.68
Brazil	0.32	0.76	0.87	2.50
India	0.40	0.49	1.93	1.33
China	1.56	0.72	0.85	1.29
Russia	0.08	0.45	2.74	0.49

Source: European Commission, *European Competitiveness Report. Towards knowledge driven reindustrialisation*, Commission Staff Working Document, Luxembourg: Publications Office of the European Union, 2013
Note: An RCA (revealed comparative advantage) value higher than 1 means that a given sector performs better than the reference group and has comparative advantage, while a value lower than unity indicates comparative disadvantage.

It should, however, be noted that RCA as an indicator of competitiveness may gradually lose some of its significance, since it does not fully capture the recent developments in how industrial activities are organised in global value chains. It has therefore become more complex to capture how and where value is created, as exporting products might contain a high foreign input. Eurostat has started an initiative related to measurement of value creation in global value chains and as the basis for developing new statistical indicators[37].

2.3.3. Recovery - measures and barriers

Already during the financial crisis in 2008, the European Commission launched an Economic Recovery Plan[38] to mitigate the effects of the crisis. The Plan had two main parts:

- An immediate budgetary impulse amounting to EUR 200 billion (1.5 % of EU GDP), made up of a budgetary expansion by Member States of EUR 170 billion (around 1.2 % of EU GDP) and EU funding in support of immediate actions of the order of EUR 30 billion (around 0.3 % of EU GDP).
- A number of priority actions, grounded in the Lisbon Strategy, and designed at the same time to adapt the European economies to long-term challenges, which continue to implement structural reforms aimed at raising potential growth.

The priority actions included planned/proposed initiatives in a number of areas, including:

- *People: Launching a European employment support initiative, simplifying criteria for* European Social Fund (ESF) support and stepping up advance payments from early 2009, creating demand for labour.

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[37] http://www.cso.ie/en/newsandevents/conferencesseminars/eurostatseminarglobalvaluechainsandeconomicglobalizationtheeurostatinitiative/.

[38] European Commission, *A European Economic Recovery Plan*, COM(2008) 800 final, Brussels, 2008.

- *Business:*

  Enhancing access to financing for business, e.g. through the EIB (a package of EUR 30 billion for loans to SMEs), speeding up the state-aid decision process.

  Reducing administrative burdens and promoting entrepreneurship, including easing the start-up process for companies, removing the requirement on micro-enterprises to prepare annual accounts, and ensuring that public authorities pay invoices.

- *Investment: Investments in infrastructure, improving energy efficiency in buildings,* promoting the rapid take-up of "green products".

- Increasing investment *in R&D, Innovation and Education:* including developing clean technologies for cars and construction, and high-speed Internet for all (development of broadband infrastructure).

Many of these proposals have since been implemented. Under the "business" heading, examples of implementation include the recast Late Payment Directive [39] (Directive 2011/7/EU of 16 February 2011) on combating late payment in commercial transactions and the new Accounting Directive[40], among others.

The plan's increased investments in developing clean technologies for cars and construction became fully operational with the "European Economic Recovery Plan 2010-2013 - Public Private Partnerships in Research Activities", which covered an investment by the European Commission and industry to of EUR 3.2 billion[41], 50 % of which to be provided through the FP7 research programme. The three PPPs were:

1. "Factories of the Future" initiative for the manufacturing sector (EUR 1.2 billion for R&D).
2. "Energy-efficient Buildings" initiative for the construction sector (EUR 1 billion for R&D); and
3. "Green Cars" initiative for the automotive sector worth a total of EUR 5 billion, of which EUR 1 billion is for research activities.

Despite these measures recovery remains sluggish. The Commission, in a staff working paper, points to a set of factors which could help provide some of the explanation. Among the main factors pointed to are[42]:

- *Access to credit*: Constrained access to credit has become a serious threat to the survival of significant parts of Europe's competitive industries. Loans to non-financial corporations have not yet recovered from the crisis, and lending activity continues to decrease in the euro area. Many SMEs have significant difficulties in getting loans.

- *Aggregate demand conditions*: Demand remains subdued in the EU, and governments have not been able to compensate by supplying internal demand. Exports, mostly to the rest of the world, have been the main driver of industrial activity, but for SMEs access to remote markets remains a challenge.

- *Insufficient structural adjustment*: There is a certain lack of dynamism of the EU economy due to structural problems such as administrative obstacles and the barriers faced by firms wishing to expand. Firm renewal in Europe is slow. "Large

[39] Directive 2011/7/EU of 16 February 2011.

[40] Directive 2013/34/EU of 26 June 2013.

[41] For More information see European Commission Press Release - IP/09/1116 13/07/2009 http://europa.eu/rapid/press-release_IP-09-1116_en.htm?locale=en.

[42] The following is based on European Commission, *Industrial performance scoreboard - A Europe 2020 initiative*, Commission Staff Working Document, Brussels, 2013e.

firms tend to fail less than in more dynamic economies such as the US and small firms tend to have difficulties growing. This has hindered both the development and penetration of new high-growth sectors and the reallocation of resources to more innovative parts of the economy"[43]. Structural and institutional rigidities in European labour, product, and services markets remain, and the ability to access markets with a new product and to reach an efficient scale is often hindered by a heavy regulatory environment.

- *Insufficient (commercialisation of) innovation*: There is a bias towards fundamental research in Europe and an insufficient amount of innovation that is close to market.

43 Op.cit.

3. COMPETITIVENESS AND GROWTH FACTORS - OVERVIEW

3.1. Introduction

Sources on competitiveness and growth suggest that there are several factors that influence competitiveness and growth, which can be grouped in the following categories:

- quality of human capital/labour costs,
- capital,
- inputs and infrastructure,
- technological progress/R&D,
- production,
- sales markets, nature of competition,
- firm creation and growth,
- administrative requirements and/or regulations,
- financial markets, including euro exchange rate, and
- financial risk sharing.

Human capital (labour): Uptake of more advanced production and material technologies, increased use of ICT in manufacturing, a growing international outsourcing of low-value manufacturing, and a greater level of integration of service features linked to products are all factors which have and will impact skills demands in industry. In general, the skills intensity in industry has increased and the crisis has in particular affected the low-skilled. The negative impact has been increased by the low level of development of lifelong learning and active labour market policies in some Member States. To fully take advantage of automation and digital technologies in manufacturing, new combinations of skills are needed both at the shop floor level and in white-collar occupations. The availability of such skills and the responsiveness of the education and training systems, the willingness of employers to invest in continuing education and training of their workforce, and their ability to implement work practices that put the skills of the workforce into productive use, are all factors which influence labour productivity.

Capital: The turbulence in financial markets has somewhat stabilised, but the crisis continues to negatively impact access to finance in many Member States. There are signs that firms have delayed investments in new automation equipment and further digitalisation due to lack of capital, but also due to continuing market volatility. This will have a negative impact on productivity compared to global competitors[44]. Yet the biggest challenge for European SMEs is the lack of demand[45].

Produced inputs and infrastructure: European industry production increasingly relies on the national and international sourcing and purchasing of inputs enabled by the liberalisation of trade and developments in ICT. An individual final manufactured good is thus often processed in many countries, with different parts of the value chain being performed in the location most suited to the activity. The input prices are therefore important constituents

[44] For further discussion on country differences please refer to European Commission, Industrial performance scoreboard - A Europe 2020 initiative, Commission Staff Working Document, Brussels, 2013.

[45] European Central Bank, Survey *on the access to finance for small and medium-sized enterprises in the euro-area*, ECB, Frankfurt, 2013.

for the overall cost base of an industrial firm. In general, more specialised and smaller economies tend to have higher shares of foreign value added embodied in their export products. Larger countries tend to make wider use of domestically sourced intermediate goods, and they are therefore less impacted by potential trade barriers than small countries are. In the publication "Guide to resource efficiency in manufacturing", it is estimated that raw materials account for 40 % of European manufacturing firms' costs; including energy and water this figure is 50 %, compared to only 20 % for labour[46]. Resource efficiency can therefore drive profitability. Data from German SMEs show that investments in resource efficiency lead to savings of 5-10 % of materials input, and can lead to return on investment within a year.

Technological progress: The relative competitiveness of firms in the same product markets is defined by their ability to innovate. Governments can play a central role in driving technological innovation by being the initial purchasers of new technological innovations as a means to accelerate product maturity, which will also drive down costs[47]. The advances made in low-cost advanced automation technologies and digitalisation offer new opportunities also for SMEs to improve productivity and resource efficiency, whilst adding new functionalities to products, for example through the use of sensors which can inform the customer when it is time for a service check. Digital technologies open up for modularisation of products and hence more efficient, faster and customised production of small series products[48]. Digital technologies have also led to increased services in pre-sales and after sales functions in B2B and B2C markets. Adoption of automation and digital technologies may have very different forms with effects on both labour and capital.

The key to innovation performance in SME manufacturing firms is often not interaction with the formal innovation system; their key sources are rather their lead customers who enable their growing specialisation so that they are able to compete in global niche markets. Actors within the innovation system including cluster organisations can play a central and critical role. National innovation policies need to take into account how they can support SMEs in moving up the value chain as advanced sub-suppliers.

Production: In value chains where the transactions between firms are highly complex, the lead firms tend to cut down on the number of sub-suppliers to obtain a higher degree of control over the quality and timely delivery of components. As mentioned before, specialisation becomes the key factor to obtaining a strong position in the upstream high value adding part of the value chain. As manufacturing is dispersed over multiple locations, standards become critical to ensure high quality production. The growing upstream and downstream interconnections increase country interdependency, and enabling framework conditions require more policy coordination across trade, labour market, and competition and transport policies. Completing the single market for supporting services linked to transport, logistics, ICT infrastructures and Smart Grids can drive manufacturing revitalisation in Europe.

Sales markets: Economic growth has shifted towards emerging markets. McKinsey[49] has estimated that consumption by developing economies could grow from 12 trillion dollars in 2010 to 30 trillion dollars in 2025. In 2025, developing economies could account for 70 % of the global demand for manufactured goods. Demand is not just driven by economies such as China and India, but increasingly by smaller emerging economies like Vietnam,

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46 Europe Innova, Guide to resource efficiency in manufacturing, 2012.

47 World Economic Forum and Roland Berger Strategy Consultants, Rebuilding Europe's Competitiveness, Insight Report, World Economic Forum, Geneva, 2013.

48 Rytz, Benita Kidmose, Hanne Shapiro, Leif Jakobsen, *IKT i globale produktions værdikæder*, Erhvervsstyrelsen, Copenhagen 2013 (in Danish).

49 McKinsey Global Institute, Manufacturing the future. The next era of global growth and innovation, 2012.

Indonesia, or some African countries. The effects of this demand shift and opportunities afforded by the shift vary across geographies and sectors of manufacturing. In pharmaceuticals for example it drives a growing global demand for generic products at a lower price than brand name products. But the overall effects are clear. The shifts in markets are leading to demand fragmentation. Africa, China and India are complex markets made up of a diverse composition of consumers in terms of cultures, living conditions and income. This raises pressures to adapt manufacturing to new patterns of demand, and the greater variation in product requirements puts pressure on manufacturing business models, which can support flexible production for more varied product lines for different product markets. Another change in sales is the increasing importance paid to services as a competitive parameter, and not just associated with consumer products. This development is one of the explaining factors behind revenue streams generated from services within manufacturing. Diversified consumer demands constitute an opportunity for those firms that are capable of using input from their lead users as sources of innovation. Firms that also manage to modularise their production processes through digitalisation are better capable of tailoring their products to different markets in a cost effective way.

Firm creation and growth: Although production in a sector might be more or less concentrated, i.e. a limited number of large firms which may have a number of SME sub-suppliers account for a high share of the production value, it is very often the case that innovation in such a sector is driven by smaller firms and start-ups. The reason is that such firms often possess a particular entrepreneurial culture that is conducive to innovation. Developments across the US in affordable 3D print technologies and the emergence of Tech-Shops, which are technology workshops furnished with 3D printers and other manufacturing equipment, are driving an industrial renaissance and a positive ambience around advanced small-scale manufacturing, which also could be replicated in Europe.

Administrative requirements and/or regulation: Industry production in Europe and the sale of the respective goods and services are subject to many administrative requirements and/or regulations. Examples are registration of a firm, certification of products and services and their respective mutual recognition schemes, requirements related to emissions and the security of produced industrial goods, safeguarding intellectual property rights, and technical standards. All of these factors have implications on costs. Differences in regulations or how regulations are implemented and interpreted across Member States can lead to additional costs, and firms might experience a competitive disadvantage in worldwide markets.

4. BARRIERS AND ENABLERS TO GROWTH AND COMPETITIVENESS

4.1. Human capital: Education and skills

Drivers of change in skills supply and demand in Europe

Europe is in the middle of a second wave of globalisation enabled by liberalisation of trade, increased use of ICT, and massive global expansion of higher education systems. There is increasing evidence that in the sourcing of high-skilled talent, in particular larger firms no longer necessarily look to national universities and labour markets. Labour markets for high-skilled graduates and doctoral candidates have thereby become more globalised as an increasing number of firms adopt global recruiting patterns as a means to tap into global talent and to gain cost/quality advantages[50].

In the light of the crisis, the emergence of a global talent pool and the potentials of global sourcing of European industry research hubs raise complex questions regarding the future demand and supply of skills for European industry growth.

Until recently, studies on skills and innovation have tended to focus primarily on Human Resources for Science and Technology (HRST); that is, scientists, engineers, and technologists. Scientific and engineering skills will also in the future be critical in stimulating technological R&D that can lead to leading edge market innovations, particularly because breakthrough innovations may emerge from technological convergence, for example nanotechnologies and micro-electronics. Skills demands are changing in science, technology and engineering due to changing global specialisation patterns resulting in that firms increasingly collaborate in specialised global value chains[51]. The implications are that the workforce will be expected to work in environments that require collaboration across multiple fields of disciplines as well as the ability to interact with and work in virtual teams. Trans-disciplinarity has been identified as one of 10 advanced workplace skills that will help organisations handle disruptive technological and societal change[52]. The European High Level Expert Group on Key Enabling Technologies has similarly identified trans-disciplinarity as a driver of innovation in the future European industry. Due to the characteristics of European manufacturing industry with many SMEs, a European skills strategy for advanced manufacturing cannot only rely on the supply of scientists and engineers. It needs to consider a comprehensive approach to developing the skills needed at the shop floor level to make advanced usage of automation and digitalisation technologies. This could prove to be an alternative strategy to offshoring specialised manufacturing from the EU, and it could be a pathway to job-rich recovery, as increased use of digitalisation technologies can improve design functionalities, cut resource consumption, and embed new services in manufacturing products, factors which have shown to improve competitive edge. The recent initiative The European Alliance for Apprenticeships[53] could play a critical role in that respect. Several studies have shown that the skilled workforce and technicians play an essential role in models of incremental

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[50] Brown, Phil; Hugh Lauder, David Ahton, *Global Auction - broken promises of education, jobs and earnings,* Oxford University Press, 2011.

[51] Shapiro, Hanne, Emerging skills and competences for the HRST workforce, do higher education systems in Europe get it right?, DG Research, Innovation Union, 2013.

[52] Appolo Research Institute, *10 skills for the future workforce*, 2012 .

[53] http://ec.europa.eu/education/policy/vocational-policy/alliance_en.htm.

innovation, often involving users and front-end employers and the deployment of known technologies for innovation purposes[54].

Contributions and challenges for competitiveness and growth.

Since the 1990s, European education and skills policy has concentrated on targets derived from comparisons with other advanced economies. This has led to policies focusing on raising qualification levels across the EU. The Community Innovation Survey and the findings of PIAAC- OECD's large-scale assessment of adults' skills indicate that supply side policies must be complemented by measures to drive innovation performance in companies. The OECD PIAAC study[55] reports underutilisation of skills in several countries. The Community Innovation Survey similarly shows major variations when it comes to organisation innovation performance. Both skills utilisation and organisational innovation performance are associated with the quality of managerial practices and how work is organised. In firms characterised by narrow job functions and low levels of autonomy there is a big risk that the workforce over time will lose its initial skills base. Hence, a skills-enabled growth in European industry will not only depend upon the quality of graduates and doctoral candidates, but also upon how these skills are put to use and further developed in manufacturing companies in Europe. Although skills mismatches are to some extent part of a dynamic economy, there are for example in Denmark now emerging signals of growing skills mismatches in small manufacturing firms. It will be a timely recovery measure to implement accelerated apprentice routes for particularly the unskilled part of the workforce who lost their jobs in manufacturing during the crisis, if focused on up-skilling for advanced manufacturing based on new automation and digital technologies.

The UK Skills pilot is an interesting example of a public-private partnership, also because of its scale (see Case 6 in Annex 1).

4.2. Access to finance

One of the key consequences of the economic and financial crisis is that it has become increasingly difficult for SMEs to get access to finance in many EU countries. In 2013, access to finance was the second largest concern for SMEs. An average of 16.3 % of the SMEs in the euro area considered access to finance as their most pressing problem.

Table 3: The most pressing problems faced by SMEs in 2013

	Euro area
Finding customers	24.1%
Competition	11.7%
Access to finance	**16.3%**
Costs of production or labour	13.9%
Availability of skilled staff or experienced managers	14.2%
Regulation	12.6%
Other	7.1%

Source: European Central Bank Database.

54 Working paper for DG Education (2012): *VET Excellence- the role of innovation in vocational education and training*. Shapiro Hanne, Tine Andersen, Danish Technological Institute.

55 http://www.oecd.org/site/piaac/.

SMEs in the Southern European countries have been hit especially hard by lack of access to finance.

Box 2: Access to finance in Italy and Spain[56]

In Italy and Spain, respectively 23.4 % and 20.0 % of the SMEs reported access to finance as the most pressing problem. In Germany and Austria the same number was only around 8 %. Furthermore, 50 % of SMEs in Italy and Spain report that access to finance is a very pressing problem in their current situation. The corresponding percentage in Germany and Belgium is around 30 %.

Source: European Central Bank, 2013a.

The deteriorating economic outlook has taken its toll on the availability of venture capital. Of the about EUR 4 billion that EU venture capital firms managed to raise in 2011 - half of the 2007 total - around 40 % came from government agencies. That is a big increase from pre-crisis days when government funds provided 10 % of new capital[57].

The shortage of capital is particularly evident in sectors where the return on investment is very long and/or uncertain, which makes investors/venture capitalists reluctant to invest, as the example below illustrates.

Box 3: Financing new investments in the eco-industry[58]

Before the economic crisis in 2008, Europe was at the forefront of technological innovation in the eco-industry. The economic crisis has delayed public investments in measures that could accelerate the growth of the eco-industry. Cleantech investments are highly capital intensive and the time horizon for achieving success is rather long - almost as long as for new pharmaceutical products in the biotech industry. Access to risk capital is a critical growth factor for the eco-industry. Another issue is the development of curriculum for new occupations in the eco-industry. The joint initiatives between CEDEFOP and OECD on green skills and the new opportunities in Horizon 2020 and COSME could be a means to overcome some of the existing barriers for the eco-industry.

Current initiatives

Although financing has been highlighted as one of the key barriers for the manufacturing industry during the crisis, several measures have in fact been taken by e.g. the European Investment Bank and the European Investment Fund as well as the measures provided within the framework of the European Commission's initiatives, such as the Competitiveness and Innovation Programme (CIP), the European Progress Microfinance Facility, the Risk Sharing Instrument Facility (RSI) or the Joint European Resources for Micro to Medium Enterprises (JEREMIE). To illustrate the scale of investments, the EIB lent EUR 11 billion to SMEs in 2012. The estimated leveraged impact of 2012 EIB SME financing was at least EUR 21.4 billion. Approvals of loans for SMEs increased 14 % to EUR 14.0 billion, of which EUR 12.6 billion was in the EU (an 18 % increase compared to 2011).

Access to funding for R&D with a high potential to result in innovations is critical for spurring smart growth in European manufacturing. Until now the EU Framework Programmes for Research have been criticised substantially for not addressing Europe's relatively weak performance (compared to the US in particular) when it comes to bringing research results to the market – the so-called "Valley of Death" issue. Horizon 2020 has

56 See also case study 5, Annex 1.

57 European Commission 2012c, citing the Economist, 19 April 2012.

58 See case study 1, Annex 1.

been designed to overcome this limitation. At the same time it should be noted that more than EUR 15 billion has been made available for SMEs under the CIP (Competitiveness and Innovation framework) programme between 2007 and 2013. *COSME*, specifically created for SMEs, is a funding instrument which will largely continue the activities of the CIP programme, but will even better respond to SME needs:

- Its equity facility for growth-phase investment will provide SMEs with commercially oriented reimbursable equity financing, primarily in the form of venture capital through financial intermediaries.
- A loan facility will provide SMEs with direct loans or other risk-sharing arrangements with financial intermediaries to cover loans.

The COSME instrument will be complemented by financing for research- and innovation-driven enterprises under the Horizon 2020 programme.

However, there are still unsolved challenges. One of the issues is the cost of loans and restrictions regarding access to loans with major variations between Member States.

4.3. ICT infrastructures

Changing demand patterns in the market with a much more diverse but also more volatile global demand will force European manufacturing companies to explore new business models that can improve their agility if they are to remain globally competitive. European manufacturing industry will still depend upon efficient transport and logistics to be effectively integrated in global value chains. Increasingly however, digital infrastructures will be the key driver of the next generation of advanced manufacturing. In the USA, the Smart Manufacturing Leadership Coalition[59] is a non-profit organisation of public and private players who have come together for collaborative research purposes and to develop and test shared digitally based distributed infrastructures and services for smart manufacturing. In the current industrial climate with focus on efficiency and productivity gains, there is a latent risk of not fully capturing the opportunities afforded by integrated data-driven digital manufacturing platforms not only for efficiency purposes, but as a means to drive the next generation of advanced manufacturing.

Developments in big data, analytics and use of sensor technologies to monitor production processes, supply chain interactions and products in use, and when they need service, could gradually transform European manufacturing to a highly information- and knowledge intensive industry. This could allow for the type of flexibility and flow of information about customers needed for markets that are much more diverse[60]. The objectives of the Digital Agenda Europe provide a coherent framework for addressing some of the changing market challenges and opportunities[61]. Also, the 'Factories of the Future' initiative in Horizon 2020 includes actions to build such new capabilities in public private partnerships[62].

[59] https://smartmanufacturingcoalition.org/.

[60] For a wider discussion on smart manufacturing see for exampleCap Gemini Consulting (2014): *Digitizing Manufacturing: Ready, Set, Go!.*

[61] The Digital Agenda for Europe covers 13 interrelated objectives dealing with broadband coverage and use, on-line sales and roaming tariffs, Internet usage, E government, to double public investment in ICT R&D to EUR 11 billion by 2020, and to reduce energy use of lighting by 20 % by 2020.

[62] http://ec.europa.eu/research/industrial_technologies/factories-of-the-future_en.html.

Box 4: Key findings of the case study "ICT – an enabler for closing the productivity gap[63]"

The case study on "ICT as an enabler for closing the productivity gap" identified that across all sectors of the economy there is a continuing proliferation of physical facilities and devices which are connected to the Internet allowing the implementation and usage of advanced (intelligent) ICT based applications and solutions (Internet of things). The results are increasing functionalities, an increasing individualisation of products, and an increasing dynamic regarding delivery of products. The full exploitation of ICT along the internal value chain of a firm from R&D to design and to post-sale services offers opportunities to add value to products, but also increases the complexity of manufacturing processes.

The internet of things and the networked firm as well as trade in data raise new policy issues regarding data protection privacy and data security, which can only be addressed on an international scale.

Energy

Energy policy is on top of the agenda of the European Commission and Member States alike. This has not led to a coherent Europe-wide energy policy. In effect, there is no level playing field regarding energy cost, as a study on energy costs conducted by the European Centre for Policy Analysis has shown[64]. Globally, Europe is also under pressure from US manufacturing firms and their access to cheap gas. It will be a challenge for European policy to stimulate the creation of a harmonised European energy market with clear targets regarding climate change mitigation mid-term, whilst ensuring that the most energy intensive industries are not adversely affected short term.

Setting up a more coherent energy policy in Europe - comprising both objectives and instruments building on all of the opportunities of the Smart Grid is an example of an area, where European policy can accelerate transformation. Smart grids can drive innovation in consumer led services and products. Smart grids can also reduce energy costs and lead to energy efficiency for both consumers and industry through competitive pricing regulations.

Several Member States (e.g. Denmark and Germany) are currently implementing a number of policy measures to spur energy efficiency in industry, which could be effectively shared through European level actions. The importance of energy costs for energy-intensive industries is illustrated by the case study on the European construction products industry, below.

[63] See case study 7, Annex 1.

[64] Egenhofer Christian, Schrefler Lorna, Rizos Vasileios, The Composition and Drivers of Energy Prices and Costs in Energy-Intensive Industries: The case of Ceramics, Glass and Chemicals, Center for European Policy Studies, 2014.

Box 5: Energy costs – the case of the construction products industry[65]

The European manufacturing of construction materials subsector faces considerable competitiveness challenges due to the rising costs of energy and raw materials. Parts of the sector are highly energy-intensive. This particularly applies to extractive and manufacturing industries. In the cement industry, for instance, energy costs are estimated to constitute 30-40 % of total costs. Energy prices for EU industry are three to four times higher than in the US or Russia.

Interviewed industry representatives are concerned about the shift of the equilibrium in the 2020 package between security of supply, cost-competitiveness and sustainability. At present, the European energy and climate policy is focused mainly on environmental sustainability. This implies that sustainability and competitiveness are poorly connected, and that a more balanced approach, which takes into account all three objectives, is called for.

Note: The sector also has an impact on energy consumption of buildings (energy-efficient buildings/sustainable construction[66]. However, as the focus in this section is on the input side, we shall limit ourselves here to considering energy as input to the industry.

Raw materials and recycling

Availability and cost of raw materials is high on the European agenda, particularly with the European Commission's "Raw Materials Initiative" launched in 2008 and the establishment in 2012 of the "European Innovation Partnership on Raw Materials"[67].

Recycling materials – especially those that are scarce – has the triple benefit of providing new opportunities for the recycling industry, bringing environmental benefits, and reducing scarcity and/or costs of input for the industries for which the materials are relevant. Recycling of Waste of Electrical and Electronic Equipment is a case in point, as shown in the box below.

Box 6: Recycling of Waste of Electrical and Electronic Equipment[68]

Waste of Electrical and Electronic Equipment (WEEE) is defined as a combination of various metals, different types of plastics, and ceramics. Much WEEE includes so-called critical raw materials, which is a group of materials with a particularly high economic importance and a high supply risk[69].

WEEE is one of the world's fastest growing waste streams due to the short lifespan of electrical and electronic equipment. Around 10 million tonnes of WEEE are generated in Europe each year. Only a minor part of the WEEE reaches the final recycling step where critical materials are recovered for secondary use.

There are four challenges: insufficient collection of WEEE, the export of WEEE from the EU as used products rather than WEEE, sub-optimal pre-processing and dismantling, and the need for systemic solutions and interdisciplinary approaches to improve the recycling chain.

65 See case study 8, Annex 1.

66 See e.g. European Commission, Strategy for the sustainable competitiveness of the construction sector and its enterprises, COM(2012) 433 final.

67 https://ec.europa.eu/eip/raw-materials/en.

68 See case study 2, Annex 1.

69 http://ec.europa.eu/enterprise/policies/raw-materials/critical/index_en.htm.

Recycling of materials is relevant in many industries – for instance also the construction products industry. New measures to improve collection of recyclable materials should however be designed in such a way that they do not bring excessive costs upon the industries producing the waste directly or those producing the products that can be recycled.

4.4. Technological progress and innovation

Technological Innovation is critical to future competitiveness of European industry in globalised and diverse markets. To that end, the European Commission has launched a series of measures to strengthen the innovation output of research within key enabling technologies; nanotechnology, micro- and nano-electronics including semiconductors, advanced materials, biotechnology, and photonics [70]. These technologies can in combination with automation technologies and ICT bring about innovations in products, processes, and services and combinations thereof.

The case of Eindhoven provides an example of how technological innovation can drive economic growth and job creation.

Box 7: Eindhoven – innovation-driven growth[71]

The high innovation intensity in Eindhoven drives economic growth in the region and the transformation of jobs with higher knowledge intensity. The economy in the Eindhoven region recovered better from the economic crisis than the Netherlands' economy at large. In 2009, the Eindhoven region suffered from a negative growth rate of 6.4 %, but already in 2011 it showed an economic growth of 3.2 %. This was far better than the Dutch average of 1.2 %. Furthermore, the unemployment rate in the Eindhoven region has remained below the country average since 2005. In the period 2002-2013 there was a job growth of 10.2 % in the Eindhoven region, compared to a Dutch level of 6.4 %

There are however major differences in innovation performance among EU Member States as indicated also by the Innovation Union Scoreboard 2014. Key differences between the best performing Member States and those with the lowest performance concern excellence in knowledge, internationalisation, and business innovation cooperation. These factors are essential differentiators for European manufacturing firms in terms of being able to position themselves strategically in global value chains.

4.5. Production and value chains

The industrial sector in Europe consists of a total of 24 different sub-sectors[72] covering areas as diverse as the manufacturing of food products; textiles; coke and refined petroleum products; chemicals; pharmaceutical products; basic and fabricated metal products; computer, electronic and optical products; electrical equipment; machinery; and motor vehicles and other transport equipment. EU manufacturing firms are therefore highly diverse, and changing global dynamics are impacting their opportunities as global

[70] For more information on the European activities on Key Enabling Technologies see http://ec.europa.eu/enterprise/sectors/ict/key_technologies/index_en.htm.

[71] See case study 4, Annex 1.

[72] Manufacture of food products, beverages, tobacco products, textiles, wearing apparel, leather and related products, wood and of products of wood and cork, except furniture plus manufacture of articles of straw and plaiting materials, paper and paper products, Printing and reproduction of recorded media, coke and refined petroleum products, chemicals and chemical products, basic pharmaceutical products and pharmaceutical preparations, rubber and plastic products, other non-metallic mineral products, basic metals, fabricated metal products, except machinery and equipment, computer, electronic and optical products, electrical equipment, machinery and equipment n.e.c., motor vehicles, trailers and semi-trailers, other transport equipment, furniture, Other manufacturing; Repair and installation of machinery and equipment; See Nace Rev. 2 classification, Section C „Manufacturing".

leading firms increasingly reduce their number of sub-suppliers to manage quality and timely delivery. Deployment of standards and the use of automation and digital technologies become a proxy for and a prerequisite to becoming a preferred supplier, because it signals efficiency in processes, as seen in the following[73].

Box 8: Key results from the Eindhoven and EEE recycling case studies[74]

- Eindhoven: The appropriate integration of SMEs into the value chain might spur growth and competitiveness regarding innovation. Indeed, the Eindhoven case study has shown that SMEs are contributing to the right balance of firms in the innovation ecosystem.
- WEEE: A complex waste stream such as WEEE requires a systemic solution and interdisciplinary approaches to improve the entire recycling chain substantially and thereby increase the recycling rates of critical metals. It is thus important to involve players from the electronics industry, WEEE processors (at different stages of the recycling process), EEE users, etc., in this solution.

Foreign Direct Investment (FDI) can be an enabler of technology diffusion and it can drive the restructuring of the industrial base. This is underlined by the Slovak case study.

Box 9: FDI in the Slovak Republic[75]

Slovak manufacturing has been able to expand its base into a variety of products since the independence of the Slovak Republic in 1993, when manufacturing was mainly based on heavy industry. In particular, exporting enterprises in medium- and high-tech manufacturing industries have been able to add value through new solutions.

FDI has been a major driver of innovation in production as it has led to capital-induced technological innovation, which has led to more efficient manufacturing processes.

Continuing external demand and strong manufacturing activity have been key factors for the recent successful recovery of the Slovak economy.

There are examples of companies that manage to maintain competitiveness despite a relatively low labour productivity.

Box 10: Labour productivity and competitiveness of the mechanical engineering (ME) sector[76]

Even though there have been improvements of labour productivity over time (Compound Annual Growth Rate (CAGR) of 3.4 % between 1995 and 2008), overall European ME labour productivity is roughly half the productivity of the respective US sector, and Japanese ME labour productivity exceeds the EU’s level by more than 50 %.

Despite this, numerous EU ME companies exhibit a very competitive position in the global market and they perform (much) better than competitors from for example the US and the People’s Republic of China.

How can the sector at present be competitive despite its a priori disadvantage regarding labour productivity? The following factors are worth mentioning.

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73 Rytz, Benita Kidmose, Hanne Shapiro, Leif Jakobsen, *IKT i globale produktionsværdikæder*, Erhvervsstyrelsen, Copenhagen 2013 (in Danish).

74 See case studies 2 and 4, Annex 1.

75 See case study 3, Annex 1.

76 See Annex 2.

Box 11: Key characteristics spurring the competitiveness of the mechanical engineering industry[77]

Considerable parts of the mechanical engineering (ME) industry in Europe are focusing their activity on the mid-end to high-end market segment. High-end manufacturing focuses on the development and production in the premium product segment, taking account of unique customer demands. Key assets of many ME companies in Europe are longer-term, stable and trustful relationships with the customer. Innovation typically occurs in close iteration with customers, leading to a high level of specialisation.

It is not only tangible goods, in particular machinery and equipment that are supplied by a high-end ME company; the service component is increasingly important. High-end (and to a lesser extent also mid-end) ME companies provide a whole range of pre-sales and after-sales services linked to the hardware supplied to customers. Overall, this is resulting in the development of advanced solutions for client industries' production processes.

For the ME industry the specialisation enables the development of customised solutions and the incorporation of service components into the portfolio of industry outputs. Similar patterns of strategic market positioning were found in a Danish study on small, primarily family owned and highly successful manufacturing companies[78]. In contrast to ME companies, the small Danish manufacturing companies compete based on a high level of specialisation. They are at par with the German *Mittelstand* (the small family owned companies) when it comes to overall profitability including productivity.

This raises important policy questions about the future direction of SME policies. If investments are to accelerate growth in a post crisis environment, should these continue to be rather broad-based in focus or should they target different groups of SMEs, with less emphasis on sector base or level of technology intensity and more emphasis on SME market behaviours, internal capabilities, and linkages[79]?

Benchmarking with global competitors

This section provides a comparison of the EU with some of its main global economic partners including Australia, the BRIC countries, and South Africa, Canada, Japan, South Korea and the United States.

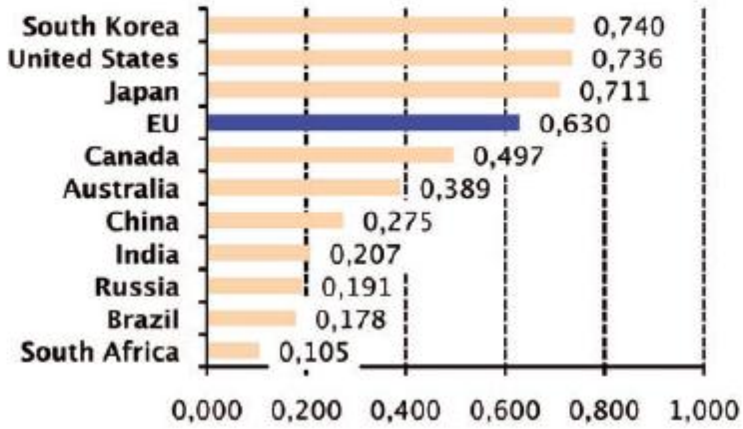
South Korea, the US and Japan have a performance lead over the EU. The performance lead has been increasing for South Korea as its growth over 2006-2013 has been more than double that of the EU. Innovation performance for the EU has been improving at a higher rate than that for the US and Japan. Consequently, the EU has been able to close almost half of its performance gap with the US and Japan since 2008. These three global top innovators are particularly dominating the EU in indicators capturing business activity as measured by R&D expenditures in the business sector, public-private co-publications and PCT patents but also in educational attainment as measured by the share of population having completed tertiary education. It means that enterprises in these countries invest more in research and innovation and that collaborative knowledge-creation between public and private sectors is better developed. Further, the skilled workforce in these countries is relatively larger than in the EU.

[77] See Annex 2.

[78] Jakobsen Leif, Yding Sørensen Stig, Shapiro Hanne, Damgaard Johansen Kasper (2013) De *Skjulte Helte Danske produktivitetssucceser*. For Forsknings- og Innovationsstyrelsen.

[79] http://www.fm.dk/publikationer/2013/vaekstplan-dk-staerke-virksomheder-flere-job/.

Figure 11: Innovation performance – the EU compared to competitor countries



Source: European Innovation Scoreboard 2014- page 29.

The lesser expenditures on manufacturing R&D in Europe also translate into fewer patents. This could indicate that there is, in fact, no "European paradox" – European firms simply spend less on R&D, resulting in fewer scientific results, which is further exacerbated by the fact that "the transition of EU research to the market seems to be more difficult than for major competitors[80]". The Competitiveness Report finds that in a number of high- and medium-high technology industries (such as pharmaceuticals, optical equipment, electrical equipment, medical and surgical equipment, telecom and office equipment, radio and TV, and accumulators and batteries), the EU is lagging behind the US in patenting. It may be hard to defend current comparative advantages in these industries if they lose their technology lead.

Developments in R&D investment are not only negative. Public R&D intensity in the EU has progressed during the crisis. After seven years of relative stagnation at around 1.85 % of GDP between 2000 and 2007, the R&D intensity of the EU has been slowly progressing since 2007, reaching 2.03 % of GDP in 2011.

This contrasts with a decrease in investments in the US and Japan. What is most noticeable globally is a rapid and sustained R&D intensity growth in South Korea and China, driven primarily by the business sector. Governments in the EU have tried to protect or increase R&D funding despite the economic crisis period of 2008-2012. Many catching-up economies, e.g. Slovenia, Poland, Estonia, the Czech Republic, and Malta, have managed to increase their public R&D budgets, the impact of these strengthened further through the EU Structural Funds and competitive R&D funding in FP7. In Germany, Austria, and the Nordic countries there has also been a growth in public R&D investments. In contrast, public R&D investments from 2008-2011 have decreased in particular in France, the United Kingdom, Italy and Spain.

Business expenditure on R&D has continued to increase in the EU between 2007 and 2011, although at a slower pace than between 2000 and 2007 (a 2.3 % average annual growth over 2007-2011 compared to a 4 % growth in the pre-crisis period). In recent years China, India, Singapore, Taiwan and Malaysia have become new centres for R&D sourcing from foreign-owned firms as part of the globalisation of knowledge production. Nevertheless, it is important to emphasise that the EU remains attractive in terms of

[80] European Commission, DG Enterprise and Industry, *European Competitiveness Report 2013:Towards Knowledge Driven Reindustrialisation*, Commission Staff Working Document SWD(2013)347 final, Publications Office of the European Union, Luxembourg, 2013c- p. 37.

foreign overseas R&D investments. US firms' investments in the EU more than doubled between 1994-2008[81].

4.6. Access to markets

Unhindered access to markets both within and outside the EU is central to the growth and competitiveness of European industry. A key objective of EU policy is to enable European firms to gain equal access to all markets within the EU – the internal market. The opening of markets beyond the EU raises new challenges and opportunities for European firms. In the following, we will therefore look at issues connected to both the internal and the external markets.

The internal market

"Since the Single Market became a reality in 1993, intra-EU trade in goods has grown as a share of GDP by around 5 percentage points. Intra-EU trade represented around 17 % of EU GDP in 1999 and close to 22 % in 2011. Furthermore, intra-EU trade represents a very high percentage of GDP in most Member States[82]". Strengthening the effectiveness of the internal market for industrial products is a key pillar in European industrial policy towards the re-industrialisation of the EU. One of the factors impacting the internal market for industrial products is exchange rates. The latter are relevant both within the European Union inasmuch as there are countries belonging to the Euro zone and countries still using their own currency. Exchange rate changes, in turn, might be favourable for some countries in the Euro zone and for others not.

While substantial progress has been made towards implementing the Single Market, barriers still exist. Although transposition and implementation of Single Market legislation by Member States has progressed and significant gains (macroeconomic effects) have been achieved, there are still gaps to be filled[83].

Various reasons for this have been identified, including the slow and sometimes incomplete implementation of EU Directives, the inadequacy of some instruments, a persistence of barriers to cross-border trade and investment, particularly in services, and the slow development of an internal market for knowledge[84].

Box 12: Key findings of the case study on construction products[85]

A key characteristic of the construction products sector (and more generally, of the whole construction sector) is the fragmented internal market. There is a new common European regulatory framework (the Construction Products Regulation from 2011), which specifies harmonised conditions for the marketing of construction products - in particular a standardised way of presenting information about the products. However, different building traditions, standards and regulations across Member States mean that there is in practice no common market. The national and even regional markets have different requirements – for instance due to different climatic/environmental conditions - which means that products have to be adapted to each market.

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81 Shapiro, Hanne, Emerging skills and competences for the HRST workforce, do higher education systems in Europe get it right? DG Research, Innovation Union, 2013.

82 European Commission, *A vision for the internal market for industrial products*, COM(2014) 25 /2, Brussels, 2014a.

83 See e.g. European Commission, Single Market Act II, COM(2012) 573 final, Brussels 2012, and the Single Market Scoreboard, http://ec.europa.eu/internal_market/score/index_en.htm.

84 Ilzkovitz Fabienne, Dierx Adriann, Kovacs, Vikotria, Sousa Nuno, *Steps towards a deeper economic integration: The Internal Market in the 21st century,* European Commission, Université Libre de Bruxelles (European Economy. Economic Papers. 271), Brussels, January 2007.

85 See Case Study 1, Annex 1.

The European Commission recently carried out an evaluation of EU law in the area of industrial products and found that "despite its stage of development and advanced integration, the internal market for products needs to continue evolving in order to keep up with the pace of technological and societal challenges of the 21 century. However, issues of regulatory stability need to be considered. Therefore, in the short term, the Commission will focus its efforts on the consolidation of legislation and the strengthening of enforcement mechanisms without furthering burdening the industry. The Commission will work on a proposal consisting of a harmonised approach to economic sanctions and a common framework for the marketing of industrial products based on Decision 768/2008/EC[86]".

Another challenge is linked to the actual implementation of market surveillance practices of industrial goods.

Box 13: Surveillance of goods[87]

Less than 1 % of all manufactured goods imported via the big European harbours are checked on their arrival for conformity with EU provisions[88, 89], and there is generally a high degree of fragmentation in Europe as to the actual implementation of market surveillance practices.

The European Commission[90] outlines that in most Member States the focus tends to be on the surveillance of consumer goods[91] while industrial goods are not given sufficient attention. Market surveillance of industrial products remains a key challenge.

Access to markets outside Europe

- The EU is the world's largest trading block and the world's largest trader of manufactured goods and services.
- The EU ranks first in both inbound and outbound international investments (see Table 5 below).
- The EU is the top trading partner for 80 countries. By comparison the US is the top trading partner for a little over 20 countries[92].

86 European Commission, *A vision for the internal market for industrial products*, COM(2014) 25 /2, Brussels, 2014a.

87 See Annex 2.

88 The result is that dangerous or counterfeit products, especially electrical, can enter the internal market. See European Economic and Social Committee (2013): Opinion on "The challenges of the European engineering industry (mechanical, electrical,- on safety of products and services electronic and "metalworking") in a changing global economy"; own initiative opinion; Rapporteur: Ms Studničná; Co-rapporteur: Mr Atanasov; Brussels, 11 December 2013; available at: http://www.eesc.europa.eu/?i=portal.en.ccmi-opinions.26786.

89 See also RAPEX http://ec.europa.eu/consumers/safety/rapex/reports/index_en.htm.

90 European Commission (2014): Staff working document accompanying the document "*For a European Industrial Renaissance*"; Comm(2014) 14; available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SWD:2014:0014:FIN:EN:PDF.

91 Nonetheless, counterfeiting and illegal trade seem to increase also in the agri-food industries; see European Commission (2014), op. cit. p. 45.

92 DG TRADE website, http://ec.europa.eu/trade/policy/eu-position-in-world-trade/.

Table 4: Share of Foreign Direct Investment in 2010

Country / region	Inward stock (%)	Outward stock (%)
EU	24.4	32.6
US	21.3	28.5
Latin America	8.1	2.4
China	3.6	1.7
Japan	1.3	4.9

Source: European Commission, DG TRADE website, http://ec.europa.eu/trade/policy/eu-position-in-world-trade/.

Global markets are not only of growing importance for large companies with a broad portfolio of products and thousands of employees. European industry also includes a great number of smaller market participants, many of which are "hidden champions" (cf. the previous section), which are among the world market leaders in their specific niche market segment. The EU's trade relationship with the BRIC countries has increased in importance for the EU. The total value of exports from the EU to Brazil, Russia, India, and China increased from USD 80.6 billion in 2001 to USD 432.57 billion in 2011. In percentage of total EU trade, EU exports to the BRIC countries formed 14 % of total EU exports in 2001. In 2011, exports to the BRIC countries accounted for 29.7 % of all goods exported from the EU-27 – an average increase in share of EU exports of 1.5 % a year[93].

Box 14: Market access[94]

Dismantling of trade barriers is not only a relevant issue for growth markets (e.g. BRIC) but also for emerging markets and in advanced economies such as the US (Transatlantic Trade and Investment Partnership, TTIP)[95].

A particular challenge is the diversity in certification systems in countries outside the EU. In several non-European countries, there are specific requirements to be fulfilled regarding product sales that in effect turn out to be protectionist measures as the costs of adaptation to meet the requirements are too high.

The European Commission explicitly has stated trade barriers also for the forest-based industries and the glass industry[96].

EU trade policy should therefore continue to identify existing market entry issues in markets outside Europe, should combat protectionism and seek to open up markets, and should seek to ensure a level playing field for European companies compared to their counterparts in other parts of the world by lowering non-tariff barriers.

93 Doody, Justine, *Shutting Out the BRICs? Why the EU Focuses on a Transatlantic Free Trade Area,* Global Economic Dynamics, Bertelsmann Stiftung, 2013, http://www.ged-project.de/viz/articles/shutting-out-the-brics-why-the-eu-focuses-on-a-transatlantic-free-trade-area/.

94 See Annex 2.

95 Issues relevant for European ME firms are e.g. the harmonisation or alignment of technical requirements, standards, and acceptance procedures as well as the mutual recognition of certificates and specific materials.

96 See European Commission (2014). As to the forest-based industries the document underlines that protectionist measures on international markets are creating market distortions, both for import of input materials and export of final products. As to the glass industry the document states that fighting unfair trade practices is a key challenge.

Shifts in consumer behaviour

Consumers in the European Union but also outside Europe have been affected by the financial crisis. Consumer confidence and spending have dropped. Apart from these short-term effects, critical factors for future competitiveness and growth are changing consumer preferences and changes in location of demand to the BRIC countries and to emerging markets in South East Asia and in Africa. The need to be closer to growth markets to better understand and accommodate for the needs in these markets is therefore an important outsourcing driver.

The effects of the demand shift to emerging economies as well as the challenges and opportunities it represents vary across industry sectors. In processing industries such as food processing, industry growth in output has followed growth in demand with an increase in India, Brazil and China from 8 % to 18 % annually in nominal terms since 1995. In the same period, annual growth rates in food processing industries in advanced economies have remained at 2-3 %. The shift in demand increases the complexity of strategic planning. Africa, China, India, and Brazil comprise highly diverse markets representing a potential volume in demand which makes them highly attractive in spite of the complexity of understanding demand patterns in these new markets. As an example, the GDP of the city Shanghai is the same size as that of Switzerland[97].

As for the shifts in consumer preferences, Accenture has identified "10 dimensions of consumer behaviour change that are affecting the ways in which, and the reasons why, consumers buy[98]". European industry focuses on mid- to high-end product and technology solutions offered on the worldwide markets. Thus, to the extent that such shifts in consumer behaviour persist, the need arises for European industry to react to the changes in order to maintain the currently existing competitive advantage. In the opposite end, pharmaceuticals experience growing pressure to be able to deliver generic products in a range of areas, for example diabetes, in the new emerging markets. Navigating in emerging market is therefore a considerable challenge and requires resources, which are typically beyond the capacity of the individual SME.

4.7. Firm creation and growth

It is often brought forward in policy documents that Europe is less effective at bringing research to the market compared to its main competitors such as the US, Japan, and South Korea due to the absence of an entrepreneurial culture[99].

The most recent Eurobarometer survey on entrepreneurship[100] provides some evidence. In 2012, 37 % of Europeans said that they would prefer to be self-employed, while 58 % preferred to be an employee. This contrasts quite sharply with other regions, where the percentages preferring to be self-employed are much higher: 51 % in the US, 56 % in China and 53 % in South Korea. What is more, attitudes seem to have changed drastically during the crisis. Fewer Europeans now see it as attractive to become self-employed. In the previous survey conducted in December 2009, the responses were more evenly split:

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[97] McKinsey Global Institute, Manufacturing the future. The next era of global growth and innovation, 2012.

[98] Accenture distinguishes 10 types of consumers: Connected consumers; social consumers, co-productive consumers, individual consumers, experiential consumers, resourceful consumers, disconnected consumers; communal consumers, conscientious consumers, and minimalist consumers. See Accenture (2013): Unlocking Industrial opportunities – An EU strategy for competitiveness, study prepared for the European Business Summit 2013; available at: http://www.accenture.com/SiteCollectionDocuments/PDF/Accenture-EBS-2013-Unlocking-Industrial-Opportunities.pdf.

[99] European Commission, DG Enterprise and Industry, *European Competitiveness Report 2013:Towards Knowledge Driven Reindustrialisation*, Commission Staff Working Document SWD(2013)347 final, Publications Office of the European Union, Luxembourg, 2013c.

[100] European Commission, *Entrepreneurship in the EU and beyond*, Flash Eurobarometer 354, 2012a.

then, 45 % expressed a preference for being self-employed, while 49 % said they would rather work as an employee. There is an increasing awareness that other than the individual characteristics, the broader environment influences the entrepreneurial opportunities, hence the growing interest in entrepreneurial eco-systems.

The regulatory environment also impacts entrepreneurial behaviour, for example the ability for failed entrepreneurs to get a "second chance" and start again[101]. Therefore, actively supporting a 'second chance' policy can potentially create more start-ups and thereby growth in Europe. Some initiatives have already been taken at European and national level to address this problem. In May 2011 the Competitiveness Council invited "Member States to promote a second chance for entrepreneurs by limiting, when possible, the discharge time and debt settlement for honest entrepreneurs after bankruptcy to a maximum of three years by 2013", which is now implemented in many Member States. Furthermore, the European Commission launched a new approach to business failure and insolvency[102], which includes a proposal to amend the Council Regulation on insolvency and a Communication. The main objective of this is to shift the focus away from liquidation towards encouraging viable businesses to restructure at an early stage to prevent insolvency.

The case of Eindhoven provides a prime example of how entrepreneurship and growth of small companies can be fostered in a close "triple helix" collaboration characteristic of eco-systems for entrepreneurship.

Box 15: Eindhoven – an environment fostering growth and innovation[103]

The key player in the Eindhoven area is the Philips Research Laboratories – with more than 1,500 researchers located in Eindhoven – that opened up its facilities to other technological companies in 2003. This laid the foundation for the open innovation hub High Tech Campus Eindhoven that consists of more than 120 companies. The campus contains both research institutions and a wide range of companies from start-ups (around 40) to SMEs and global companies. The High Tech Campus is an example of how co-location can foster innovation collaboration that benefit all the firms involved. The campus constitutes a knowledge hub of High Tech companies that together makes an innovative ecosystem. According to the High Tech Campus Manager for Marketing and Communication (interview), such an innovative ecosystem must have the right balance of firms, including multinationals, SMEs, service providers, and research institutes. Start-ups are important because they bring inspiration into the ecosystem. For large firms, start-ups can be a way to cash in on intellectual property if the large firms create start-ups based on spinout technology from their research activities.

Summing up, many factors are at play when it comes to firm creation and growth, which also has to do with the wider institutional environment.

Administrative and regulatory framework

Since 2006, the European Commission has worked on a comprehensive programme to reduce the regulatory burdens created by EU legislation (e.g. in connection with reporting and monitoring) – making administrative processes easier and more efficient for citizens and businesses. The Commission's initiatives followed that of several Member States, for example the Netherlands and Denmark, which had begun in the preceding years. A High

[101] See for instance PLANET S.A. et al. (2011) economic impact of legal and administrative procedures for licensing, business transfers and bankruptcy on entrepreneurship in Europe.

[102] Insolvency: Commission recommends new approach to rescue businesses and give honest entrepreneurs a second chance, http://europa.eu/rapid/press-release_IP-14-254_en.htm.

[103] See case study 4, Annex 1.

Level Group (HLG) of Independent Stakeholders on Administrative Burdens was set up in 2007 and is still active (the mandate has been extended twice, currently until October 2014). The focus of the work of the HLG is now on small businesses and micro enterprises, and how to make Member State public administrations more efficient and responsive to the needs of stakeholders when implementing EU legislation[104].

At the level of EU legislation, the Regulatory Fitness and Performance Programme (REFIT) systematically undertakes a review of EU legislation to simplify and reduce administrative burdens[105]. The way in which the Commission now prepares regulation has changed significantly. Impact assessments and stakeholder consultations are systematically applied across the Commission. Red tape has been reduced by well above the 25 % target set out in the Administrative Burden Reduction programme[106].

Between a third and half of administrative burdens in Europe are said to derive from EU regulation, but almost a third are not derived from legislation as such, but from inefficient national implementation of the requirements[107]. Future reduction of administrative burdens thus depends on better implementation in Member States. The HLG has identified a number of best practices in Member States, and the Group recommends that Member States set up an exchange of best practice. Further, the HLG recommends promoting the use of eGovernment and digital solutions as key tools for reducing the administrative burdens on companies to access necessary information.

An example of recent legislation which is seen as imposing heavy administrative burdens on companies is the Construction Products Directive. It is clear that some burdens could be eased through digitisation so that the companies covered by the Regulation could provide the required information by electronic means only, but a requirement to submit the information on paper as well has been maintained.

Box 16: The Construction Products Regulation – administrative burdens[108]

The new Construction Products Regulation (CPR), which replaced the Construction Products Directive from 1989, entered into force in 2011 and most of the "operative articles" were to be applied from 1 July 2013. The new regulation establishes conditions for placing and/or availability of construction products in the market by establishing harmonised rules on how to express the performance of construction products and on the use of CE marking on those products. Compared to the 1989 Directive, the CPR requires displaying additional information on characteristics of construction products and also establishes new basic requirements for construction works. This could lead to additional administrative burdens for companies.

One of the key differences between the former Construction Products Directive and the new Construction Products Regulation is the requirement to supply a copy of the Declaration of Performance in paper form or by electronic means. This obligation has caused an extensive discussion among the construction products manufacturers.

Some of the necessary acts for implementation of other CPR requirements are still in the process of being drafted by the Commission. The industry is concerned with the practical administrative implications of several of these articles and awaits the drafts from the Commission with anticipation.

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[104] See http://ec.europa.eu/smart-regulation/refit/admin_burden/high_level_group_en.htm.

[105] http://ec.europa.eu/smart-regulation/refit/index_en.htm.

[106] European Commission, Regulatory Fitness and Performance (REFIT): Results and Next Steps, COM(2013) 685 final, Brussels 2013h.

[107] High Level Group of Independent Stakeholders of Administrative Burdens, Europe can do better: Report on best practice in Member States to implement EU legislation in the least burdensome way, European Commission, Warsaw 2011.

[108] See case study 8, Annex 1.

Apart from the continued existence of administrative burdens, industry representatives in the construction products sector and in mechanical engineering point to the need for more regulatory stability. The investment horizons of industry are often long, but the changes of the regulation occur frequently, for example regarding energy conservation, product safety, work safety, and environment. This results in an uncertain environment for long-term investments, costs of changing product features, transaction costs related to integrating new requirements into their business, etc. The Commission has recognised that the uncertainties and inconsistencies in the regulatory environment are a likely reason why investment by European companies has stayed well below long term values and seems to be unresponsive to policy actions following the economic crisis[109].

[109] European Commission, *Industrial performance scoreboard - A Europe 2020 initiative*, Commission Staff Working Document, Brussels, 2013e.

5. CONCLUSIONS AND POLICY RECOMMENDATIONS

Shaping European "industrial policy" is an on-going task. What the notion of industrial policy entails is in no way straightforward. Current and planned measures illustrate that industrial policies are now broader in scope, driven by the fact that there are a broader set of factors, which impact competitiveness in the longer perspective. This is illustrated by the way in which World Economic Forum measures competitiveness and the set of indicators used to do so. It is worth while noting that not all the EU-28 Member States are defined as being part of the group of innovation economies according to the World Economic Forum's measurement. This is also why several of the recommendations provided in the following section strongly emphasise what is also at the core of the Open Method of Coordination – the need for systematically sharing best practices based on rich and comparable data. The differences between Member States as well as similarities between groups of Member States can enable policy learning.

The analysis has led to the identification of eight factors which are particularly relevant for the medium term growth and competitiveness of the European industrial sector. These eight factors are:

- the relevance and quality of skills and the relative cost of labour,
- access to finance,
- inputs: Energy and raw materials, and ICT,
- innovation and R&D,
- entrepreneurship,
- production and value chains,
- access to markets,
- administrative and regulatory framework conditions.

The following present our recommendations based on the analysis in previous sections.

5.1. Skills

The European Alliance for Apprenticeship recently formed at the initiative of the European Commission should with the direct involvement of the relevant stakeholders take action to develop an automation and digitalisation competency framework for the European manufacturing industry at the skilled worker/technician level - similar to actions taken regarding the e-competency framework. This must be linked to the European qualification framework to create coherence to existing European policy instruments. It is particularly aimed to support to those countries that are in a process of major restructuring of their manufacturing, and as an alternative to offshoring.
Time frame: Immediate action.

Member States could take timely action to avoid future skills mismatches in manufacturing by implementing accelerated apprentice routes for particularly the unskilled part of the workforce who lost their jobs in manufacturing during the crisis. Such initiatives should be focused on up-skilling for advanced manufacturing based on new automation and digital technologies.
Time frame: Immediate action.

Under the management of the European Foundation for Working and Living Conditions a regular survey mechanism on the job destruction and job creation effects of advanced automation and digitalisation in manufacturing should be established.
Time frame: 2015 - 2023.

Knowledge about the supply and demand of skills for advanced manufacturing exists only at a highly aggregate level (so-called STEM skills). Eurostat should in cooperation with national statistical offices take initiatives to develop better statistical instruments to measure skills demand and skills supply in advanced manufacturing, linked to key enabling technologies (KETS).
Time frame: Immediate – on-going.

Another instrument for upgrading the skills of the manufacturing workforce that has been made redundant during the crisis is lifelong learning systems. These are, however, advanced to a varied level across the Member States. To create efficiency of scale and linked to the European Commission "Opening Education Initiative[110]" a feasibility study should be launched to assess a European modular structure for advanced manufacturing course delivery, and it should propose a delivery model including an assessment of a viable model for a digital solutions[111].
Time frame: 2014-2015.

As part of the European Skills Panorama Initiative and complementary to the EUROSTAT initiative on Global value chains, a study should be commissioned to analyse how skills supply and demand can be analysed qualitatively and quantitatively within the context of global value chains.
Time frame: 2015-2017.

The commercial exploitation of emerging technologies increasingly builds on technological convergence, making skills anticipation more complex. More information about the long-term emerging skills needs within different broad converging industry areas such as the biotech is needed. To ensure widest possible impact such measures should be taken in close cooperation with established KET/multi KET platforms. A study undertaken by the European Chemistry Industry, CEFIC, represents a best practice example as it both covers skills needs for engineers and scientists as well as proposals for core curriculum[112].
Time frame: Immediate action.

5.2. Access to finance

There is evidence based on the most recent survey data from European Central Bank that access to finance is improving overall, but with big differences between Member States.

Proposals for actions:

The European Parliament is ideally positioned together with UEAPME (the European Association of Craft, Small and Medium-sized Enterprises) to ensure that better and more reliable on-going information about the financing situation of SMEs reaches relevant national stakeholders through relevant media channels. The European Commission should set up mechanisms to monitor the use, uptake and adequacy of EIB financing instruments with a view to monitoring their short and medium term uptake and impact.
Timeframe: immediate action.

Securitisation is increasingly perceived as a means to spread risk in lending to SMEs. The EU Commission should initiate a comparative documentation and analysis of best practices to help stimulate the uptake of consistent best practices among Member States. A high-level seminar should be convened in cooperation with UEAPME and with involvement of

[110] http://ec.europa.eu/smart-regulation/impact/planned_ia/docs/2013_eac_003_opening_up_education_en.pdf.

[111] http://see.stanford.edu/.

[112] CEFIC-"Skills for Innovation in the European Chemical Industry", http://www.cefic.org/Policy-Centre/Industry-Policy/Skills-Needed-for-Innovation/.

relevant financial actors to stimulate uptake and dissemination of practices.
Time frame: immediate action.

There are particular funding needs for high growth SMEs and midcap businesses in terms of long term investment capital, for example linked to advanced upgrading of the manufacturing infrastructure or investments needed for strategic expansion to emerging markets. If these companies cannot get such investment capital within the EU, their only alternative can be to be bought up by investors from outside the EU. Building on the recommendations of the so-called UK Breedon report for the establishment of a European Agency for Capital Lending[113], a European comparative assessment should be conducted regarding existing national and EU instruments for long-term investment capital, and the adequacy, usage, and limitations of existing instruments. Based on such an analysis a number of scenarios should be developed with the relevant user groups as the basis for a consolidated proposal for a European framework for long-term investment capital. *Time frame: 2015- 2020 – possibly as a regular monitoring mechanism.*

There is evidence that there is some level of information asymmetry in terms of the funding available for strategic development and R&D purposes, particularly at the EU level. In cooperation with national and regional SME and sector organisations, steps should be taken to correct the situation, which should then be monitored closely. *Time frame: immediate action*.

5.3. Inputs – energy and raw materials

Raw materials

A European benchmark and monitoring framework should be established as the basis for a long-term action plan for the realisation of a circular economy. *Time frame: 2014-2015*.

EU funded initiatives that prioritise circular economy concepts in Smart City initiatives should be prioritised.
Time frame: Immediate action.

Upcoming European trade negotiations should put raw material trade high on the agenda, it should seek to identify WTO-incompatible restrictions, and find appropriate long-term solutions to secure access to raw materials which need to be sourced by European industries on world markets.
Time frame: Immediate action.

Current EU regulations concerning waste at EU level should be reassessed with a view to their intended and non-intended effects on implementation of the circular economy.
Time frame: 2015-2020.

An EU-28 study on approaches to the circular economy in countries handling of waste should be conducted as the basis for dissemination and dialogue on best practices. Steps could be taken at European level towards encouraging further integration of waste streams, their handling and recycling, supporting coordinated action across groups of Member States for instance with respect to investment in shared facilities for recycling of high-value waste such as precious materials, preferably in co-operation with private investors (Public-Private Partnership).
Time frame: 2015-2020.

[113] www.afme.eu/WorkArea/DownloadAsset.aspx?id=7139.

Energy

Building on the Communication on "Smart Grids: from innovation to deployment"[114] and the follow-up study on security measures, a European-wide monitoring framework should be established to share and promote best practices in Member States regarding the 11 security risks identified.
Time frame: Immediate action - ongoing.

A grid modernisation ranking should be established with indicators on the policy and regulatory environment, consumer engagement, grid operations improvements to facilitate the move toward a more innovative and efficient smart grid. An EU smart-GRID implementation award could be considered, as used previously in the EU E-government policy framework.
Time frame: Immediate action, on-going monitoring framework.

The European Commission could take the lead regarding issues relating to data ownership of consumer data from smart grids. Policies that put consumers in charge of the access to their data will also allow for innovation in consumer-focused applications and consumer-oriented services.
Time frame: 2015-2020.

Future smart grids are expected to incorporate dynamic pricing for electricity consumers, to improve market efficiency through demand response. A timely action could be that the Commission undertakes a study on the potentials of dynamic pricing to drive economic efficiency, energy savings, and integration of renewable energy within EU and to accelerate implementation of smart grids in the EU.
Time frame: Immediate action.

The Commission should in cooperation with the relevant actors at EU and Member State level take actions to promote regulations which require utilities to develop and propose performance-based metrics, which could maximise the value of utility smart grid investments. There are lessons to be learned from models adopted for example in California and Ohio in the US.
Timeframe: 2015-2020.

5.4. Innovation

The European Commission has taken important actions to secure the long-term industrial R&D basis in Europe - notably linked to the various initiatives on key enabling technologies and with the Horizon 2020 programme. With lack of demand as the biggest problem at present for SMEs, actions are needed however to stimulate the market. The European science, technology, and engineering workforce is aging, and therefore new cohorts must be attracted to pursue an industrial science career.

Areas for possible intervention

Public technology procurement is a policy instrument with large potentials to contribute to the 3 % target[115]. The boost to innovation derived from defence spending in the US could be matched in Europe by innovation-oriented procurement in sectors such as health, public security, environment, waste, energy refurbishment of public buildings and buildings as energy efficient systems. Indicators, best practice studies on impact should be disseminated widely. The concept of "European Networks of Procurers" has already been introduced in certain parts of Horizon2020; initiatives in this area could be further supported.
Time frame: 2015-2020.

[114] European Commission, Smart Grids: from innovation to deployment; COM(2011) 202 final; Brussels 2011.
[115] 2020 strategy sets a 3 % objective for R&D intensity.

The delayed payments in the European R&D programmes constitute a considerable cash flow barrier in SMEs. Immediate action should be taken with the relevant stakeholders to explore different solutions for the improvement of the cash flow solutions. All programmes should at least contain information about cash flow guarantees that can be used in negotiations for loans or bank guarantees.
Time frame: Immediate action.

The relationship between an excellent science base and industrial innovation is far from automatic. Continuing emphasis upon the whole range of direct measures that exist to promote industry-science relations is needed. This could for example include training modules in PhD programmes on all the aspects that are concerned with commercialisation of R&D.
Time frame: 2015-2020.

European benchmarks within the European Innovation Union Scoreboard should be established about the number of PHDs that take up an industrial research career after completion of their PhD.
Time frame: 2015-2017.

A European statistical monitoring mechanism should be established as part of the Innovation Scoreboard to monitor off-shoring of European R&D and its effects on the national labour markets for the science, technology and engineering. It should be linked to the existing inter-country statistical cooperation on off-shoring.
Time frame: 2014- 2016.

European Monitoring on mechanisms to promote private investment in high-risk or prioritised R&D projects should be established to promote and learn from best practices at Member State level.
Time frame: immediate action.

5.5. Entrepreneurship

Benchmark and monitoring tools have been published, but changes are by no way uniform- and few are of a systemic nature.

There is some evidence from both EU studies and from the OECD, that eco–innovation systems have some impact on entrepreneurial business performance. The feasibility of establishing an SME accelerator growth program for high-potential start-ups in connection with existing and emerging eco systems of innovation should be examined, drawing on global best practice.
Time frame: 2015-2020.

The Madame Curie Initiative should include an action line specifically targeting European researchers who are in the initial stage of company creation and/ or international researchers who wish to pursue an industrial research career in Europe.
Time frame: 2015 – on-going.

Within Horizon 2020 or the ProInno platform a virtual laboratory, which connects existing and emerging eco-innovation systems, could be a means to systematically begin to collect data about their development characteristics and enablers over time, as a basis for more systemic initiatives on entrepreneurship[116].
Time frame: 2015-2020.

[116] A study on the performance of Europe's fastest-growing companies shows that companies founded by re-starters have higher turnover and employment growth than companies run by entrepreneurs who have never failed. Source: *Setting the Phoenix Free.* Boston Consulting Group, 2002.

5.6. Production and value chains

A full indicator framework monitoring the EU initiative to promote "the smart use of information technologies for SME integration in global value chains [117]", should be established at the micro, meso and macro level. It should link closely to the Eurostat work on global value chains. It should include indicators on the role of ICT for improving productivity as well as its enabling role in resource optimisation. A high level seminar should ensure that the notion of global value chains and the enabling role of ICT is embedded in the national policy framework of European Member States.
Time frame: Immediate action - 2020.

The Commission must undertake an internal review of horizontal SME actions to ensure that they are aligned to the EU initiative on smart use of ICT for SME integration in global value chains.
Time frame: immediate action.

5.7. Access to markets

A key objective of EU policy is to enable European firms to have equal access to all markets within the EU – the internal market. The global market is a key to a significant part of EU industry, both with respect to trade and investment.

The internal market

While substantial progress has been made towards implementing the Single Market, barriers still exist. Although transposition and implementation of Single Market legislation by Member States has progressed and significant gains (macroeconomic effects) have been achieved, there are still many gaps to be addressed. Many of these issues relate to correct implementation of existing soft and hard regulation by Member States, for instance in relation to the principle of mutual recognition. Commission has therefore decided in the short term to focus its efforts on the consolidation of legislation and the strengthening of enforcement mechanisms and other application of EU law, in co-operation with the Member States. This decision is strongly recommended to achieve the intended implementation of existing rules and enforcement mechanisms relating to the Internal Market. *Time frame: Immediate action.*

Access to external markets

The EU is the world's largest trading block and the world's largest trader of manufactured goods and services. It ranks first in both inbound and outbound international investments and is the top trading partner for 80 countries (while the US is the top trading partner for a little over 20 countries). The EU's trade relationship with the BRIC countries increased more than five-fold between 2001 and 2011.

There are protectionist behaviours and non-tariff trade barriers in a number of foreign markets. For some sub-segments of the European industrial sector, the risk of IPR violations is a particularly important. Developments in ICT also have implications for trade. EU trade policy should therefore continue to identify existing market entry barriers in markets outside Europe. It should combat protectionism and seek to open up markets, and it should seek to ensure a level playing field for European companies in other parts of the world by reducing non-tariff barriers[118]. *Time frame: Immediate action*.

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[117] http://ec.europa.eu/enterprise/sectors/ict/ebsn/index_en.htm.

[118] The Transatlantic Trade and Investment Partnership (TTIP) is a trade agreement that is presently being negotiated between the European Union and the United States. It aims at removing trade barriers in a wide range of economic sectors to make it easier to buy and sell goods and services between the EU and the USA. http://ec.europa.eu/trade/policy/in-focus/ttip/.

5.8. Administrative and regulatory framework conditions

For almost a decade, the European Commission has worked on a comprehensive programme to reduce regulatory burdens created by EU legislation, following the initiatives of several Member States.

These initiatives have had an effect. It is estimated that red tape has been reduced by well above the 25 % target set out in the Administrative Burden Reduction programme. Between a third and half of administrative burdens in Europe are said to derive from EU legislation; however almost a third are not derived from legislation as such, but from inefficient national implementation of the requirements. Future reduction of administrative burdens thus depends on better implementation in Member States.

Key tools for continuing simplification and reduction of burdens include the use of eGovernment and digital solutions for reducing the administrative burdens on companies. *Time frame: Immediate action.*

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ANNEX 1: CASE STUDIES

Annex 1.1: Case study: The European Eco-Industry – access to finance

ABSTRACT

Before the economic crisis in 2008, Europe was at the forefront with regards to the exploitation of technology opportunities presented by a progressive eco-industry. However, the economic crisis has led many political agents to postpone environmental investments. Lack of competences and lack of capital are two large obstacles for the further development of the cleantech industries. Financing is difficult to obtain, as cleantech investments are highly capital intensive and the time horizon for achieving success is rather long. Although it is possible for SMEs to obtain funding for tests and demonstrations through for instance Horizon 2020, there is a lack of funding for implementation when the technologies are ready for commercialisation. New ways of financing, for instance Public-Private Partnerships, ESCO models and measures that can decrease the risks for venture capitalists, should therefore be promoted.

The sector

The eco-industry is a broad category. According to OECD and Eurostat, the core eco-industries are "sectors within which the main – or a substantial part of – activities are undertaken with the primary purpose of the production of goods and services to measure, prevent, limit, minimise or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems[119]".

Two broad categories of eco-industries can be considered, according to the European Commission. One category contains small and innovative companies acting in the field of for instance renewable energy, waste recycling, environmental auditing and consultancy. The other contains the more capital-intensive enterprises providing goods and services in specific areas such as waste, wastewater, and transport[120]. It is especially the SMEs that experience problems with funding. EU funding is often available for these companies for test and demonstration[121].

The EU has set ambitious targets to reduce carbon emissions, increase use of renewable energy and improve energy efficiency. Meeting these targets requires new businesses and technologies, and intelligent use of capital[122].

Contributions and challenges for competitiveness and growth

Before the economic crisis in 2008, Europe was at the forefront with regards to the exploitation of technology opportunities presented by a progressive eco-industry. In fact Europe possessed a market share ranging from 30 % to 50 % in almost all eco-industry subsectors, and Europe was especially far ahead in such subsectors as renewable energy, water supply and recycling. However, the economic crisis has led many political agents to postpone environmental concerns[123]. Europe has been at the cutting edge on the international stage. From electric vehicles to software applications for environmental-quality monitoring, Europe is a leading investor in cleantech. However, maintaining this

[119] Ecorys et al (2009): Study on the Competitiveness of the EU Eco-Industry – Part I and II.

[120] http://ec.europa.eu/enterprise/policies/sustainable-business/eco-industries/index_en.htm.

[121] Interview with Copenhagen Cleantech Cluster.

[122] EVCA (2010): Bridging the Chasm: Venture capital is critical to delivering Europe's low carbon objectives and 21st century European jobs and companies.

[123] Ecorys et al (2009): Study on the Competitiveness of the EU Eco-Industry – Part I and II.

high level of leadership requires even greater commitment, given the increasing performance of other players such as the US and China. This is where venture capital can provide support to commercialise technologies and create jobs in high-tech growth industries[124].

Figure 12 shows that the clean technology market is expected to grow towards 2015 with green buildings, smart grid, and offshore wind as the fastest-growing platforms. However, the 'centre of gravity' for clean technology growth is moving towards the US and Asia.

One reason for this can be found in lack of capital. In general, there are two major challenges in realising clean technology projects; lack of capital and lack of competences. There is often a competence gap. This occurs if urban planners/politicians are not knowledgeable about the latest methods and technologies, and/or if they think along traditional lines, using solutions that they know and which have worked before. The competence gap on city level/planning level can cause projects to follow more traditional patterns with well-known technology, processes, and relations instead of potentially more attractive clean technologies[125].

The basic problem with financing is that cleantech investments are highly capital intensive and the time horizon for achieving success is almost as long as for new pharmaceutical products in the biotech industry[126]. This means that many venture capitalists are reluctant to invest in clean technology, since the risks are too big and the return on investment too slow.

Data show that in 2009 alone, venture and growth capital investments in Europe totalled more than EUR 1 billion in over 300 European cleantech companies. Moreover, 85 % of the capital required to provide Europe with low-carbon growth came from the private sector[127]. However, although cleantech is relatively dependent on the private venture capitalists, not all projects can be funded through venture capital – especially not the ones with a long ROI. In 2009, the problem of access to financing was described as follows: "Some of the eco-industries were hit hard by the lack of access to finance. For instance, in the environmental technologies industry, investments are often considered to be riskier than other technology investments. These perceived risks have a negative influence on capital injections. Venture capitalists that are active in the market mainly focus on larger companies and projects and less on SME's, who will have to rely on local banks for their funding. They tend to be rather risk-averse and are not specialised enough in the technological characteristics of eco-industry projects to fully evaluate the risks involved. The situation has furthermore been aggravated by the crisis, so the need to find new investors is urgent[128]". This situation is still valid today.

Policies

Third party financing models are developing, driven by a lack of financing for implementation of technologies, especially for SMEs. One of the key ways to overcome high capital intensity and long time horizon or return is the use of (large) Public-Private-

[124] Cleantech investment: a key component for Europe's sustainable future http://ec.europa.eu/environment/ecoap/about-eco-innovation/business-fundings/eu/624_en.htm (21-03-2014).

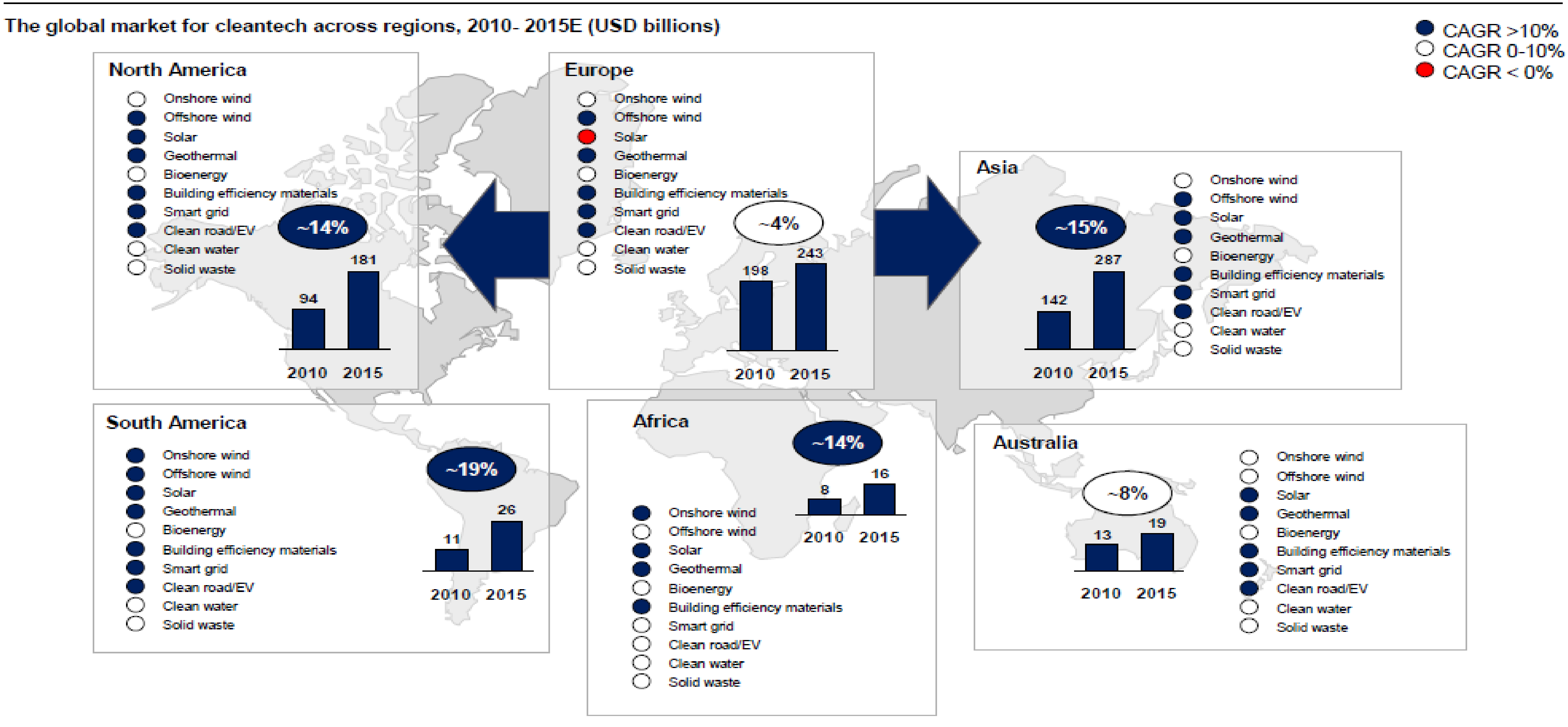
[125] Copenhagen Cleantech Cluster (2012): *The Global Cleantech Report 2012.*

[126] Berlingske Business (2014): *Nyt initiativ skal puste nyt liv i cleantech*, http://www.business.dk/vaekst/nyt-initiativ-skal-puste-liv-i-cleantech and Berlingske Business (2014): *Ventureselskaberne tøver med at investere i cleantech* http://www.business.dk/vaekst/ventureselskaberne-toever-med-at-investere-i-cleantech (in Danish).

[127] EVCA (2010): Bridging the Chasm: Venture capital is critical to delivering Europe's low carbon objectives and 21st century European jobs and companies.

[128] Ecorys et al (2009): Study on the Competitiveness of the EU Eco-Industry – Part I and II.

Figure 12: The global market for cleantech across regions, 2010-2015



Source: Copenhagen Cleantech Cluster: Global Cleantech Report 2012. CAGR: Compound Annual Growth Rate

Partnerships (PPP). The nature of PPP is that the design of solutions and the financing of projects is "outsourced" to solution partners and consortia and financed over running costs. According to Copenhagen Cleantech Cluster, PPP has been growing and it is expected that this growth will continue. In addition, energy service models such as ESCO models will be an enabler in making available the resources needed[129]. An ESCO-model (ESCO stands for Energy Service Company) implies that a private company collaborates with its public or private customer to achieve energy savings, and is thus a form of PPP. The private company plans and implements a range of energy optimising renovations.

The investment is financed through the energy savings achieved, which then "pay" for energy renovation. The private party guarantees for the energy savings. When a project starts, a baseline for the clients' energy consumption is established, and this is used by the private company (the ESCO) to guarantee certain energy savings. If the guaranteed savings are not achieved, the ESCO covers the financial loss[130]. This is clearly an advantage for the client and may help finance more projects in the future. However, for the private company there are still large risks involved if the energy savings cannot be met[131].

The industry has explored new models of open innovation where a group of companies work together to create a full value chain as a basis for creating a full-scale solution with the client. For SMEs, it is a means of overcoming limitations of size and meeting client demands for a full solution rather than a specific component or a technology. A number of companies function as facilitators in each Member State (in Denmark, it is for instance the Copenhagen Cleantech Cluster).

Alternative financing models are also seen. In Denmark, venture capitalists have been reluctant to invest in clean technology projects, as few companies have yet been able to make a profit. To overcome the long time horizon for a return on investments in cleantech projects, a Danish company called 1st Move has developed a model in which investors via the alternative exchange, Danish OTC[132] (stands for Over-The-Counter), can sell their shares on an on-going basis. This makes the shares more liquid and allows investors to avoid a loss if they want out of an investment earlier than planned[133].

Conclusions

Financing is a large obstacle for the further development of cleantech industries. Cleantech investments are highly capital intensive and the time horizon for achieving success is almost as long as for new pharmaceutical products in the bio-tech industry. Many venture capitalists perceive investments in clean technology as being too risky.

PPPs, where the design of solutions and the financing of projects are "outsourced" to solutions partners and consortia and financed over running costs, can be a means to overcome barriers to capital investment. The Danish model where investors via the alternative exchange, 'Danish OTC' sell their shares on an on-going basis could be replicated and transferred.

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[129] Copenhagen Cleantech Cluster (2012): *The Global Cleantech Report 2012.*

[130] Udbudsportalen – ESCO-samarbejder http://www.udbudsportalen.dk/Strategi-og-Politik/ESCO/ (28-03-14) (in Danish).

[131] Interview with Copenhagen Cleantech Cluster.

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Annex 1.2: Case study: Electronics recycling

ABSTRACT

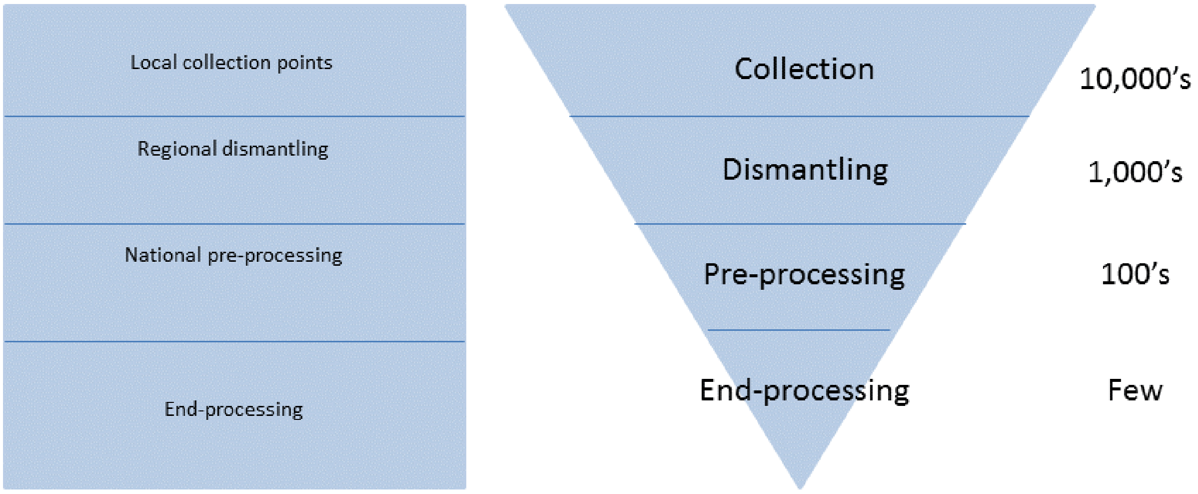
Natural resources used for electronics and electric equipment are concentrated in few countries, which increase Europe's dependency on these countries. Therefore, recycling of Waste of Electronics and Electrical Equipment (WEEE) becomes increasingly important. There are large economic gains related to recycling of WEEE. Critical challenges for European companies are insufficient collection of WEEE; sub-optimal pre-processing and dismantling; the export of WEEE from the EU is in the form of used products rather than WEEE; there is a need for systemic solutions and interdisciplinary solutions to improve the recycling chain.

The sector

Waste of Electrical and Electronic Equipment (WEEE) is defined as a combination of various metals, different types of plastics and ceramics. Much WEEE includes so-called *critical raw materials*, which is a group of materials with a particularly high economic importance and a high supply risk[134]. Twenty raw materials are currently listed as critical to the EU: antimony, beryllium, borates, chromium, cobalt, coaking oil, fluorspar, gallium, germanium, indium, natural graphite, magnesite, magnesium, niobium, platinum group metals, phosphate rock, rare earths heavy and light, silicon metal, and tungsten[135]. Precious metals such as silver and gold are also constituents of WEEE that can be recycled[136].

The processes related to the recycling of WEEE and the companies involved are illustrated in Figure 13.

Figure 13: Recycling of WEEE – steps and number of players in the EU



Source: DTI, based on a presentation by Dr Christian Hagelüken, Umicore Precious Metals Refining, for the Eionet workshop on waste in Istanbul, October 4th 2012.

[134] http://ec.europa.eu/enterprise/policies/raw-materials/critical/index_en.htm.

[135] http://ec.europa.eu/enterprise/policies/raw-materials/critical/index_en.htm.

[136] DTI/Ecorys (2013): *Treating waste as a resource for the EU industry*. Analysis of various waste streams and the competitiveness of the client industries.

When Electrical and Electronics Equipment (EEE) becomes WEEE, it can be collected either non-separated or separated. Only separated WEEE is reused or recycled to produce secondary material input for new production processes, within a range of different industries. However, separated WEEE may also be exported to be reused by consumers outside the EU[137].

Contributions and challenges for competitiveness and growth

Natural resources are concentrated in a few countries. This implies limited access to resources for European industry, which constitutes a potential threat for the industry. Other ways of obtaining the natural resources needed must thus be investigated. In this respect, it is of great importance that WEEE is recycled.

Around 10 millions of tonnes of WEEE are generated in Europe every year[138]. Only a minor part reaches the final recycling step where critical metals are recovered for secondary use. WEEE is one of the world's fastest growing waste streams due to the short lifespan of EEE[139].

Initially, there are four issues that can challenge the competitiveness and growth of the WEEE market[140].

1. *Insufficient collection of WEEE*: Overall, the collection rates of WEEE could be improved. There are large differences between EU Member States and between WEEE categories as regards collection rates[141]. The low collection rates are particularly found in small household appliances, light equipment and electrical and electronic tools[142].
2. *(Illegal) exports*: Often, WEEE is exported from the EU as used products rather than WEEE. Used but working products do not require notification before shipment and can be shipped to non-OECD countries legally. However, these old products are not always fully functional or they end up as WEEE after only a short time. Consequently, much of what should have been registered as WEEE appears to be exported (illegally) out of the EU disguised as used EEE[143, 144, 145]. Consequently, valuable critical metal is lost as a resource for the EU industry[146].
3. *Sub-optimal pre-processing and dismantling:* WEEE is often derived from complex products that contain a multitude of critical metals. These need to be separated manually or mechanically to ensure their efficient recovery. If the mechanical techniques are not sophisticated enough to sort the metals from the product

[137] DTI/Ecorys (2013): *Treating waste as a resource for the EU industry*. Analysis of various waste streams and the competitiveness of the client industries.

[138] http://ec.europa.eu/environment/waste/weee/index_en.htm.

[139] DTI/Ecorys (2013): Treating waste as a resource for the EU industry. Analysis of various waste streams and the competitiveness of the client industries.

[140] Ibid.

[141] Bakas, I., Fischer, C., Harding, A., Haselsteiner, S., Kosmol, J., Milios, L., Plepys, A., Wilts, H. and Wtittmer, D., 2012. *Present and potential future recycling of critical metals in WEEE – final draft paper. ETC/SCP:* Working paper 2012; Copenhagen.

[142] Ibid.

[143] European Environment Agency, 2012. *Movements of waste across the EU"s internal and external boarders*, EEA Report No 7/2012, Copenhagen.

[144] Bakas, I., Fischer, C., Harding, A., Haselsteiner, S., Kosmol, J., Milios, L., Plepys, A., Wilts, H. and Wtittmer, D., 2012. *Present and potential future recycling of critical metals in WEEE – final draft paper*. ETC/SCP: Working paper 2012; Copenhagen.

[145] Fischer, C., Hedal, N., Carlsen, R., Doujak, K., Legg, D., Oliva, J., Lüdeking Sparvath, S., Viisimaa, M., Weissenbach, T., and Werge, M., 2008. *Transboundary shipments of waste in the EU- developments 1995-2005 and possible drivers*. ETC/SCP Technical report 2008/1.

[146] DTI/Ecorys (2013): Treating waste as a resource for the EU industry. Analysis of various waste streams and the competitiveness of the client industries.

properly (which is often the case), high losses of critical metals occur at many pre-processing facilities. This in turn lowers the final metal recovery efficiency[147].

4. *Comprehensive involvement of stakeholders:* A complex waste stream such as WEEE requires a systemic solution and interdisciplinary approaches to improve the entire recycling chain substantially and thereby increase the recycling rates of critical metals. It is thus important to involve players from the electronics industry, WEEE processors (at different stages of the recycling process), EEE users, etc., in this solution. Moreover, research and development should be funded across these stakeholders[148].

Policies

EU legislation is an important driver for the collection and recycling of WEEE. The most recent WEEE Directive[149] came into force on 13 August 2012, which had to be integrated into the national legislation of the Member States by 14 February 2014. The new WEEE Directive sets higher targets for collection, recycling and recovery of all types of WEEE[150]. The following targets apply:

- From 2016, the minimum collection rate to be achieved annually is 45 % of the average weight of the amount of EEE placed on the market in the three preceding years in the Member State concerned. From 2019, the minimum collection rate to be achieved is 65 % of the average weight of the amount of EEE placed on the market in the three preceding years in the Member State concerned, or alternatively 85 % of WEEE generated in the territory of that Member State.
- Depending on the category of WEEE, minimum targets for recovery and recycling are applicable as described in Annex V of the Directive. From August 2012 until August 2015, 70-80 % of WEEE must be recovered, and of this 50-75 % must be recycled. From August 2015, 75-85 % must be recovered and 55-80 % must be recycled.

The new RoHS Directive places tighter restrictions on European manufacturers concerning the material content of new electronic equipment placed on the market[151].

Higher collection rates are mentioned in the WEEE Directive’s Article 7.6[152], where it is suggested that higher collection rates could be achieved by setting collection rates per product category instead of a total amount. Higher collection rates could also be ensured through raising public awareness of the importance of WEEE recycling for the environment and for Europe’s competitiveness, and by developing new business models and infrastructure for collection, in the form of deposit systems or leasing systems, etc.[153].

High-quality pre-processing and dismantling of WEEE are necessary for efficient recovery of critical metals, which is also evident from the Umicore example. One possible solution is to improve the pre-processing technologies for complex WEEE able to generate output fractions that fit optimally into subsequent metallurgical extraction and refining processes.

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[147] Ibid.

[148] DTI/Ecorys (2013): Treating waste as a resource for the EU industry. Analysis of various waste streams and the competitiveness of the client industries.

[149] Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE), recast.

[150] DTI/Ecorys (2013): Treating waste as a resource for the EU industry. Analysis of various waste streams and the competitiveness of the client industries.

[151] Ibid.

[152] Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE), recast.

[153] DTI/Ecorys (2013): Treating waste as a resource for the EU industry. Analysis of various waste streams and the competitiveness of the client industries.

Moreover, recovery rates of critical metals can potentially be increased by supporting technological development of WEEE end-processing. The material composition of EEE changes when new and improved products are developed. Hence, the flexibility of end-processing technologies is critical[154].

Box 16: Umicore

Umicore (BE) is one of the few European companies specialised in recycling of precious metals. Other companies include Bolliden (SE), Aurubis (DE), and Metallo-Chimique (BE). The history of Umicore goes back more than 200 years, when a number of mining and smelting companies merged and gradually evolved into the materials technology and recycling company Umicore is today. One of the main strands of Umicore started out as Union Minière in 1908. Today, Umicore is a global materials technology and recycling group, with a turnover of EUR 12.5 billion and more than 14,000 employees worldwide.

Today, Umicore is one of the most important players in the eco-efficient recycling (achieving the environmental and economic balance in recycling) of a wide range of electronic materials.

It is important for Umicore to tackle insufficient collection of WEEE and sub-optimal pre-processing and dismantling. Umicore receives fractions of products containing precious materials from suppliers. How these suppliers sort their material has a great impact on the value of the products for Umicore, and on the functioning of the WEEE market, since sub-optimal pre-processing and dismantling lower the amount of material reused. To ensure that the suppliers sort the materials to a satisfying extent, Umicore prefers to have longer-term relationships with their suppliers (Interview with Umicore).

Sufficient collection of WEEE starts with consumer awareness of recycling and collection points where consumers can hand in their end-of-life product. From the perspective of Umicore not every Member State can have a full recycling chain, instead WEEE processes should be addressed as a European policy issue.

Conclusions

Recycling of WEEE becomes increasingly important for Europe because natural resources are concentrated in very few countries, limiting the access for European industries, but also because of the environmental gain of recycling. Greater focus on the collection process as well as an optimal process for dismantling and pre-processing, where European resources are exploited optimally, are important aspects of improving the conditions for European industries.

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Annex 1.3: Case study: "Slovak Republic – the European value-added leader"

ABSTRACT

Among the Member States of the European Union, the Slovak Republic stands out as an economy with a particularly positive development in terms of growth and competitiveness between 1995 and 2008. This is mainly due to a shift from agriculture and heavy industry to medium- and high-tech manufacturing industries. The case study aims at illuminating the key factors that have contributed to this development. Yet, like many other countries, Slovakia has also been hit hard by the crisis in 2008 and thereafter. We therefore address to what extent Slovakia has been able to maintain the positive development post-crisis.

Relevant features of Slovakia's position regarding the international division of labour

Between 1995 and 2009 the Slovak Republic successfully managed the transition from a planned economy towards a market economy deeply integrated in the international division of labour. The World Bank report identifies key drivers of this development[155].

The country has been able to expand its base into a variety of products, also through new solutions in medium- and high-tech manufacturing industries[156]. Overall, the Slovak Republic incurred a growth in value added of 2.8 % per year (Compound Average Annual Growth Rate, CAGR) between 1995 and 2009.

The Slovak Republic accounted for the highest average labour productivity growth rate across OECD countries in the period 2001–2009. The Slovak Republic however still lags behind other industrialised European economies as to the level of labour productivity: data for the reference period 1995-2004 show that the level is less than a third of the EU 15 average[157]. Services constitute a relatively small part of the economy and have not been able to match the productivity improvements in manufacturing.

The country has also had a comparably slow growth of unit labour costs. It should however be noted that with increased levels of automation the relative cost of labour in terms of overall production costs are dropping, whilst issues of resource productivity are becoming more critical (materials as well as energy costs)[158, 159, 160].

There has been a substantial level of Foreign Direct Investment (FDI) mainly by multinational companies, in particular in the country's manufacturing sector, which has

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155 World Bank (2012): Golden Growth - Restoring the lustre of the European economic model; Country Benchmarks; pp. 34-37.

156 The term "region" in this context comprises the countries Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic, Slovenia, Croatia, and Turkey.

157 Ifo et al. (2012) report that labour productivity in the Slovakian mechanical engineering industry is at EUR 17,000 and lower than in Poland and in the Czech Republic; this level equals less than one third of the EU average. See IFO Institute, Cambridge Econometrics, Danish Technological Institute (2012): *An introduction to Mechanical Engineering: Study on the Competitiveness of the EU Mechanical Engineering Industry*; for European Commission (DG Enterprise & Industry; 2012; p. 65.

158 For a wider discussion about the growing disconnect between productivity increases and wage increases, see: http://oecdinsights.org/2012/02/20/do-workers-reap-the-benefits-of-productivity-growth/.

159 Labour productivity is defined as the ratio of physical volume to the number of hours worked. The unit labour cost multiplied by labour productivity equals the average hourly rate of pay (the unit labour cost is defined as the cost of labour per unit of output). Thus, changes in factor inputs can affect the level of productivity, which in turn may affect the total unit cost.

160 In 2006, the minimum monthly wage in the Slovak Republic amounted to EUR 181 in comparison to EUR 223 in Poland, EUR 230 in Hungary, and EUR 280 in the Czech Republic. Ifo et al. (2012), op. cit., p. 65 report that wages in the Slovakian mechanical engineering industry are around one third of the EU-27 average, on a similar level to those found in Poland and the Czech Republic.

driven technological innovation[161]. The stock of inward FDI as a percentage of GDP was above 10 % in the period 2008-2010. FDI was particularly high in the automotive sector which, in turn, has become a strategic sector for the Slovak economy. FDI had a positive impact on labour productivity. FDI inflows in Slovakia were virtually unaccompanied by respective foreign business investments in research and development.

The most important manufacturing sectors in terms of their share in total production value are electronics, electrics, and machinery (22.1 %), cars and transport (17.2 %), chemicals et al. (14.5 %), and metals (9.5 %). These sectors are also particularly important for Slovakian exports[162].

Contributions and challenges regarding competitiveness and growth

Slovakia was heavily affected by the financial crisis[163, 164]. Manufacturing output in Slovakia fell by 32 % in the wake of the economic and financial crisis. However, the economy recovered very quickly after the downturn. The result was that manufacturing output was 4.1 % higher in April 2011 than in its previous peak. In 2012, Slovakia's economy grew by 2 %[165] and manufacturing continues to play a prominent role in the economy[166]. The production of some export-driven manufacturing sectors reached record levels with car plants operating at close to full capacity[167]. Low labour costs position the Slovak industry as one of the most competitive in the 'catching-up' Member States. Key factors in the relatively quick recovery of the Slovak economy have been the relatively high level of FDI in the past combined with that the country has been able to maintain its cost competitiveness. Slovakia has implemented a broad set of measures in response to the crisis, among them:

- three stimulus packages,
- labour and product market reforms,
- measures to support the banking sector,
- a car scrapping scheme (designed to boost demand for automobiles and accelerate the change for newer models with lower environmental impact),
- interest-free loans for projects increasing energy-efficiency[168],

[161] The World Bank report mentions e.g. Siemens, T-Systems, Volkswagen, and Deutsche Telekom from Germany; HP, IBM, and DELL from the USA; Peugeot, Citroën and Alcatel R&D from France; Kia Motors, Hyundai, and Samsung from Republic of Korea; as well as Yazaki, Sumitomo, Panasonic, and Sony from Japan; see World Bank (2012), op. cit., p. 35.

[162] European Commission (2013), op. cit.; p. 244.

[163] Information in this section is mainly based on the European Commission's reports on Member States competitiveness performance and policies. See for example European Commission (2011): *Member States competitiveness performance and policies;* 2011, *Reinforcing Competitiveness; Communication from the Commission Industrial Policy*; COM(2011) 0642 final; Brussels, SEC(2011) 1187; European Commission (2012): *Industrial Performance Scoreboard and Member States' Competitiveness Performance and Policies*; 2012 Edition; Brussels; SWD(2012) 298; European Commission (2013): *Member States' Competitiveness Performance; Performance and Implementation of EU Industrial Policy, Industrial Scoreboard*; 2013 Edition; Brussels.

[164] A few examples illustrate the impact of the crisis. Estonia saw a reduction of manufacturing output of over 38 %. For other countries and (in alphabetic order) figures are: Austria 20 %; Czech Republic 23 %; Denmark 26 %; Germany 25 %; Latvia 27 %; Lithuania 28 %; the Netherlands 15 %; Poland 17 %; Portugal 20 %; Romania 20 %; Slovenia 28 %.

[165] The recovery slowed down in the first half of 2013, but the European Commission expects a rebound due to stronger private investment and external demand.

[166] Manufacturing plays a much bigger role for Slovakia than for the EU in total: the share of value added in the manufacturing sector in total value added was 24 % compared to 17 % for the EU in total in 2008; 19.6 % vs. 14.9 % in 2009, and 25.9 % vs. 15.5 % in 2010.

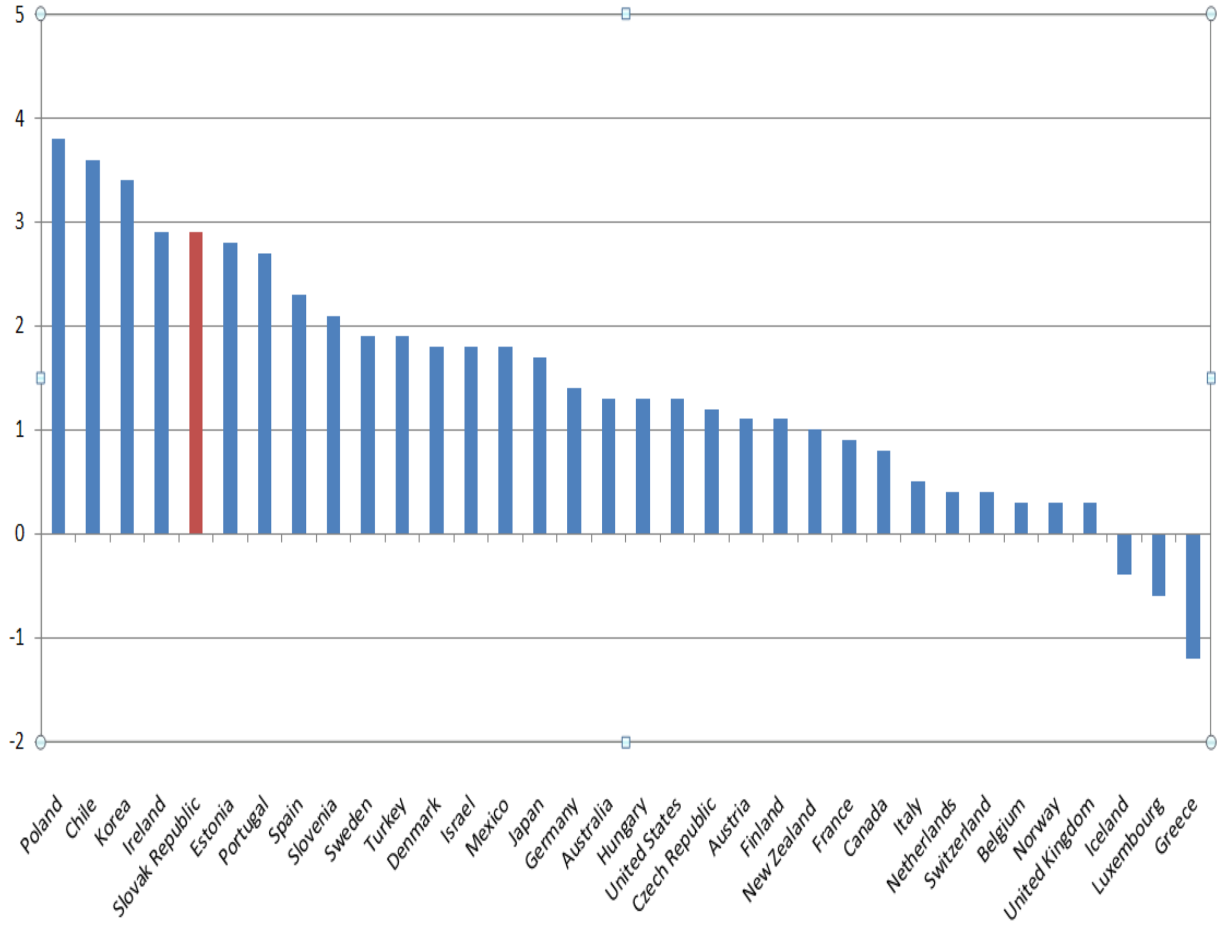
[167] European Competitiveness report 2013— Country chapter on Slovakia.

[168] The programme ran from 1 June 2009 to 31 December 2009.

- a number of temporary actions encouraging R&D[169],
- measures related to VAT[170],
- initiatives in support of corporate cash flows, both in terms of tax administration measures and direct financial support[171].

For the period 2009-2012, the average annual labour productivity growth (CAGR) was slightly below 3 %. This was significantly lower than in the previous period 2001-2009 where CAGR was nearly 5 %. Among the European countries only Poland exhibits a better productivity performance.

Figure 14: Labour productivity growth in OECD countries (CAGR 2009 – 2012)



Source: WIK-Consult based on OECD. StatExtracts (http://stats.oecd.org/Index.aspx?DataSetCode=PDYGTH).

Key future challenges

The Slovakian government expects that a gradual increase in domestic and foreign demand in the coming years will spur economic growth to 3 % in the medium term and enabled by:

[169] Slovakia adopted temporary stimuli for business R&D in the form of public subsidy and income tax relief for the private co-financing part. In addition, the R&D Agency of Slovakia was financing three anti-crisis programmes in 2009.

[170] Slovakia introduced the possibility for rollover of VAT deductions; moreover, it implemented more general measures like the introduction of group VAT registrations, retroactive tax registration, as well as simplified VAT and income tax administration for small entrepreneurs as of spring 2009.

[171] Specific SME support programmes were designed in the form of an extended micro-loan scheme, incubator care, as well as via a consulting and training support scheme.

- *Level of FDI:* The level of FDI and exports will be critical. Technology imports were a key source of major productivity gains in past years. However, this potential might be threatened due to declining inflows of FDI.
- *Education, skilled labour*: coherent skills strategies to ensure a match between supply and demand of labour for the industry.
- *Innovation*: Stimulate partnerships between clusters, enterprise networks and research and educational institutions to accelerate innovation.
- *Energy costs*: The key requirement is a reliable and secure supply of energy
- *Appropriate business environment*: Critical have been identified as (1) the creation of a long-term and efficient legislative environment and processes; (2) the improvement of the enforceability of rights (achievement of fair decisions in an acceptable time; (3) the reduction of the administrative burden of businesses and the improvement of the efficiency of State and other public administrations[172].
- *Infrastructure:* Emphasis on an integrated transport infrastructure particularly with a view to strengthen access opportunities for remote regions.
- *Environmental requirements*: Support to the manufacturing industry to meet environmental requirements, in particular those of the Directive on Industrial Emissions, is a key task for the evolving Slovakian industry[173].

Conclusions

Compared to the innovation brought about by FDI in the Slovak Republic (in the production sector) the actual innovation performance derived from R&D is much lower, and well below the EU average. The lack of domestic industrial R&D capacity has given rise to a split between highly productive export-oriented multinationals and a domestic sector consisting largely of SMEs and a few large companies with low productivity and innovation capacity[174]. Currently, there is a large group of companies that mainly compete on cost efficiency, broad based programmes to stimulate innovation remain a major challenge to medium term competitiveness of the Slovak economy including transformation to lower energy consumption.

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- European Commission (2012): Industrial Performance Scoreboard and Member States' Competitiveness Performance and Policies; 2012 Edition; Brussels; SWD(2012) 298;

[172] Examples are the simplification and the transfer of certain actions on the government, the computerization of the administration, and avoiding unnecessary obligations.

[173] See e.g. European Commission (2013): *Member States' Competitiveness Performance*…; op. cit.

[174] See European Commission (2013); p. 242.

available at: http://ec.europa.eu/enterprise/policies/industrial_competitiveness/monitoring-member-states/index_en.htm.

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Annex 1.4: Case study: Eindhoven – competitiveness through innovation

ABSTRACT

The case of Eindhoven shows how innovation can thrive through innovation collaborations in a triple helix involving high-tech companies, universities, and public authorities.

Eindhoven is the area in the world with the highest innovation intensity. This derives from a strong High Tech Campus where high-tech firms constitute an innovative ecosystem. To be successful, the innovative ecosystem must contain the right balance of firms (multinationals, SMEs, start-ups, service companies and research institutes) and focus on a limited number of technology areas. Strong cross-border collaboration with firms in Belgium and Germany is another enabler for Eindhoven's innovation activities.

Eindhoven – an innovative region

Globally, the Eindhoven area is characterised as a regional innovation leader measured in the number of patents per inhabitant. Almost half of all Dutch patents originate from the Eindhoven area. This is in particular due to the presence of several R&D-intensive and innovative companies, such as Philips (electronics), ASML and Atos (ICT), NXP semiconductors, Storck (machinery) and the Sioux Group (embedded systems). According to the 2013 EU Industrial R&D Investment Scoreboard, Philips is currently ranked number 19 among all European companies in terms of total R&D investments in 2012. Another key factor for Eindhoven's innovative competitiveness is Eindhoven University of Technology (TU/e). Several companies in the region started as spin-offs from the university or chose to locate near the university[175].

Eindhoven is also home to two Knowledge Innovation Communities (KIC) of the European Institute of Innovation and Technology, namely KIC InnoEnergy and KIC ICT. InnoEnergy is a commercial company consisting of 27 stakeholders including industries, research centres and universities, with locations across six countries and with the headquarters in Eindhoven. KIC ICT builds upon nodes in Berlin, Eindhoven, Helsinki, London, Paris, Stockholm and Trento. It consists of global partners from the industry (e.g. Philips, Siemens, Nokia and Ericsson), research institutes (e.g. Fraunhofer, TNO) and universities (e.g. Aalto Universities, TU Berlin)[176].

Eindhoven has a variety of public and private actors with strong R&D and technology activities which constitute a "dense network of knowledge-intensive resources in close proximity[177]". The collaboration between science and industry works as a facilitator for innovation with several successful public-private partnerships[178].

The population in Eindhoven represents 4 % of the overall population in the Netherlands and 7 % of industry jobs. The Eindhoven region attracts relatively more FDI (10 %), educates a higher share of technology students (11 %), occupies a significantly higher share of researchers (21 %), spends an even higher share on private R&D (27 %) and last but not least accounts for 42 % of all patents in the Netherlands.

[175] TTR-ELAt, Background report to OECD study cross-border regional innovation policies, March; presentation to the OECD mission, 13-15 March 2013, 2013.

[176] KIC ICT, Nodes & Co-location Centres, located at http://www.eitictlabs.eu/about-us/nodes-co-location-centres/.

[177] Nauwelaers, C., K. Maguire and G. Ajmone Marsan, The Case of the Top Technology Region/Eindhoven-Leuven-Aachen Triangle (TTR-ELAt) – Regions and Innovation: Collaborating Across Borders, OECD Regional Development Working Papers, 2013/22, 2013 OECD Publishing. http://dx.doi.org/10.1787/5k3xv0lg3hf5-en.

[178] World Economic Forum, Rebuilding Europe's Competitiveness, World Economic Forum, Geneva, 2013.

Contributions and challenges for competitiveness and growth

In 2009, the Eindhoven region suffered from negative growth rates of 6.4 %, but already in 2011 it recovered to an economic growth of 3.2 %. This was far better than the Dutch average of 1.2 %. Furthermore, the unemployment rate in the Eindhoven region has remained below the country average since 2005. In the period 2002-2013, there has been a job growth of 10.2 % in the Eindhoven region, compared to a Dutch level of 6.4 %[179, 180, 181].

The high innovation intensity in Eindhoven provides the basis for economic growth in the region. This was particularly important as some of the major industrial companies in the region implemented massive cutbacks in employment in the 1990's. Due to continuous creation of new products in the high-tech sector, the city of Eindhoven has succeeded in creating new knowledge jobs to replace jobs lost.

Most of the R&D activities in Eindhoven are concentrated around the High Tech Campus that accounts for 42 % of all patents in the Netherlands.

Philips has played a key role as a facilitator for the establishment of Eindhoven's innovative ecosystem. The Philips Research Laboratories – with more than 1.500 researchers located in Eindhoven - opened up their facilities to other technological companies in 2003. This laid the foundation for the open innovation hub High Tech Campus Eindhoven that consists of more than 120 companies[182, 183].

The High Tech Campus Eindhoven is a campus for technological companies primarily concerned with technologies in the domains of microsystems, high-tech systems, embedded systems, medical technology, and infotainment. The campus covers research institutions as well as a wide range of companies, ranging from start-ups (around 40) to SMEs and global companies[184].

The High Tech Campus is an example of how co-location can foster innovation collaboration that benefit all the firms involved. The campus constitutes a knowledge hub of High Tech companies that together makes an innovative ecosystem. According to the High Tech Campus' Manager for Marketing and Communication (interview), such an innovative ecosystem must have the right balance of firms, so a variety of different firm types is required:

- Multinationals are necessary because of their strong knowledge base, and they have the economic capacity to finance and organise their innovation activities. This provides the solidity to the eco-system.
- SMEs are vital as hardware sub-suppliers. Multinationals cooperate with a whole chain of SMEs. A recent trend is that OEMs (Original Equipment Manufacturers[185]) have become very solution focused in their requirements to their suppliers, which is a shift from a traditional order relationship. In other words, OEMs set out specific

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179 BP Monitor, *Brainport Monitor 2012* – Summary. Power of the Smartest.

180 BP Monitor, *Brainport Monitor* 2013.

181 Holland Trade, Brainport Eindhoven shows growth despite crisis, 2012: http://www.hollandtrade.com/media/news/news-archive/index.asp?bstnum=5060&PageIndex=24.

182 High Tech Campus Eindhoven, High Tech Campus Eindhoven, The smartest square km in the Netherlands, Fact Sheet October 2013.

183 Philips, *Philips Research Eindhoven*, located at http://www.research.philips.com/locations/eindhoven.html.

184 High Tech Campus Eindhoven, High Tech Campus Eindhoven, The smartest square km in the Netherlands, Fact Sheet October 2013.

185 Original Equipment Manufacturers (OEM) in this context refers to "*a company that purchases, for use in its own products, a product made by a second company.*" Please be aware that OEM can refer to the complete contrary as well, namely "manufactures products or components that are purchased by a company and retailed under the purchasing company's brand name" (Princeton 2014).

objectives and require SMEs to develop respective solutions. This enhances the need to innovate together on how new products can meet the needs specified by the OEMs. Being in proximity to each other is an advantage in open models of innovation, which are highly iterative.

- Start-ups bring inspiration into the eco-system. For large firms, start-ups can be a way to cash in on intellectual property, if the large firms create start-ups based on spinout technology from their research activities.
- A knowledge based service industry has grown out of manufacturing such as IP-lawyers, Human Resource (HR) companies. They allow high-tech firms to focus on their core activities.
- Research Institutes are needed to bridge the gap between the academic and the private sector increasingly focused on market-oriented R&D. The research institutes are partly funded by public authorities.

Furthermore, several of the firms located on the High Tech Campus have formalised collaboration with the Technical University Eindhoven[186].

The network of firms improves the export potential for smaller companies. Smaller firms can draw on their network in the campus and make use of larger firms' personal international contacts:

"*The idea of this hub is that if we combine our joined forces we can open all doors in the world. This gives a massive export potential for start-ups, because they can get high entrance level to other international firms through their networks in the hub*"[187] (Interview).

Policies

Eindhoven collaborates with border regions in Belgium and Germany, called TTR-ELAt (Top Technology Region Eindhoven-Leuven-Aachen triangle). The rationales behind this techno-logical cross-border partnership include the ambition to create a critical mass of knowledge, and to complement each other's assets in terms of research and technology[188].

The southeast Netherlands is referred to as "Brainport" and has status as a port along with two other ports: The Airport around Amsterdam and the Seaport around Rotterdam. These ports hold certain privileges from the national authorities, primarily with respect to earmarked public funding[189]. However, it is important to emphasise that the initiative to create a coherent strategy for the competitiveness of the region originated from a triple helix of local policy makers, knowledge institutions, and firms. The original Task Force Brainport consisted of the respective leaders of these institutions, namely the mayor of Eindhoven, the chairman of Philips Electronics Netherlands, the president of the Technical University's executive board, and the chairman of the local Chamber of Commerce. Today, Brainport Eindhoven serves as a platform for the triple-helix partnership, and it sets out a collectively defined strategy for the Eindhoven area[190].

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[186] Interview with Bert-Jan Woertman, Manager Marketing & Communications, Eindhoven.

[187] Ibid.

[188] OECD, OECD Science, Technology and Industry Scoreboard 2013, OECD Publishing, 2013. http://dx.doi.org/10.1787/sti_scoreboard-2013-en.

[189] Brainport, Brainport 2020 Top economy, smart society. Summary. Vision, strategy and urgency programme, 2013.

[190] Van den Berg, Leo & Alexander H.J. Otgaar, *Brainport Eindhoven: a proactive approach towards innovation and sustainability.* In: Peter Karl Kresl & Daniele Letri 2012, European Cities and Global Competitiveness. Strategies for Improving Performance. Edvard Elgar Publishing, Inc.: Cheltenham, UK.

The Holst Centre is a prime example of cross-border collaboration on innovation. The initiative was established in 2005 by the Belgian research centre Imec and the Dutch equivalent TNO with support from the Dutch Ministry of Economic Affairs and the Government of Flanders.

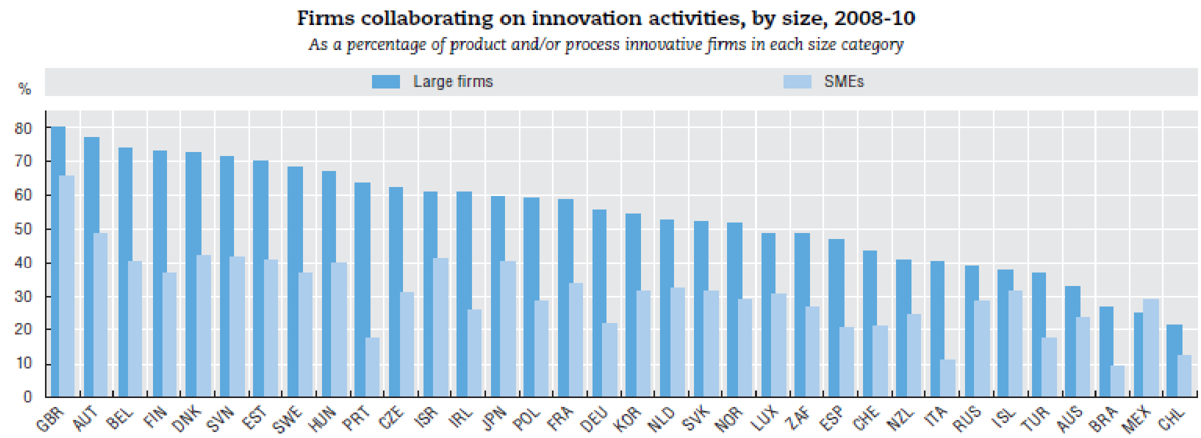
Box 17: Holst Centre

The Holst Centre is a cross-border institute located at the High Tech Campus in Eindhoven (Holst Centre 2014). Today the Holst Centre receives funding from a variety of different organisations: the Dutch Ministry of Economic Affairs, Agriculture and Innovation; the Province of North Brabant; the Brainport Eindhoven region; Imec in Flanders; TNO; the Dutch Organisation for Scientific Research (NWO); and a fiscal ruling (called "TKI toeslag") issued by the Dutch government [191]. The Holst Centre is characterised by a strong programme-based partnership model with industrial and academic partners. The programmes are defined through workshops and in dialogue with industrial and academic players in the field. Currently, the centre has grown to 180 employees with around 30 nationalities. It also has current commitments from almost 40 industrial partners[192, 193].

Innovation and competitiveness

Globally, OECD data show that open innovation models play an increasing role in the R&D activities of firms, and are increasingly also becoming a source of specialisation, so that suppliers can deliver more value added in terms of total solutions.

Figure 15: Open innovation by firm size



Source: *OECD Science, Technology and Industry Scoreboard 2013*. Collaboration is defined as "*active participation in joint innovation projects with other organisations*".

[191] Ibid.

[192] Ibid.

[193] Holst Centre, *Holst Centre in a nutshell*, located at http://www.holstcentre.com/AboutHolstCentre/Nutshell.aspx.

Conclusions

The Eindhoven area accounts for the highest innovation intensity in the world. Key enablers for this position are first, a strong High Tech Campus where high-tech firms constitute an innovative ecosystem. Second, this innovative ecosystem contains the appropriate balance of organisations (multinationals, SMEs, start-ups, service companies and research institutes). Third, the focus is on a limited number of well-defined technology areas. Fourth, there are strong cross-border collaborations with firms, universities, research institutions and local authorities in Belgium and Germany supporting the innovation dynamics.

Public authorities can play an enabling role by supporting the research infrastructure and by providing the framework for open innovation. However, the incentive to engage in open innovation must emerge from the firms themselves, and that only occurs if they can see the real value added.

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Annex 1.5: Case study: SMEs in Spain and Italy – "access to capital" as a barrier compared to the EU-28

ABSTRACT

Italian and Spanish SMEs have been especially affected by developments following the crisis, and today access to finance is one of their greatest concerns. Due to the significant contributions SMEs make to the Italian and Spanish economies, access to finance for SMEs is a particularly critical issue in Italy and Spain, also to kick-start job creation. Several measures have been introduced, but access to finance for SMEs remains a severe problem.

The significance of the problem

The financial crisis has had significant effects on all sectors and across all economies in Europe. However, small and medium-sized enterprises (SMEs) are particularly vulnerable, due to the lack of equity capital invested in small firms. This makes SMEs more reliant on other sources such as bank lending and other types of financial products, though there are major differences across the EU-28[194].

Table 5 below presents an overview of the most pressing problems faced by SMEs in the euro area, Italy and Spain. The Table shows that, in 2013, next after finding customers, access to finance was the second largest concern for SMEs. An average of 16.3 % of the SMEs in the euro area considered access to finance as the most pressing problem. It is interesting to note that for Europe as a whole, lack of demand is perceived to be the most serious problem.

Table 5: The most pressing problems faced by SMEs in Italy, Spain in comparison with Europe as a whole, measured in percentage of firms (as of 2013)

	euro area %	Italy %	Spain %
Finding customers	24.1	17.8	27.3
Competition	11.7	11.1	14.1
Access to finance	16.3	20.0	23.4
Costs of production or labour	13.9	23.1	11.3
Availability of skilled staff or experienced managers	14.2	5.5	5.4
Regulation	12.6	17.2	5.7
Other	7.1	5.4	12.9

Source: European Central Bank Database, April-September 2013.

New data indicate that "Access to finance" was slightly less of a concern for SMEs in 2014 (14.3 % for the whole euro area, down from 16,3 % in the previous survey round shown in the table above) with a wide divergence across countries[195].

[194] European Central Bank, 2013a. Survey on the access to finance of small and medium-sized enterprises in the euro area.

[195] European Central Bank, 2014. Survey on the access to finance of small and medium-sized enterprises in the euro area.

Due to the predominance of SMEs in Spain and Italy, bank credit is becoming much more important as one of the main sources of finance. The importance of the banks is emphasised by the percentages of SMEs in Italy and Spain that apply for bank loans, which is one of the highest percentage in the euro area[196].

The financial crisis has underlined many of the traditional obstacles faced by SMEs such as lack of financing, low productivity, and lack of competitiveness. These obstacles have become more prevalent and acute.

The SME sectors in Italy and Spain

SMEs play a major role in the Italian and Spanish economies owing to their significant contribution to the economies by employing a large share of the workforce and their total economic value added compared to elsewhere in the EU.

The SME sector profiles in Italy and Spain differ from the average sector profiles in the EU. First, the SME sectors in Italy and Spain have a higher proportion of micro-enterprises compared to the EU average (Italy: 94.4 %; Spain: 93.8 % and EU27: 92.1 %). Second, the micro-firms in Italy and Spain represent a greater share of employees than the EU average (Italy: 46.1 %; Spain: 39.8 % and EU-27: 28.7 %). Third, they generate more value added than on average in the EU (Italy: 29.8 %; Spain: 27.5 % and EU-27: 21.5 %).

The micro-enterprises in both countries are concentrated in low- to medium-tech manufacturing (manufacturing of food products and beverages, textiles and wearing apparel, furniture, etc.) and less knowledge-intensive services (trade, accommodation and foods services, travel agencies, etc.). High value-added sectors, such as high-tech manufacturing and knowledge intensive services are under-represented in terms of the number of firms, employment, and value added, which puts a dent in the competitiveness of the overall economies of Italy and Spain[197, 198].

In Italy, large enterprises and SMEs have experienced negative growth. SME value added shrank by 10 % in the period 2008-2012, the number of employees dropped by 5 % and the number of enterprises by 2 %. In large enterprises, value added has returned to pre-crisis levels with only a slight decrease in the number of employees. Hence, large enterprises have outperformed SMEs[199, 200]. In Spain, the most negative impact of the crisis was on employment. Around 1.5 million jobs were lost in SMEs between 2008 and 2010, i.e. almost 14 % of the total workforce. The majority of the jobs were lost in construction and manufacturing SMEs. In comparison, the respective percentage in large companies only amounted to approx. 9 %[201].

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196 European Central Bank, 2013a. Survey on the access to finance of small and medium-sized enterprises in the euro area.

197 European Commission, 2014a. *SBA Factsheet Italy 2013*.

198 European Commission, 2014b. *SBA Factsheet Spain 2013.*

199 European Commission, 2014b. *SBA Factsheet Spain 2013.*

200 European Commission, 2013c. *SBA Factsheet Italy 2012.*

201 European Commission, 2012a. *SBA Factsheet Italy 2010/11.* European Commission, 2012b. *SBA Factsheet Spain 2010/11.*

Table 6: SMEs in Italy and Spain in 2012

	Number of enterprises					Number of employees					Value added				
	Italy		Spain		EU	Italy		Spain		EU	Italy		Spain		EU
	No.	%	No.	%	%	No.	%	No.	%	%	EUR bn	%	EUR bn	%	%
Micro	3,492	94.4	2,103	93.8	92.1	6,931	46.1	4,318	39.8	28.7	185	29.8	121	27.5	21.5
Small	183	5.0	121	5.4	6.6	3,237	21.5	2,298	21.2	20.4	136	21.9	91	20.6	18.3
Medium	19	0.5	15	0.7	1.1	1,861	12.4	1,513	13.9	17.3	101	16.3	73	16.7	18.3
SMEs	**3,694**	**99.9**	**2,240**	**99.9**	**99.8**	**12,029**	**80.0**	**8,129**	**74.9**	**66.5**	**422**	**68.0**	**284**	**64.8**	**57.6**
Large	3	0.1	3	0.1	0.2	3,013	20.0	2,731	25.1	33.5	198	32.0	154	35.2	42.4
Total	3,691	100.0	2,243	100	100	15,042	100	10,860	100	100	620	100	439	100	100

Note: Number of enterprises and number of employees are stated in thousands.
Source: Database for the Annual Report on European SMEs.

SMEs' lack of access to finance is a barrier to increased competitiveness and growth

SMEs play a vital role in creating jobs and boosting economic growth in Italy and Spain. It is the SMEs, rather than large companies, that are best placed to create new employment opportunities. Reasonable access to finance for SMEs is critical to improve competitiveness and growth[202].

SMEs often face significant difficulties in obtaining the finance they need to grow and innovate. There are multiple explanations for such barriers, but information asymmetries between the supply of and demand for funds play a major role[203].

Access to finance in Italy and Spain - distance from the EU average

Italy scores below the EU average in five specific areas. Banks are less willing to provide loans to SMEs, and this together with higher rates of rejection and high interest rates signal a drying-up of private-sector financial support. There are challenges regarding access to early stage venture capital, and total invoice payment time remains one of the longest in Europe (117 days) and doubles the EU average (53 days).

The Spanish SMEs also have difficulties regarding access to finance, considerably more adverse in Spain compared to the EU average[204]. Despite a few signs of improvement, Spain performs well below the EU average in five specific areas. The general credit conditions and standards that banks apply to SMEs were relaxed from 2009 to 2011 but were significantly tightened in 2012[205]. The credit crunch for small firms has worsened and has caused economic hardship. Hence, the proportion of rejected loans has increased and more Spanish business owners reported a decrease in the banks' willingness to provide loans. Furthermore, one of the indicators most directly under policy control 'access to public financial support' stands out as being very weak. Finally, the excessively long payment times exacerbate the liquidity problems that businesses in Spain face.

Primary finance sources

The primary sources of external financing for SMEs are bank loans, bank overdrafts and trade credits. In 2013, SMEs in Italy and Spain experienced an increase in their need (demand) for all three external financing sources; 62 % and 51 % of the Italian and Spanish SMEs only used external financing. In Germany and Austria the same numbers were only around 45 % and 44 %, respectively [206]. Among the factors affecting SMEs' need for external financing, the largest roles are played by fixed investments (machinery, land, buildings, technology, etc.), inventory and working capital, and internal funds. The SME sectors in Italy and Spain report some of the highest increases in their need for bank loans, which may reflect the demand for loans to finance working capital in an environment of continuing weak profits and squeezed liquidity buffers.

Since the financial crisis started, SMEs' demand for credit has shifted from long-term investment capital to short-term working capital. Some of the shift has been driven by SMEs seeking new export markets requiring short-term funding to help them build new customer relationships or adapt their products. However, some of the shift also comes

[202] YMIR, 2012. Study on research SMEs Access to Finance: Background Analysis.

[203] European Commission, 2011. COM(2011) 870 final. An action plan to improve access to finance for SMEs.

[204] European Commission, 2012a. *SBA Factsheet Italy 2010/11.*

[205] Ibid.

[206] European Central Bank, 2013a. Survey on the access to finance of small and medium-sized enterprises in the euro area.

from payment delays by local and regional authorities. This was identified as the main cause of growing receivables in Italy and Spain[207].

Factors affecting the availability of external financing

Conditions of bank loan financing have worsened for SMEs with variations across countries. In Italy and Spain, interest rates have increased, whereas SMEs in Germany and France have experienced a drop in interest rates. Thus, the net percentage of SMEs reporting an increase in bank lending rates in 2013 was highest in Spain and Italy. Italian and Spanish SMEs also face other significant and increasing finance barriers. SMEs in Italy and Spain indicate a reduction in the size and maturity of loans and an increase in collateral requirements[208].

For the coming period, European SMEs (EU-28) expect a balance or no deterioration in the availability of bank loans, bank overdrafts, and international funds, which reflects some expected improvements in the economic outlook. Spanish SMEs expect improved access and higher internal funds, and the assessment of Italian SMEs is less negative. Spanish SMEs also expect the availability of bank loans to improve. The main factors that affect the availability of external financing for SMEs are the general economic outlook, firm-specific outlook, SMEs' own capital, and firm credit history[209].

Policy initiatives and new financial instruments

The current economic environment with tightened credit supply conditions has increased the focus on SMEs and their needs[210].

The Small Business Act for Europe is the EU's flagship policy initiative in that respect. It comprises a set of policy measures organised around ten principles, including access to finance[211]. Additionally, one of the key priorities set out in the EU's growth strategy for the coming decade (Europe 2020) is to facilitate access to finance for SMEs. In this context, there will be an implementation of financial services aimed at bringing regulatory benefits to SMEs. Furthermore, new targeted EU-level funding will be released to address the key market failures that limit the growth of SMEs[212, 213].

At the national level, the Italian government has undertaken several measures to ensure SME access to finance through loan guarantees (in addition to the general measures to increase bank capitalisation such as underwriting bank bonds). New instruments to stimulate economic growth such as project- and mini-bonds, and moratorium for debts have been implemented. Existing instruments have been reinforced and traditional mechanisms have been used extensively. The increased administrative rigidity of banks in providing loans and guarantees to SMEs is coupled with higher differential rates between large enterprises and SMEs, and this particularly undermines SMEs[214].

In Spain, several measures have been implemented and adopted to address the growing challenges facing SMEs in accessing finance. One of them is the Growth Lines programme

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[207] Institute of International Finance and Bain & Company, 2013. *Restoring financing and growth to Europe's SMEs.*

[208] European Central Bank, 2013a. Survey on the access to finance of small and medium-sized enterprises in the euro area.

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[211] Commission for the European Communities, 2008. "Think Small First" - A 'Small Business Act' for Europe".

[212] European Commission, 2013b. *A recovery on the horizon?* Annual report on European SMEs 2012/2013.

[213] European Central Bank, 2011. Financing obstacles among Euro area firms who suffers the most?.

[214] European Commission, 2014a. *SBA Factsheet Italy 2013*.

introduced by the public company ENISA, under the Spanish Ministry of Industry. The programme provides a growth fund targeting SMEs with high growth potential[215]. The Spanish administration has launched the credit lines of the Institute of Official Credit to cover the risk of collateral credit schemes for SMEs aimed at improving liquidity for SMEs by tackling the arrears of local and regional administrations. The plan has already eased liquidity problems of 30,000 SME suppliers to regional governments and 115,000 SME suppliers to local administrations. Finally, the European Investment Fund and a venture capital branch of the ICO Group called AXIS have launched the EAF-Fondo Isabel La Católica as part of the pan-European European Angels Fund initiative, which is intended to promote new non-banking sources of finance for entrepreneurs[216].

An access to finance initiative, which aims to bring liquidity in the Spanish market and directly help SMEs, is the ICO Lines (Lineas de Financiacion the Institute of Official Credit). In 2012, The European Investment Bank (EIB) granted a EUR 500 million loan to Spain's Instituto de Crédito Oficial (ICO) to finance on favourable terms the investment projects and working capital of SMEs mainly in the industrial and service sectors. The aim of the measure was to finance small and medium-scale projects carried out by SMEs, mainly in convergence regions in Spain, where small businesses are key to safeguarding and creating jobs[217]. The programme covered the risk of collateral credit schemes for SMEs in order to ease access to finance for innovative projects of new enterprises. The programme granted guarantees as collateral for the financial needs of SMEs[218].

Tightened credit standards - demand-side or supply-side factor?

A number of studies have investigated whether reductions in lending during the crisis were caused by demand-side or supply-side factors, results of the analyses not providing any conclusive results[219].

Soana et al. found that during the crisis Italian firms that requested more bank credit were small companies showing fewer available internal sources and fewer substitutes for bank finance. On the supply side, banks tended to reduce their lending to the small, riskier and highly indebted firms. Financial companies preferred to allocate new credits to SMEs that could offer collateral and showed higher increase in sales. The study also found that older firms have been more financially constrained than the younger ones.

The crisis has affected technology spending, employment, and capital spending. Constrained firms also spent more cash, drew more heavily on lines of credit for fear that the banks would restrict access in the future, and sold more assets to fund their operations. The inability to borrow externally caused many firms to bypass attractive investment opportunities and cancel or postpone planned investments.

Conclusions

The increasingly risk-sensitive banking sector asks for more collateral and higher risk premiums, and this in turn may lead to insufficient finance as well as missed business and employment opportunities. Therefore, the availability of credit and loan guarantee schemes is crucial to exploit growth and job potential. Despite the progress already made, the EU still needs to take further significant measures to release the full potential of SMEs.

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[215] European Commission, 2013d. *SBA Factsheet Spain 2012*.

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Annex 1.6: Case study: Changing dynamics of skills supply and demand

ABSTRACT

The changes that occur in manufacturing driven by technological changes and further global specialisation within the value chains pose new skills requirements to the manufacturing industry. A strong science and engineering base is critical to the technological innovation capabilities in the sector. Key enabling Technologies offer new opportunities afforded by technological convergence. The result is that there will be a likely growth in demand for engineers and scientist with more T shaped profiles. But SMEs within the manufacturing sector rely less on R&D-based technological innovation, and more on innovation through interaction with their customers; hence the supply of skilled workers for the actual manufacturing processes are vital to ensure a strong manufacturing base in Europe. Efforts to boost and expand apprentice systems at the upper secondary and post-secondary level could prove critical to future innovation performance of SMEs in manufacturing. The European Alliance for Apprenticeship could offer a strategic platform for action.

Drivers of change in skills supply and demand in Europe

In the last decades, the dynamics of national research and innovation systems have been transformed through a massive global expansion of higher education systems. This has led to an overall global increase in the supply of higher education graduates with a science, engineering or technical degree. Measures to improve also short-term mobility could solve some of the problems regarding access to high skilled labour or persons with advanced STEM skills (science, technology, engineering, and math).

Trans-disciplinarity - an emerging concept

Increasingly, the HRST workforce will be expected to work in environments that require collaboration across multiple fields of disciplines as well as the ability to interact with and work in virtual teams. Trans-disciplinarity was identified in a report written by the Institute for the Future for Apollo Research Institute, "Future Work Skills 2020," as one of 10 advanced workplace skills that will help organisations handle disruptive technological and societal change.

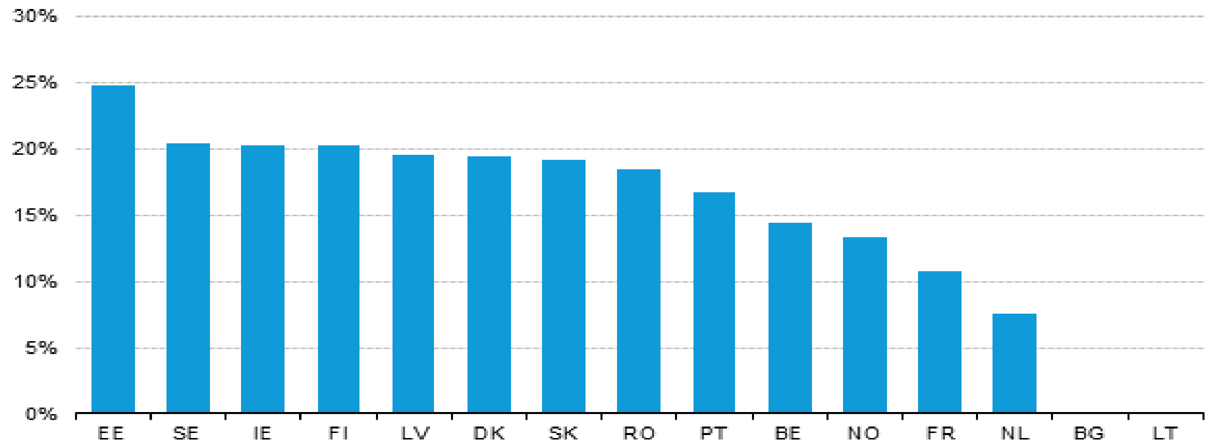
Trans-disciplinarity refers to knowledge and skills that transcend and unify different disciplines. It is driven by the views that complex ill-defined real world challenges call for multiple perspectives to generate new knowledge that can lead to innovations in the way particular challenges are dealt with. Another critical defining characteristic of trans-disciplinary research is the inclusion of stakeholders in defining research objectives and strategies to incorporate the diffusion of innovation better as an outcome of research. Trans-disciplinarity therefore requires an integration of *problem framing*, *problem solving*, *communication* and *collaboration* that cuts across disciplinary and organisational boundaries.

The patterns of global sourcing have changed dramatically, making forecasting the need for skills in European manufacturing more complex. In the first phase of contemporary globalisation[220] in the 1980s, global sourcing mainly encompassed routine work tasks in

[220] Globalisation is not only a temporary phenomenon; globalisation can be understood as a world-wide circulation of goods, information, ideas, people, and as establishing or intensifying of world-wide political and economic connectivity. If so, then globalisation dates back to the 15th and 16th century. Since that time there have been three periods or "waves" of globalisation: 1) 15th – 18th centuries, 2) 19th century (until 1914) and 3) since the 1980s. Within the context of contemporary globalization, several argue that we

services and in mass manufacturing. Production, design, and research can now be located around the globe wherever the right mix of skills is available at the optimal cost/quality ratio. This has kick-started a strategic use of offshoring beyond mass manufacturing and low-value services which characterised the first wave of globalisation. Developments in international sourcing of high-value functions are shown in the table below. It should be noted that more recent data from Denmark show that since 2011 the international sourcing of R&D has substantially accelerated[221].

Figure 16: Enterprises sourcing R&D and engineering support function internationally, 2009-2011 (pct. of total number of enterprises sourcing internationally)



Source: Eurostat- International Sourcing of Business Functions[222]

More importantly, the second wave of globalisation has initiated a process of globalisation of human resources management whereby large multinational companies have achieved much more functional flexibility in their skills acquisition strategies by reducing their dependence on national systems of skills formation and national labour markets[223]. An issue emerging from recent studies is the extent to which European companies other than the multinationals are capable of implementing recruitment and retention practices which can draw on the global mobility of talent. A study conducted by Accenture suggests that beyond the transnational companies there is a large group of small and medium sized companies that do not find themselves capable of making full use of the global growth and global mobility of the high-skilled people[224].

Until recently, studies on skills and innovation within the economic literature have tended to focus primarily on scientists, engineers, and technologists. Scientific and engineering skills will be critical in stimulating technological R&D that can lead to leading edge market innovations. The share of the population with a university degree level qualification in mathematics, science and technology is an important proxy of the availability of human resources qualified to carry out research and development activities pertaining to technological innovation. The EU has already progressed at more than twice the rate

are now in a second phase with major implications for innovation and competitiveness policies- and the dynamics of skills supply and demand (Romand Szul Warsaw University).

221 Danish Agency for Innovation and Danish technological institute, 2014, *Danske virksomheders forsknings- udviklings- og innovationsadfærd* (in print).

222 http://goo.gl/t0OVOq.

223 Brown, Phil, Lauder Hugh, Ashton David (2011) *Global Auction- Broken promises of education, jobs and earning*. Oxford University Press.

224 Accenture (2011) No shortage of talent, how the global market is producing the STEM skills needed.

foreseen by the EU benchmark for 2010 in this field, though several countries have seen a drop in the number of graduates since 2005 such as France and UK[225].

Yet many studies have shown that the skilled workforce and technicians play an essential role in models of incremental innovation, often involving users and front-end employers and the deployment of known technologies for innovation purposes - and furthermore a critical driver of innovation and international competitiveness in European SMEs[226]. New automation and digitalisation technologies offer viable alternatives to off-shoring of manufacturing and new ways for companies to attain efficiency in small series production. However, it does require different skills at the upper secondary and post-secondary levels. Work-based/work-placed vocational education and training systems are particularly suited to develop the types of skills needed. Students are offered rich opportunities to learn in an authentic practical environment, which is critical to acquiring the types of soft competences considered to be conducive to incremental innovation[227]. The European Commission initiative "The European Alliance for Apprenticeship" could provide the platform for a strategic dialogue on how apprenticeship systems can be developed and scaled to match the emerging skills needs for advanced and highly specialised manufacturing.

Contributions and challenges for competitiveness and growth

Since the 90s, European education and skills policy has concentrated on targets derived from comparisons with other advanced economies. However, efficiency in European skills systems is not only a question of quality in the supply. So-called 'demand side' policies have received growing attention, most recently driven by the findings of PIAAC- OECD's large scale assessment of adults skills[228]. Within the context of the survey, the underutilisation of skills is reported in several countries, due to poor work organisation arrangements and an insufficient strategic focus on workforce development within companies. This form of skills mismatch is critical, as it leads to skills obsolescence for the individual and is a waste of private and public investment in higher education. Research conducted as a background to the OECD skills strategy furthermore suggests that the relative utilisation and on-going development of skills is influenced by the competitiveness strategies a firm pursues[229]. Hence, a skills-enabled growth in European industry will not only depend upon the quality of graduates and doctoral candidates, but also upon how these skills are put to use in both R&D-based and non-R&D-based forms of innovation. As the Innovation Union Scoreboard[230] shows, there are major differences in innovation performance between Member States and within countries. An efficient European skills strategy must therefore be complemented by demand-side policies. The former Finnish initiative TYKES[231] constitutes such an example, addressing both skills development of the workforce as well as development of work organisation practices and leadership capabilities.

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226 Jakobsen, Leif & Shapiro, Hanne (2013). *The hidden champions- SME industrial champions in the global economy*. Danish Technological Institute.

227 Shapiro Hanne, Andersen Tine (2012b) *VET and Innovation- contribution to VET excellence in the EU*. For DG Education 2012.

228 http://www.oecd.org/site/piaac/.

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230 http://ec.europa.eu/enterprise/policies/innovation/policy/innovation-scoreboard/index_en.htm.

231 http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country_pages/fi/supportmeasure/support_mig_0039?avan_type=support&matchesPerPage=5&orden=LastUpdate&searchType=advanced&intergov=all&tab=template&index=Erawatch+Online+EN&sort=&avan_other_prios=false&searchPage=4&subtab=&reverse=true&displayPages=10&query=&country=fi&action=search.

In spite of high unemployment figures, there have been several reports of employers not being able to find graduates with the right mix of skills. There is some evidence that employers increasingly expect young graduates to be 100 % workforce ready when they first enter the labour market. If education systems specialise further, the risk is that it could occur at the expense of broader skills sets that are critical to mobility within labour markets.

An important policy message is therefore that advanced economies characterised by rapid change can expect to experience skills mismatches and to some extent skills shortages. Part of the answer to a better match between demand and supply of high-level skills therefore rests in the further development of transparent and flexible lifelong learning systems that offer pathways between vocational and non-vocational continuing education and training at all levels. There is also a need to develop new skills anticipation methodologies to take into account the fact that that skills supply and demand are no longer confined to national education systems and labour markets due to the dynamics of global value chains, the changing patterns of global mobility and off-shoring also of knowledge intensive manufacturing job functions.

Automation technologies – impact on future skills demand in industry and services

Automation technologies and advanced software that can aggregate and analyse vast amounts of data using advanced algorithms are likely to have a pervasive impact upon the nature of job functions that can be automated in the coming years, going beyond the traditional dichotomy of high-skills/low-skills jobs. If a business can save money through automation, competitive pressures will most likely leave it no choice but to do so[232]. The employment effects of automation technologies and further digitalisation are highly debated among labour market economists in the US, and there is in no way agreement about their impact on job destruction and job creation regarding high-skilled jobs. This could indicate that existing approaches to skills anticipation are not sufficiently fine-tuned to capture the impact of disruptive technologies which span existing occupational boundaries[233].

Policies

A number of policies have been initiated to address the skills supply and demand issue. Many of them are already touched upon. An additional example is the Skills Panorama, which the European Commission launched in 2012[234]. The Panorama was developed in the Europe 2020 Flagship Agenda for New Skills and Jobs[235]. It is a website presenting quantitative and qualitative information on short- and medium-term skills needs, skills supply and skills mismatches. The Panorama, drawing on data and forecasts compiled at EU and Member State level, highlights the fastest growing occupations as well as the top 'bottleneck' occupations with high numbers of unfilled vacancies[236].

Skills policies should support employers in making better use of the skills available to them[237]. To improve the skills of current and future employees while ensuring that the skills being taught are based on a corporate need, it is essential to acknowledge the importance of professional, technical training, as these skills are often the ones which

232 Brynjolfsson, Erik and McAfee, Andrew (2011). *Race Against the Machine. Lexington: Digital Frontier Press*, 2011.
233 http://www.economist.com/blogs/babbage/2011/11/artificial-intelligence.
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236 http://europa.eu/rapid/press-release_IP-12-1329_en.htm and http://euskillspanorama.cedefop.europa.eu/.
237 http://skills.oecd.org/hotissues/skillsmismatch.html.

employers find it difficult to find among the unemployed. The development of training systems should therefore be a focus point, particularly the underlying funding models with a view to scale and efficiency in expenditure. A way to do that is to facilitate public-private collaboration in the field of employee training and skills development. The UK Commission for Employment and Skills' public-private competitive fund, the UK Employer Ownership of Skills, is a good example of such a solution.

The Employer Ownership of Skills pilot[238] is a public fund open to corporate employers who wish to invest in improving the skills of their current and future employees. In other words, the government invests in the chosen projects through the fund as long as the employers are committed to invest own private funds as well.

The idea behind initiating this public-private funding scheme is that it makes it possible to learn from employer knowledge in relation to the skills needed in today's society and thereby target public growth investments more efficiently. By means of the Employer Ownership of Skills pilot, the UK Commission for Employment and Skills wishes to increase the amount as well as the quality of apprenticeships and on-job training. Furthermore, the Commission wishes to help young employees set off their careers through high quality work experience, as well as to encourage SMEs to start training programmes themselves, perhaps for the first time. This is intended to create better opportunities to match employees with the skills required by a specific industry or workplace. The UK government has chosen to invest up to GBP 340 million over a four-year period. The UK Commission for Employment and Skills is currently assessing how to improve the pilot. The aim is to turn it into a more sustainable and enduring system less dependent on government management.

Skill ecosystems

The concept of *Skill Ecosystems*[239] was gradually developed as a concept to ensure a more integrated approach to supply and demand. The background for developing the ecosystem approach was a growing body of evidence of significant skill wastage whilst employers continued to highlight skill shortages. In a skills eco-system approach the value of training is not taken for granted, but takes its point of departure in business problems and how work organisation practices and improvement of the skills base through strategic educational planning can lead to productivity improvements and a stronger innovation base. Central elements in the skills eco-system approach are to regroup the firms so they can learn from each other, and that measures take their point of departure in raising business profitability and capability.

[238] https://www.gov.uk/government/publications/employer-ownership-of-skills-pilot.

[239] Buchanan, J., Schofield, K., Briggs, C., Considine, G., Hager, P., Hawke, G., Kitay, J., Meagher, J., Mounier, A. and Ryan, S. (2001); *Beyond Flexibility: Skills and Work*.

Conclusions

A comprehensive skills strategy for European manufacturing will rely not only on the supply of engineers and scientists, but on the quality of the shop floor workers at the upper secondary level. Further expansion and renewal of apprentice systems can be one of the steps in a comprehensive alternative strategy to off-shoring of advanced manufacturing. The success of such a strategy will furthermore depend upon the innovation capabilities in the SME manufacturing base being strengthened substantially, as there is evidence of under-utilisation of skills and uneven organisational innovation performance within the EU. Efficient skills policies therefore require a careful balancing of supply and demand side factors, also taking into account variations across the Member States[240, 241, 242](OECD 2011a, Shapiro 2012b, Shapiro 2013).

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Annex 1.7: Case study: ICT - an enabler for closing the productivity gap

ABSTRACT

A migration towards a "networked economy" has been underway for many years. Across the different sectors of the economy there is a continuing proliferation of physical facilities and devices which are Internet capable and connected to the Internet. These developments have the potential to bring about deep economic and societal changes - linked to what is called "the Internet of Things". The present case study focuses on the current state of deployment and use of Information and Communications Technologies (ICT) in the economy as well as on the potentials and challenges of the increasing deployment and use of ICT in the economy.

The future use of ICT in a firm is thus likely to be part of the broader development towards the "Internet of Things, (IoT)"/"Internet of Everything, (IoE)" where people, processes, data and devices are interacting 24x7Putting ICT and the "networked economy" into perspective[243].

Booz&Co[244] have analysed the degree of "digitisation" across 15 industries in Europe. The study shows major variations across economic sectors. The most digitised sector is financial services and insurance, and the least digitised sector is construction.

Extent of automated information sharing along the supply chain

Automated information sharing along the supply chain can be viewed as a significant precursor for the migration to a fully networked and more information and knowledge intensive economy, which makes use of data for business intelligence purposes. According to Eurostat data[245], 58 % of all enterprises with 10 or more employees and 60 % of manufacturing enterprises share information electronically in the frame of their Supply Chain Management (SCM)[246] with suppliers and/or customers.

Contributions and challenges regarding competitiveness and growth

There is clear evidence that the overall growth of ICT investment and ICT capital provides a positive contribution to output and productivity growth. Studies underline this assertion:

- "The majority of studies indicate that the productivity effect of ICT is indeed positive and significant and IT increases competitiveness with variations across firms and sectors[247, 248]".

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243 The definition of the "Internet of Things" provided by the IoT European Research Cluster (IERC) provides a good overview of the many facets that are relevant in this respect: "The Internet of Things (IoT) is an integrated part of Future Internet including existing and evolving Internet and network developments". See http://www.internet-of-things-research.eu/about_iot.htm.

244 Booz&Co (2012): *The 2012 Industry Digitization Index*; available at: http://www.booz.com/global/home/what-we-think/reports-white-papers/article-display/2012-industry-digitization-index.

245 Eurostat (2013): Information Society Statistics: ICT-Use in Enterprises.

246 There are several definitions of Supply Chain Management; for example "Supply chain management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers." See Council of Supply Chain Management Professionals; available at: http://cscmp.org/about-us/supply-chain-management-definitions.

247 See e.g. The Conference Board (ed.) (2011): *The Linked World - How ICT Is Transforming Societies, Cultures, and Economies*; Research report R-1476-11-RR.

248 Cardona, M., Kretschmer, T. and T. Strobel (2013): *ICT and productivity: conclusions from the empirical literature;* in: Information Economics and Policy, vol. 25, pp. 109-125.

- "ICT are potentially able to generate increases in the productivity in the whole economy, mainly due to the spillover effects associated with them: 1) vertical spillovers between the ICT producing sector and a particular productive sector in which the ICT are applied, 2) horizontal spillovers between different sectors where ICT are applied[249, 250]".
- "ICT has driven productivity and growth in developed countries over the past two decades. Investment in ICT generates a bigger return to productivity growth than most other forms of capital investment[251]".

Apart from the direct impacts on productivity and costs, the implementation and usage of advanced (intelligent) ICT technology, applications and solutions entail significant effects on society and the economy at large. Booz&Co estimate that digitisation has boosted GDP in Western Europe in 2011 by USD 31.5 billion and created over 213,000 jobs[252]. Empirical evidence is provided for Germany: the likely efficiency effects are estimated at EUR 39 billion and the growth effect is estimated at EUR 17 billion additional GDP growth[253].

There are challenges to the implementation and use, which are discussed in the following:

Organisational requirements: Tasman[254] argues that ICT clearly is an enabler for many firms. Yet it is only a necessary but not a sufficient condition for productivity growth and transformational improvements. Firms need to have consistent organisational and ICT strategies in place and work processes and skills need to be adjusted in accordance with the specific ICT investments in order to internalise productivity gains in practice[255]. Biagi[256] arrives at a similar conclusion. He states that a priori ICT investment might entail both a positive and a negative impact on productivity. The impact of ICT becomes positive only if it is met by appropriate organisational changes in the firm. Consequently, there is a time lag between investment and benefits to be reaped.

E-skills: In order to profit from increased ICT use, firms need to have employees with the right set of e-skills[257]. In the European policy framework for e-skills, a distinction is made between three types of ICT professionals with different skills sets: (1) ICT practitioner skills, (2) ICT user skills, and (3) e-leadership skills. There will be a high demand for ICT practitioner skills as a lot of employees are needed to develop and run ICT-based solutions, which will be deeply integrated in manufacturing processes through modularisation, automation, use of digital data, and digital standards. With digitally based

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249 Biagi, F. (2013): *ICT and Productivity: A Review of the Literature*; Institute for Prospective Technological Studies, Digital Economy Working Paper 2013/09.

250 See Tasman (2009): *ICT as a driver of productivity*; White paper prepared for Telstra, January; and the literature cited therein. See also Howard, J. (2005): D*igital Factories: the Hidden Revolution in Australian Manufacturing*; study commissioned by the Department of Communications, Information Technology and the Arts; September.

251 Oxford Economics (2012): *Capturing the ICT dividend – Using technology to drive productivity and growth in the EU*, available at: http://www.oxfordeconomics.com/my-oxford/projects/128841.

252 Booz&Co (2012): T*he 2012 Industry Digitization Index*, available at: http://www.booz.com/global/home/what-we-think/reports-white-papers/article-display/2012-industry-digitization-index.

253 BITKOM and Fraunhofer ISI (2012): Macro-economic potentials of intelligent networks in Germany.

254 Tasman (2009), op. cit.

255 Moreover, a successful ICT-integration also requires effective internal and external communication and careful risk assessment.

256 Biagi, F. (2013): *ICT and Productivity: A Review of the Literature*; Institute for Prospective Technological Studies, Digital Economy Working Paper 2013/09; available at: http://ftp.jrc.es/EURdoc/JRC84470.pdf.

257 See e.g. Turcotte, J. and L.W. Rennison (2004): *The Link between Technology Use, Human Capital, Productivity and Wages: Firm-level Evidence*'; Fraunhofer Institut für Arbeitswirtschaft und Organisation (IAO) (2013): Production work in the future – Industry 4.0 (in German: Produktionsarbeit der Zukunft – Industrie 4.0). The analysis of the latter study actually focuses on Germany; however, we perceive the results also to hold true of developments outside Germany.

modularisation, manufacturing and product development become more closely connected and production workers are getting more involved in product development based on small series. Decision makers will need to understand the strategic opportunities offered by ICT to adapt business models and to lay out the strategic direction for new value added services, including how to exploit big data for gathering business intelligence[258]. The digital environment increases functional literacy, numeracy and higher order problem solving[259].

Complexity and its management: The future proliferation of ICT based solutions in the business sector will increase the complexity both within a firm and across the value chain due to an increasing individualisation of products, a multi-channel delivery of products and services, and more complex forms of inter-firm cooperation and knowledge sharing[260]. In order to manage the increasing complexity, appropriate instruments are required (e.g. planning and simulation tools as well as structures and methods to exploit digital data)[261].

Inherent limits to automation: There is a trade-off between the degree of automation in a firm or eco-system of firms and the flexibility required by the market[262]. One of the issues brought forward by a firm such as Toyota is the risk of losing core knowledge and skills critical to innovation when processes are fully automated and mainly require monitoring skills. For that purpose, Toyota has reduced the number of intelligent robots originally put in place[263]. Another challenge remains regarding the interfacing between increasingly intelligent robots (the robot co-worker) and the capacity of human workforce. Automation may go in the direction of fully integrated distributed platforms, which is the basis for the research, development and testing of the US Alliance for Smart Manufacturing[264, 265], or automation may focus on defined areas in the production process and how these can be improved through strategic approaches to automation and digitalisation.

Issues related to security, privacy, resilience: The adoption and diffusion of ICT in the business sector will lead to a high level of networked system structures including numerous IT systems, automation components, machines, humans, and data created. There will be intelligent data gathering, saving and distribution by objects and humans alike. Resilience and IT security as well as privacy of data across the entire system is a key requirement. Safety and security aspects have to be taken into account already in the design phase of intelligent production facilities[266].

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258 Shapiro Hanne, Kidmose Rytz Benita, Sylvest Janne, Jakobsen Leif (2014), *Et dansk væksttjek*; *Baggrundsanalyse*, Erhvervs- og Vækstministeriet som indspil til nyt industriprogram.

259 See OECD (2013): OECD Skills Outlook 2013; revised version, November. The report concludes: "Proficiency in literacy, numeracy and problem solving in technology-rich environments is positively and independently associated with the probability of participating in the labour market and being employed, and with higher wages.".

260 Vodafone (2013): *The M2M adoption barometer 2013*. A unique insight into what's driving M2M and what the future holds; available at: http://www.google.de/url?sa=t&rct=j&q=&esrc=s&source=web&cd=5&ved=0CFkQFjAE&url=http%3A%2F%2Fwww.m2m_alliance.com%2Ffileadmin%2Fuser_upload%2Fpdf%2F2013%2FWhitepaper%2FA412_M2M_Circle_Research_13052428_web.pdf&ei=8P8mU8W_J_mGywOjtoKwDA&usg=AFQjCNHIVhW9shaAD692O1Z48JiU3L37BA&bvm=bv.62922401,d.bGQ&cad=rja.

261 See Promotorengruppe Kommunikation der Forschungsunion Wirtschaft/Wissenschaft und Acatech (Deutsche Akademie der Technikwissenschaften) (2013): *Recommendations regarding the implementation of the future oriented project Industry 4.0.*

262 Flexibility can be viewed as key factor for production and its importance will increase as time schedules and cycles (e.g. due to pressure on time to market in output markets) become even shorter than today.

263 Shapiro Hanne: 2014, Indspil til 3Fs industristrategi (in Danish).

264 http://smartmanufacturing.com/2013/05/27/manufacturing-in-america-making-things-right/.

265 Brynjolfsson Erik McAfee Andrew (2013), *Second Machine Age*. W. W Norton and Company.

266 See Fraunhofer Institut für Arbeitswirtschaft und Organisation (2013), op. cit. Vodafone (2012), op. cit. argue e.g. that security concerns are a main barrier to implementation at the early stages of M2M strategy development.

Resource efficiency: The reduction of resource and energy consumption is a key aspect of the migration towards a networked economy[267]. ICT platforms open up for resource optimisation both in digital product design and through smart grid solutions.

Policies

In its 2010 Communication on an integrated industrial policy for the globalisation era[268], European industry is put at the centre of the new growth model for the EU economy outlined in the Europe 2020 Strategy[269]. The European Commission has recently reformulated its key priorities for industrial policy in its Communication on European Industrial Renaissance[270]. This Communication does not specifically address ICT; however, it provides an overall frame for Europe's upcoming industrial policy. The Communication shows that industrial policy and other EU policies are getting gradually more and more integrated, as indicated in the aforementioned 2020 Communication on industrial policy, and it stresses the importance of full and effective implementation of industrial policy in the EU.

The Digital Agenda Europe[271] has underlined that the deployment of ICT becomes a critical element for delivering strategic policy objectives for a smart, inclusive and sustainable Europe.

A new contractual PPP on Factories of the Future is part of the Research and Innovation programme « Horizon 2020 » for the period 2014 to 2020[272]. The first call for topics was recently launched by the European Commission[273].

Several activities have been carried out on the European policy level regarding the Internet of Things (IoT)[274]. Key items discussed in this context have been for example privacy issues, ethical issues, open and interoperable object identifiers, and the security of critical IoT infrastructures.

In order to address the looming lack of eSkills in the European labour force, policy-makers have set up the "European e-Competence Framework" in close partnership with industry, education providers, and other stakeholders from users to producers (e-CF)[275]. The objective of e-CF is to offer a general and full set of e-Competences in the European market that can be adapted in different ICT business environments.

Member States have also launched policy programmes to support the future adoption and diffusion of ICT in the business sector. One example is the German federal initiative "Industry 4.0"[276]. The "Industry 4.0" programme aims at summarising all aspects of innovative ICT use in the German industrial sector including IoT, Big Data and Cloud Computing. "Industry 4.0" is part of the "High-Tech Strategy" of the federal government to

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[267] See e.g. Promotorengruppe Kommunikation der Forschungsunion Wirtschaft/Wissenschaft op. cit., pp. 66-67.

[268] European Commission (2010): Communication "An Integrated Industrial Policy for the Globalisation Era - Putting Competitiveness and Sustainability at Centre Stage, SEC(2010) 1272, SEC(2010) 1276, Brussels.

[269] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:2020:FIN:EN:PDF.

[270] See European Commission (2014a): F*or a European Industrial Renaissance,* Com(2014) 14/2, Brussels; European Commission (2014b): Staff working document accompanying the document "For a European Industrial Renaissance"; Comm(2014) 14.

[271] European Commission (2010b): *A Digital Agenda for Europe*, Brussels, COM(2010) 245.

[272] See http://ec.europa.eu/programmes/horizon2020/.

[273] See European Factories of the Future Research Association (EFFRA), http://www.effra.eu/ and http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/main/h2020-wp1415-leit-nmp_en.pdf.

[274] See e.g. European Commission (2009): *Communication on "Internet of Things — An action plan for Europe"*; COM(2009) 278 final; IoT Expert Group (2012).

[275] See http://www.ecfassessment.org/en/3/e-cf.

[276] See http://www.bmbf.de/de/19955.php.

support the implementation of relevant ICT equipment and applications in the German industrial sector.

Conclusions

To pave the way for the future adoption and diffusion of ICT in the business sector and to reap the potentials for productivity a high-speed broadband infrastructure is needed to fully realise integrated solutions to automation across the industrial value chain is. Several broadband technologies are relevant, and policy should give incentives for a competitive model for the further deployment of broadband infrastructure in Europe. There is a growing concern regarding data security. The issue of trade restrictions is also likely to play an increasingly important role. This is because the increasing complexity of ICT-based systems implemented across industries increases the likelihood that specific components are subject to national and/or international trade restrictions. An example is cryptographic components (encryption equipment, technologies, and tools). This will become in particular relevant for trade with countries outside Europe.

Sources

The case study draws on previous research and analysis carried out for the Ministry of Economics, Transport and Regional Development of the German State of Hesse and for the Danish government as background to the national growth strategy which has just been launched.

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SEC(2010) 1272, SEC(2010) 1276, Brussels; available at: http://ec.europa.eu/enterprise/policies/industrial_competitiveness/industrial_policy/files/communication_on_industrial_policy_en.pdf.

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Annex 1.8: Case study: Construction products and the Internal Market

ABSTRACT

The European construction products industry has been hit hard by the economic and financial crisis, along with the construction sector as a whole. The sector furthermore faces significant additional challenges. Among these is an increasingly strict regulatory environment, which places significant administrative burdens on companies. In addition, the internal market for production products is highly fragmented, with significant barriers to accessing other national and regional markets. These barriers relate to varied building traditions and standards and to differences in implementation of European regulations at national level, which creates technical barriers for foreign firms to access other national markets within Europe. Finally, the sector is faced with high costs of energy and raw materials that negatively affect its international competitiveness.

The construction products sector

Construction is a key sector in the European economy. It generates almost 10% of GDP and provides 20 million jobs, mainly in micro- and small enterprises. The sector was one of the worst affected by the financial and economic crisis, with building and infrastructure works (measured in output) falling by 16 % between January 2008 and November 2011 across the EU-28. The onset of the crisis meant severe drops in demand both in the public and private construction markets[277]. Recently, however, the sector appears to have reached what is perhaps a turning point, with production in construction increasing by 8.8 % in the euro area and by 7.3 % in the EU28 between January 2013 and January 2014[278].

This case study focuses on the construction products (or manufacturing of construction materials) subsector, covering the suppliers of building products and components, which is a subsector of the overall construction sector. The sector includes activities such as the manufacture of bricks, tiles and construction products, manufacture of builders' carpentry and joinery, manufacture of cement, lime and plaster and of articles of concrete, cement and plaster, and the manufacture of metal structures.

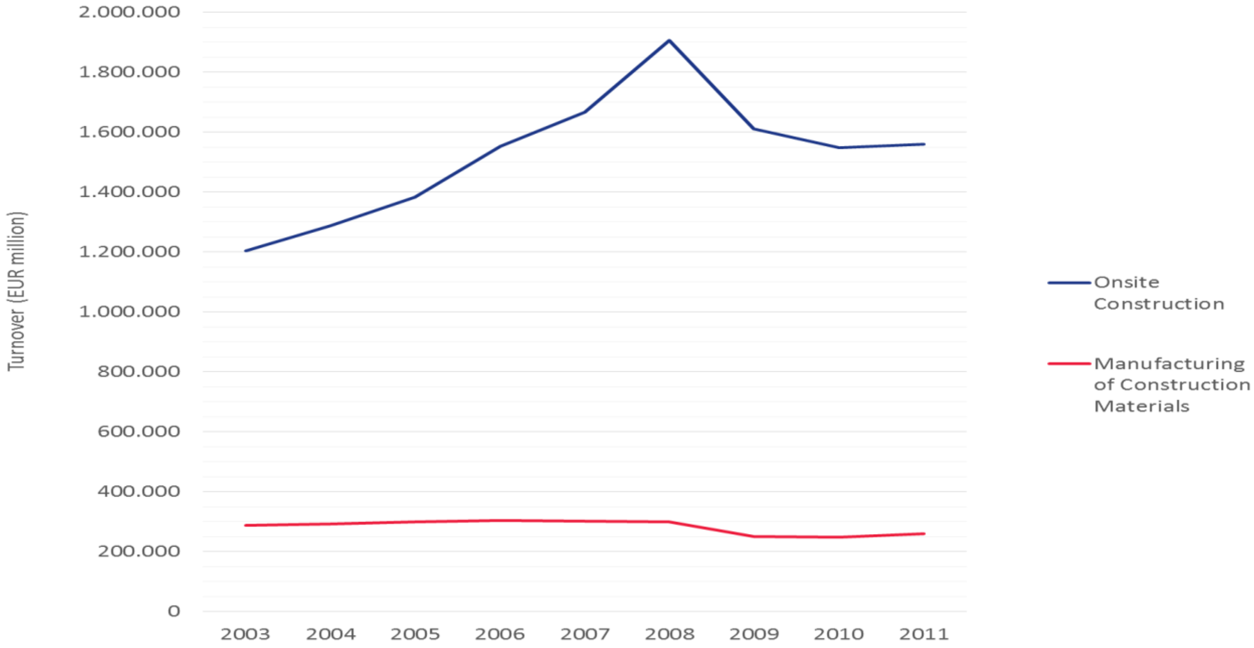
Until the financial crisis, the European construction products sector performed well with regard to turnover, value added, and employment[279]. However, as a key input sector to on-site construction activities, the construction products sector also suffered as a result of the crisis. The construction products sector employed 1.68 million persons in 2011, down from a peak of 2.02 million in 2007 (a 17 % reduction), and the total turnover in 2011 was EUR 259 billion Euro, down by 14 % since 2007. The following figure and table show the development of the subsector 2003-2011 compared with on-site construction. According to interviews with sector representatives, the crisis can still be felt in the sector, with more and more companies and production sites closing down. Although turnover rose by 4 % between 2010 and 2011, employment continued to decline, falling by 4 % during the same period.

[277] European Commission, Strategy for the sustainable competitiveness of the construction sector and its enterprises, COM(2012) 433 final, Brussels, 31.7.2012.

[278] Eurostat, *Production in construction up by 1.5% in euro area*, Eurostat News Release 44/2014 – 19 March 2014.

[279] ECORYS, DTI, Cambridge Econometrics, Ifo, Idea Consult, *Study on the Sustainable Competitiveness of the Construction Sector*, Final report, FWC Sector Competitiveness Studies N° B1/ENTR/06/054, DG Enterprise and Industry, March 2011.

Figure 17: Development in turnover, onsite construction and manufacturing of construction materials 2003-2011



Source: Eurostat

Table 7: Development in number of employees, onsite construction and manufacturing of construction materials 2003-2011 (thousands) [280]

	2003	2004	2005	2006	2007	2008	2009	2010	2011
Onsite Construction	12,928	13,170	13,542	14,087	14,782	15,047	14,663	13,423	13,015
Manufacturing of construction materials	1,834	1,858	1,897	1,948	2,017	1,978	1,799	1,752	1,675

Source: Eurostat

280 Definition of Manufacturing of Construction Materials:

Nace Rev 1 until 2008: Manufacture of builders' carpentry and joinery (DD20.3), Manufacture of bricks, tiles and construction products, in baked clay (DI26.4), Manufacture of cement, lime and plaster (DI26.5), Manufacture of articles of concrete, plaster or cement (DI26.6), Cutting, shaping and finishing of ornamental and building stone (DI26.7), Manufacture of structural metal products (DJ28.1).

Nace Rev 2 from 2008: Manufacture of other builders' carpentry and joinery (C1623), Manufacture of bricks, tiles and construction products, in baked clay (C2332), Manufacture of cement, lime and plaster (C235), Quarrying of ornamental and building stone, lime (B0811), Manufacture of articles of concrete, cement and.. (C236), Manufacture of metal structures and parts of structures (C2511), Cutting, shaping and finishing of stone (C237).

Definition of Onsite Construction:

Nace Rev 1 until 2008: Site preparation (F45.1), Building of complete structures or parts thereof; civil engineering (F45.2), Building installation (F45.3), Building completion (F45.4), Renting of construction or demolishing equipment with operator (F45.5).

Nace Rev 2 from 2008: Construction of buildings (F41), Civil engineering (F42), Specialised construction activities (F43).

Contributions and challenges for competitiveness and growth

In addition to the effects of the financial crisis on demand, some of the key challenges that the European construction products sector faces are related to the regulatory environment at EU level and nationally, and rising costs of energy and raw materials.

The regulatory environment and the internal market

A key characteristic of the construction products sector - and of the construction sector as a whole - is the fragmented internal market. There is a common European regulatory framework laying down harmonised conditions for the marketing of construction products (the Construction Products Regulation (CPR) from 2011, replacing the Construction Products Directive from 1989). However, different building traditions, climatic conditions, standards and regulations across Member States mean that there is in practice no common market. The national and also the regional markets - for instance, the German *Länder* - have different requirements, so that products have to be adapted to each market. Thus, true harmonisation is hardly attainable without standardisation of European Member States' building law.

The industry has welcomed the intention of the CPR to simplify cross-border market access and to set a clear EU-wide framework with precise rules. However, the new regulation has also added administrative burdens for the companies.

The CPR entered into force in 2011. It lays down conditions for the placing or making available of construction products on the market by establishing harmonised rules on how to express the performance of construction products in relation to their essential characteristics and on the use of CE marking on those products. Compared to the 1989 directive, the CPR requires additional information on characteristics of construction products and also puts in place new basic requirements for construction works. This means additional administrative burdens for companies. If a construction product is being marketed and is covered by a harmonised European Standard (hEN), then the manufacturer must draw up and supply a copy of the Declaration of Performance (DoP) and apply CE marking to its products.

The European Commission published a delegated act on this issue (article 7(3) and 60(b) of the CPR), in which the Commission declares that a Declaration of Performance can be supplied by electronic means but must be supplied in paper form as well. This does not simplify the publication of the DoP and hence does not reduce the administrative burden.

A company interviewed for the case study advocates a clear-cut solution towards the supply by electronic means only. The company uses QR-Codes on its products, which can be scanned so that the customer receives the Declaration of Performance online.

The European construction sector is also subject to various other national and European regulatory requirements and standards concerning energy consumption, environmental risks and impact, health and safety, quality of products, etc. Furthermore, the regulatory environment is becoming increasingly stricter. Sector organisations have consistently called for a predictable regulatory framework that allows for long-term investment planning and competitiveness at the global level[281].

[281] Interview, Christophe Sykes, Director General, Construction Products Europe. See also CEMBUREAU, Industrial Renaissance, Climate Change & Energy: CEMBUREAU supports predictable regulatory framework, Website of CEMBUREAU, the European Cement Industry Association, 22 January 2014, http://www.cembureau.eu/newsroom/industrial renaissance climate change energy cembureau supports predictable-regulatory.

The Commission recognised this in its strategy for the sustainable competitiveness of the construction sector and its enterprises[282]: "The construction sector is highly regulated at many levels (e.g. the products, works, professional qualifications, occupational health and safety, environmental impact) and many aspects are Member States' competences. In order to ensure a better functioning of the Internal Market for construction products and services, it is important that the legal framework is as clear and predictable as possible and that administrative costs are proportionate to the objectives pursued."

The global competitiveness of European producers of construction products is further affected by the fact that they often face stricter regulatory requirements and standards in European than in non-European markets. This makes it relatively more expensive to operate in Europe than in other parts of the world, and thus poses a threat to the global competitiveness of European companies. The same requirements and standards may, however, also provide the European sector and its products with a reputation for high-quality products[283].

Energy and raw materials

The construction products sector faces considerable competitiveness challenges with regard to the rising costs of energy and raw materials. The cost of energy is a key concern of energy-intensive industries. While Europe expects a further increase in energy prices in the future, the revolution in shale gas in the US is reshaping energy markets worldwide and is leading to a competitive disadvantage for EU industry. Energy prices for EU industry are three to four times higher than in the US or Russia. Parts of the construction products sector are highly energy-intensive. This applies particularly to extractive and manufacturing industries. In the cement industry, for instance, energy costs are estimated to constitute 30-40 % of total costs[284].

Interviewed industry representatives are concerned that while the 2020 package sets out a triangular approach of pursuing security of supply, cost-competitiveness, and sustainability, the European energy and climate policy is currently focused mainly on environmental sustainability, meaning that sustainability and competitiveness are not pulling together. Industry is looking for a more balanced approach which takes account of all three objectives equally, with clear targets that do not conflict and which are realistic, achievable and affordable for European industry.

Conclusions

The construction products sector in Europe – as the construction sector as a whole – has been substantially affected by the financial and economic crisis since 2008. Although there are signs of recovery in recent years, many companies have been forced to close down or reduce their activities.

In addition to the economic crisis, key challenges facing the construction products sector concern the increasingly stricter regulatory environment, the fragmented internal market, and rising costs of energy and raw materials. All of these factors affect the sector's competitiveness.

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[282] European Commission, Strategy for the sustainable competitiveness of the construction sector and its enterprises, COM(2012) 433 final, Brussels, 31.7.2012.

[283] ECORYS, DTI, Cambridge Econometrics, Ifo, Idea Consult, *Study on the Sustainable Competitiveness of the Construction Sector*, Final report, FWC Sector Competitiveness Studies N° B1/ENTR/06/054, DG Enterprise and Industry, March 2011.

[284] Ibid.

The construction industry calls for a more stable regulatory environment with a larger degree of predictability to facilitate long-term investment decisions and competitiveness vis-à-vis external competitors and markets.

The fragmentation of the internal market is partly due to differences in national and regional building traditions and standards, which are to a large extent influenced by factors such as local environmental and climatic conditions. Such barriers are difficult to completely eliminate. However, varying implementation and interpretation of European regulation at national and regional levels constitutes a significant part of the remaining barriers. There is room for further initiatives at European level to reduce the barriers to cooperation among Member States, for instance through improved application of the mutual recognition principle in the internal market for goods.

The cost of raw materials, in particular energy, constitutes another significant challenge. There is no level playing field within the EU in the form of a common European energy policy, and European manufacturers generally face much higher energy costs than their main competitors outside Europe. There is a need to integrate both environmental/climate concerns and competitiveness concerns in the European environment and energy policy areas.

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Annex 1.9: Case study: Mechanical engineering – a case of European productivity problems?

ABSTRACT

Low labour productivity is often viewed as one the main challenges regarding the competiveness of Europe vis-à-vis other parts of the world. A particularly important part of the European economy is the Mechanical Engineering (ME) sector accounting for nearly 10 % of the overall production in Europe. The ME sector exhibits a relatively low labour productivity level compared to ME sectors in other parts of the world. Nonetheless, this sector sustains a very competitive position in the world. The present case study therefore seeks to identify specific success factors for the sector's competitiveness and growth as well as key challenges of the ME sector in Europe.

Putting the sector into perspective

The mechanical engineering (ME) sector[285] (NACE Rev. 2 sector 28)[286] is one of the major branches of industry in the EU-27 in terms of production value with a share of around 9.7 % (as of 2012) of all manufacturing industries. In absolute terms, the ME sector in the EU-27 attained a production value of EUR 479.5 billion (2012)[287]. Germany accounts for 36 % of the EU-27 ME output. The share of ME's value added in total manufacturing is 11.2 % (2012). Thus, it is higher than the share of ME's production value in total manufacturing production (9.7 %). Overall, around 3.2 million people (2013) are employed in the European ME industry. In 2008 there were approximately 91,800 enterprises[288]. The subsequent characterization of key features of the European ME industry is based on IFO et al. unless otherwise indicated.

More than three quarters of total ME workforce is employed in companies with more than 50 employees. Very often these companies do not fit into the definition of SMEs of the European Commission (up to 250 employees). Rather, they are bigger family-owned firms and most companies fall within the size category of 500 to 2000 employees [289]. The European ME sector enjoyed comfortable growth rates in the period from 1995 to 2000. After this period a more sluggish development imposed a constraint on companies. The ME industry was hit hard by the global financial and economic crisis in 2009. Production fell by more than one fifth, on average, for all EU Member States. However, the ME sector benefitted from an early recovery and high growth momentum in 2010. There are currently signs of the beginning of a turnaround since the end of the third quarter of 2013 and indications for a more optimistic perspective for 2014 [290]. The core production

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285 In the present case study we use the terms "ME industry" and "ME sector" interchangeably.

286 Eurostat NACE Rev.2, Statistical classification of economic activities in the European Community.

287 The production value (in current prices) of the ME sector diminishes considerably in the past years: it was equal to EUR 598 billion in 2008 and equal to EUR 502 billion in 2010.

288 IFO Institute, Cambridge Econometrics, Danish Technological Institute (2012): An introduction to Mechanical Engineering: Study on the Competitiveness of the EU Mechanical Engineering Industry; study on behalf of the European Commission (DG Enterprise & Industry); Munich, February 1, 2012; section 2.1.1.

289 Yet, they are still "small" compared to their global competitors. A few examples might underline this assertion. Caterpillar (USA; active e.g. in the engines and turbines market) employs more than 122,000 people worldwide. Companies active in the bearings, gears and drives market are e.g. NTN (Japan; 21,000 people worldwide); Timken (USA), 19,000 people worldwide); Schaeffler Group (Germany, 79,000 people worldwide), SKF (Germany, 46,000 people worldwide) and Voith (Germany, 43,000 people worldwide). CNH Industrial (former FIAT Industrial), active e.g. in the agricultural and forestry machinery sector employs 68,000 people worldwide. Ifo reports that as of 2008 the average number of employees per company in ME amounts to 34.9. Moreover, the average number of employees for companies with a staff of 250 and more is equal to 790 (based on the countries CZ, DE, ES, FR, IT, SK, PL, UK). See Ifo et al. (2012), op. cit., p.7.

290 European Commission (2014): Commission staff working document accompanying the document "*For a European Industrial Renaissance*"; Comm(2014) 14; Section 3.3.

activities of the sector are concentrated in central Europe, including Austria, the Czech Republic, France, Germany, (Northern) Italy, the Netherlands, Poland and Slovakia[291]. Three quarters of the output of the ME industry originate from the five biggest Member States. The contribution of the ME industry to the countries' economies is particularly high in Germany and Italy, whereas for France and, in particular, for the United Kingdom the share of ME in their economies' output is well below the EU average. The output of the ME sector is used for the gross capital formation of a broad range of industries. In fact, for many industries ME supplies more than 50 % of their total investment in machinery and equipment. The product portfolio of the ME sector encompasses a whole range of different products[292]. There are a few large groups in the ME sector that have been specializing in the automotive industry and deliver key components that are crucial for the performance of transport equipment. Moreover, there are subsectors of the ME industry that provide capital goods for specific client industries such as the textile, commercial paper, pulp and paper, construction and mining and agricultural industry. They are strongly dependent on clients' investment behaviour.

Against this backdrop, one can view ME as an enabling industry inasmuch as it is important for the dissemination of advanced equipment, machinery and process technologies in most sectors of the economy. Most of the key technologies such as bio-, and nanotechnology, advanced materials, photonics, micro- and nano-electronics – that are perceived as key to Europe's competitiveness - are dependent on innovation within ME.

Contributions and challenges regarding competitiveness and growth

A lot of studies highlight a more or less significant productivity gap between Europe and other parts of the world[293]. The ME sector in Europe is particularly interesting from at least two perspectives: (1) The sector exhibits significant labour productivity disadvantages[294]. Even though there have been improvements of labour productivity over time (Compound Annual Growth Rate (CAGR) of 3.4 % between 1995 and 2008) the Ifo et al. study underlines that overall European ME labour productivity is roughly half the productivity of the respective U.S. sector and that the Japanese ME labour productivity exceeds the EU level by more than 50 %. These differences in labour productivity between Europe on the one hand and North America and Japan on the other hand have been observable over a longer period of time. On the other hand, however, numerous EU ME companies exhibit a very competitive position in the global market and they perform (much) better than competitors from e.g. the U.S. and the People's Republic of China[295]. Ifo et al. argue that

[291] Moreover, the non-EU country Switzerland is also important in this respect and a smaller but likewise strong cluster of ME is found in Spain, namely in the Basque region.

[292] Among them are component manufacturing items (pumps and compressors, taps and valves, bearings, gears etc.), non-domestic cooling and ventilation equipment, textile machinery, engines and turbines, lifting and handling equipment, agricultural and forestry machinery, machinery for mining and quarrying, and machine tools.

[293] And they continue:"The level of productivity, in turn, sets the level of prosperity that can be reached by an economy. The productivity level also determines the rates of return obtained by investments in an economy, which in turn are the fundamental drivers of its growth rates. In other words, a more competitive economy is one that is likely to grow faster over time." See World Economic Forum (2013): The Global Competitiveness Report 2013–2014, Full Data Edition; available at:
http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2013-14.pdf; p.4.

[294] See IFO et al. op. cit.; section 2.1.1. The most recent Ifo et al. data is mainly for 2008. The year 2008 can, however, be viewed as an outlier inasmuch as the economic crisis led to a sharp reduction of production output in many sectors which was not accompanied by a respective adaptation of labour force. Thus, in all likelihood the most recent values that the Ifo et al. study provides underestimate labour productivity in the ME sector. Yet, overall, the finding of a lower labour productivity in Europe compared to other parts of the world remains valid.

[295] As to the global competitive position of the Chinese ME industry see e.g. Euro Asia Consulting (2014): Implications of Chinese Competitor Strategies for German Machinery Manufacturers; study commissioned by

there is evidence that the productivity differences "have been primarily caused by stable structural differences[296]". Against this backdrop, two questions arise: What are the reasons for the low labour productivity in the ME sector? Which factors compensate for the a priori competitive disadvantage of relatively low labour productivity and spurring competitiveness and growth of the sector?

First, it is worth to take a more thorough look at the product portfolio and the positioning of sector companies in the market. Both the industrial economics literature and our interviews underline that it is pertinent to differentiate between high-end and mid- and low-end ME manufacturing. High end manufacturing focuses on the development and production in the premium product segment taking account of idiosyncratic requirements of the potential buyers. Such requirements are e.g. related to technologies, production processes and business cycles on the customer side. Our interviews suggest that considerable parts of the ME industry in Europe are focusing their activity on the high-end market segment. Second, key assets of many ME companies in Europe are therefore longer-term, stable and trustful relationships with the customer as well as tacit knowledge and expertise resulting in special competencies and a very high (sector and/or company specific) specialisation. Third, in effect, not only tangible goods, in particular machinery and equipment, are supplied by a high-end ME company. Rather, the service component is of utmost importance. Indeed, high-end (and to a lesser extent also mid-end) ME companies provide a whole range of pre-sales services (e.g. cooperative development of new technical concepts, counselling services regarding installation and the set-up of machines and systems) and after-sales services (such as training of staff, maintenance and repair) linked to the hardware supplied to customers. Overall, this results in the development of advanced solutions for client industries' production processes[297]. Ifo et al. report that a reasonable estimate for the share of services in production value is 15 % to 30 %. Moreover, they point out that a small number of ME firms even offers financial services to clients. Apart from the downstream markets, close links are required with high-tech upstream industries (suppliers of the ME industry).

Contrary to this, the outputs of mid- and in particular low-end manufacturing are mainly based on a "good enough" strategy, i.e. they are manufactured mainly for a mass market. Thus, the less specialized and service intensive the output of the ME sector is, the less labour intensive is the respective production, and vice versa. The answer to the first question is therefore inextricably linked to the production focus and the key strategic assets of significant parts of the European ME industry: They are operating in the high-end segment which is service intensive and, in turn, more labour intensive whereas substantial parts of the ME industries outside Europe are active also and in particular in the low-end segment (which is less labour intensive).

The aforementioned arguments lead to two additional conclusions: (1) In particular the high-end part of the ME industry serves as an enabler which is of crucial importance for the transmission of basic inventions and innovations[298]. (2) The close interrelatedness between the ME industry and the client industries brings about, however, also a high dependency of the ME industry from business cycles[299].

IMPULS-Stiftung of VDMA; Shanghai/Munich, February. This study focuses in particular on a comparison of the Chinese and German ME industry.

[296] Ifo et al., op.cit., p.20.

[297] See also Ifo et al. (2013), op. cit., pp. 12-13.

[298] See also Ifo et al. (2013), op. cit., p.11.

[299] "Increasingly, the ME industry is required to cope with more severe market fluctuations than most other branches of industry. As one of the prime supplying industries of capital goods, it is highly dependent on the investment activity of the purchasing companies, which are highly sensitive to developments in the economy as a whole. This applies above all to industry's investments in equipment and machinery, into which most ME

Conclusions and recommendations

It seems obvious that (1) the future global growth of the world economy, (2) the degree of industrialization of emerging economies in the world (and the respective demand for ME goods and services), and (3) the degree to which the ME industries in emerging economies are able to catch up with their European counterparts[300] are important factors affecting the (prospects of the) European ME industry. Key factors determining the longer term outlook of the potential contribution of the European ME industry to competitiveness and growth as well as particular challenges for the ME industry are the following[301]:

Human capital/labour: The ME sector is suffering from lack of appropriate skills. This holds true for both highly qualified engineers and in particular of workers employed in the actual assembly of the goods manufactured by the ME industry[302]. Measures focusing on the scarcity (or lack) of employees possessing appropriate qualifications (and available at locations where they are actually needed) might include (1) the support of lifelong learning and vocational training (on the job), (2) the education of skilled young workers, and (3) keeping older skilled employees in the ME industry longer on the job when they are reaching retirement age.

Technological progress, R&D, innovation: Based on our interviews it is fair to state that Horizon 2020 and the new rules regarding the Public Private Partnership "Factories of the Future" may be viewed as significant steps in the right direction (compared to the previous situation). Yet, it has also been underlined that it is too early to judge and assess the real effects of these instruments as the degree to which the respective potentials can be internalized depend on their actual implementation. Of particular importance are the degree of simplification (compared to previous programmes) and the reduction/avoidance of transaction costs, in order to set appropriate incentives for (SME type) ME industry firms to invest in innovation[303]. Moreover, the degree to which environmental political objectives (e.g. regarding Green House Gas) are actually implemented in the economies worldwide, and, thus, lead to the implementation of new production processes able to reduce waste generation, to limit energy consumption and to save both natural and material resources in all likelihood provide particular market opportunities for the ME sector.

Access to sales markets outside Europe: The international competitiveness of the European ME industry does not only rely on dimensions such as price and quality. Rather, market entry in markets outside Europe is possible only by meeting specific regulatory and

products flow either directly or indirectly. The one-sided dependency on investment activity repeatedly subjects the ME industry to pronounced cyclic fluctuations in demand. The client companies' investment decisions are a response to actual or expected changes in capacity utilisation, earnings, financing costs or general market conditions. These aspects develop in parallel for large areas of the economy, leading to cumulative processes. The resultant fluctuations in investment activity, which are more pronounced for equipment than for other business activities, have a decisive effect on the cyclical up-, and downturns of the economy as a whole. Consequently, the ME industry is almost inevitably at the core confronted by the boom and recession periods." See Ifo et al. (2013), op.cit., p.14.

[300] In this context it is in particular relevant to what degree these players (e.g. from China) are able to migrate from a mainly volume based business model (low- to medium-end) towards a strategy focusing on high-end key technologies and products, respectively.

[301] The following arguments are based on Euro Asia Consulting (2014), op. cit.; European Commission (2014): Staff working document accompanying the document "For a European Industrial Renaissance"; Comm(2014) 14; European Economic and Social Committee (2013): Opinion on "The challenges of the European engineering industry (mechanical, electrical, electronic and "metalworking") in a changing global economy"; own initiative opinion; Rapporteur: Ms Studničná; Co-rapporteur: Mr Atanasov; Brussels, 11 December 2013; Ifo et al. (2013), op.cit., pp. 14-16, and our interviews.

[302] Yet, it is also true that the extent to which these problems and challenges are relevant differ more or less significantly across Europe.

[303] In this context see e.g. Joanneum Research and WIK-Consult (2013): *SMEs Participation under Horizon 2020*; study for the European Parliament's Committee on Industry, Research and Energy; November.

administrative requirements in the target markets. Conditions that in one way or another are impeding market entry of European ME companies abroad are obviously existing in developed as well as developing countries. The challenge here is non-tariff barriers. Crucial issue are e.g. certification systems in other countries and the fulfilment of the respective requirements resulting often in high transaction costs for European companies making market entry virtually impossible. European policy should therefore focus on such issues in upcoming international trade negotiations and it should seek to lower non-tariff barriers. Policy should in particular aim at establishing a level playing field between the requirements for companies from outside Europe to enter the single European market and for the requirements to be fulfilled by European market players in the respective markets abroad. Moreover, EU trade policy needs to continue to identify and combat protectionist behaviour in specific countries of the world.

Administrative and regulatory framework conditions: The ME sector itself but also the industries purchasing the output of the ME sector are subject to investment horizons often spanning decades, at least regarding the basic technological concepts of a solution. Against this backdrop, our interviewees underline that the scope as well as the predictability and stability of the regulatory environment of the ME sector are key issues[304]. They claim that the speed of changes in the regulatory framework conditions relevant for the ME industry[305] is often too high and puts in practice a high burden on the companies. Changes of the legal and regulatory frame relevant for the ME industry in Europe should therefore be based on impact assessments which take into account the mid- and longer term effects on implementation costs in a suitable way.

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[304] Arguments brought about in this context include (1) changes in legislation and recasts of existing regulations and directives happen too often, (2) recasts are often followed by amendments, (3) regulations are too detailed in certain areas and (4) rules for public tenders sometimes are too complicated to understand.

[305] See next section.

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Annex 1.10: Case study: Technical Textiles in Belgium

ABSTRACT

The cluster of technical textile companies in Belgium is an interesting example of a subsector that has managed a transition from a traditional textile production industry to a niche-oriented cluster of companies which relies on specialized expertise and R&D. Among the key factors affecting the competitiveness of the cluster is the existence of specialised suppliers (mainly the strong Belgian chemical industry) and the existence of strong knowledge and educational institutions within the cluster region.

The technical textiles sector in Belgium

The Flanders region in Belgium has been a centre for textile production since the middle ages. A transition of significant parts of the traditional textile producing industry took place from the 1990s onwards, with a reorientation towards technical textiles.

Technical textiles comprise divergent textile products and materials for different markets. Compared to traditional textile materials, they are characterized by (a combination of) properties such as light weight, strength, flexibility, functionalisation, acoustics, recycling, etc. The range of products and applications is very broad and includes geotextiles (applied in road construction works, hydraulic engineering, drainage, refuse dumps, etc.) and textiles for construction, agriculture, gardening and fishing, defence, protection and security, automotive industry, medical applications, transport and packaging, industrial applications (filtration cloths, etc.), sports fields (artificial turf), etc[306].

In 1993, technical textiles made up 13 % of the added value of the textile industry in Belgium while in 2013, the share was 38 %[307]: The table below shows key figures for the technical textiles sector in Belgium.

Table 8: Key figures for the Belgian technical textile industry, 2012

Key figures for 2012	
Number of companies	130
Number of employees	7,800
Turnover (in million EUR)	2,100
Exported turnover share	70 %
Activity evolution in 2012 (in volume)	-5 %
Share in the total added value of the Belgian textile sector	38 %

Source: Fedustria website, http://www.fedustria.be/content/default.asp?PageID=22&languagecode=en.

The technical textiles sector constitutes a dynamic cluster in Flanders (which is home to 90 % of the Belgian textile industry), centered around cities such as Ghent, Kortrijk, and Oostende. The cluster builds on the centuries-old tradition for textile production in the

306 Fedustria website and Centexbel website (http://www.centexbel.be/standard-antenna-technical-textiles).

307 Interview, Fedustria.

area and is characterized by family-owned businesses, mostly SMEs. Of the 130 companies, about one third produce only technical textiles, while the remaining two thirds produce a mix of technical and traditional textiles. About 80 of these companies made the transition from traditional textiles production to technical textiles. Approximately 70 % of the turnover stems from exports, almost exclusively to other European countries and a small share to North America[308].

An example of a company which made a successful transition is a former producer of fabric for raincoats (Concordia). Their market came under high pressure from low-cost (Asian) competitors and the company decided in the late 1990s to develop new products based on their knowhow, but more specialised in areas such as protective clothing (e.g. for hospital surgeons, forestry workers, high-level sportswear, etc.). Without this transition the company would most likely have succumbed to the competition. Now, more than 2/3 of the company's turnover comes from technical fabrics. The transition was difficult but Concordia managed. Not all companies can make the transition out of traditional textiles, however – technical textile markets are completely different from traditional textile markets, with very different types of customers, and it requires a significant amount of effort and business skill to build up a new customer base[309].

Contributions and challenges for competitiveness and growth

Production in the technical textiles sector grew by about 3 % per year until the financial crisis which resulted in a significant fall in 2009, followed by modest recovery in 2010-11, and a fall again in 2012. In 2013, the volume was at the same level as just before the crisis. The sector is thus still struggling to recover, but this should be seen against the background of the overall global textiles industry which shrunk by about 2 % a year during the period 1993-2013[310].

The technical textiles industry in Flanders constitutes a good example of a "true" cluster (as described by Michael Porter[311]): the companies are located geographically close, have very strong supplier industries also in the region (mainly the chemical industry), and there is a strong specialised knowledge base represented by both research centres and educational institutions supplying labour (higher education and vocational education). There is a considerable degree of networking between the companies, the suppliers, and the knowledge institutions, creating a closely-knit cluster in a rather small geographical area. The fact that the companies of the cluster are mostly medium-sized and family-owned also means that the companies are generally flexible and able to adapt to changed conditions and take advantage of new opportunities, making the cluster very dynamic. These are among the key reasons why this industry has been relatively successful compared to traditional textile producers[312].

Human resources – the supply of skills

With respect to the supply of labour, Flanders has traditionally had a good supply of educational institutions within technical and scientific areas of relevance to technical textiles, including both academic and vocational education. Knowledge of chemistry, new fibres, new types of coatings, new structures, etc., is key. The availability of the right types of labour has been important in the development of the cluster but a shortage of

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308 Interview, Fedustria.

309 Concordia website, http://www.concordiatextiles.com, and interview with Fedustria.

310 Interview, Fedustria.

311 Porter, M. E., *The Competitive Advantage of Nations*. 2nd ed. New York: Free Press, 1998. (1st ed. New York: Free Press, 1990).

312 Interview, Fedustria.

skilled labour seems to be emerging. According to Fedustria, this is one of the issues most often brought forward by the companies and it constitutes a barrier to the further development (expansion) of the sector.

There is only one school now offering vocational education within technical textiles (in Kortrijk). According to Fedustria, the subject has disappeared from other schools because young people in general do not choose vocational education of relevance to the textile industry. This means that the industry has to look for skilled labour in other technical branches such as electronics and mechanical subjects, which means that newly educated skilled labour needs additional training to function in the technical textiles industry. In fact, calculations based on data from the Eurostat Labour Force Survey showed that Belgium had the highest index of skills mismatch in Europe in 2011[313].

So far, the industry has managed this challenge because the expansion of the sector has been hindered by the economic crisis (market demand is low) which means that demand for additional labour is not particularly high at present. The labour that is hired usually receives specialised training. However, some companies already report recruiting problems and the industry foresees that its future expansion is likely to meet with significant constraints in the form of skills shortages[314].

The value chain – customers and suppliers

The industry is research-driven, and the companies often work closely with their clients to develop new or improved products (e.g. new coatings). The companies are highly specialised and mostly produce series of smaller volumes but with high added-value, adapted to each customer. This is a strength because it makes the companies less vulnerable to competition but also a danger since switching costs for serving other customers are high. However, the potential for developing products to serve new needs and new markets is high. The technical textile industry is seen as having good growth perspectives because of the high added value of technical and complex textile products. Thanks to their level of specialisation and the various applications, producers of technical textiles are less vulnerable to the harsh international competition that is mainly focused on the mass production of cheap products[315].

Supporting industries in the region include weaving machine manufacturers (e.g. Picanol and Van der Wiele) which are major players on the world market. However, for technical textiles a key supplier industry is the chemical industry, both with respect to the chemical inputs themselves but also the knowledge embedded in the chemical industry. Belgium has an important chemical industry consisting of both large world players but also smaller suppliers that make exact formulations for the technical textiles industry.

Knowledge and R&D collaboration

The technical textiles industry is supported by a good knowledge infrastructure in the region, serving the particular needs of the industry. The textile industry has its own research centre in Flanders: Centexbel, the Belgian Textile Research Centre, was founded in 1950 at the initiative of Fedustria, the Belgian professional organisation of the textile, wood and furniture industry to reinforce the competitive position of the Belgian textile

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[313] Zimmer, Hans, *Labour market mismatches,* Economic Review September 2012, pp. 55-68, National Bank of Belgium, 2012.

[314] Interview, Fedustria.

[315] http://www.centexbel.be/technical-textiles.

companies. Centexbel offers an extensive range of activities and services to the textile industry, including testing, certification, consultancy and Research & Development[316].

Centexbel co-operates intensively with a significant number of the technical textile companies and is of key significance for involving the companies in public research programmes, including the European framework programmes for research.

In addition, there are several other knowledge institutions in the region with textile specialisation, such as the University of Ghent.

There is extensive co-operation between the companies and the knowledge institutions. The companies rely on the knowledge institutions for knowledge of new technical developments - new fibres, new coatings, etc. - and to address broader issues such as the green economy, life-cycle analysis, etc.

Other issues

The industry sees certain aspects of the European REACH policy as a threat. The problem is not REACH as such – the legislation could even create a competitive advantage since the industry has to meet very high standards. However, there is now a risk that the substance DMF (dimethylfumarate, a mold preventing biocide) will be banned. DMF is used in the coating industry, and is, according to Fedustria, required to reach high quality levels. The industry acknowledges that DMF is a hazardous product but also asserts that the industry has the knowledge and the control procedures to use DMF safely. Some companies indicate that they will have to move outside Europe if the ban is implemented.

The technical textile industry also suffers from high energy costs since the processes are relatively energy intensive. Energy costs may amount to upwards of 10 % of the total costs, whereas in traditional textile production energy cost is only at around 2-3 %[317].

Conclusions and recommendations

The technical textile cluster in Belgium provides an excellent example of a traditional sector with high competitive pressures from low-cost competitors, which has managed to make the transformation into a future-oriented, highly specialised and knowledge-driven industry.

The transformation of the cluster seems not to have been driven to any significant extent by public policies but rather by the dynamics within the cluster itself, with a strong knowledge base and dynamic companies reacting to the external pressures.

The case illustrates both the importance of the existence of a skilled labour force (combined with high-level scientific/academic knowledge) for the creation of the cluster and the risk that increasing skills mismatches may endanger its future development and growth. There is a clear basis for policy intervention in this area, particularly with respect to vocational and technical education.

The cluster also benefits from specialised knowledge institutions and from a dynamic network where companies and knowledge institutions work closely together.

Finally, the technical textiles industry, like so many other industries, faces strict regulations which provide an incentive to reach a very high level of safety and quality but which may also, in some cases, endanger the future of the sector if environmental and industrial considerations are not carefully balanced. The same can be said for the sector's

[316] http://www.centexbel.be/.

[317] Interview, Fedustria.

high dependence on energy and its vulnerability with respect to both high costs and the lack of a level playing field in this area, both within and outside the EU.

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ANNEX 2: OVERVIEW OF CASES AND COMPETITIVENESS AND GROWTH FACTORS

Competitiveness factors Cases	Human capital/ labour	Capital, access to finance	Inputs and infrastructure	Technological progress	Production and value chains	Access to markets	Firm creation and growth	Admin. & regulatory framework conditions
1. Eco-industry – access to finance through public-private partnerships (PPP's)		Enabler: PPPs for long-term finance Barrier: venture capitalists reluctant to invest in long-term projects with late ROI						Public procurement as an enabler
2. Electronics waste recycling value chain			Barrier: Insufficient collection of WEEE		Barrier: Sub-optimal pre-processing and dismantling in value chain			Enabler: Minimum collection rates in WEEE Directive
3. Slovakia – "the European value-added leader"	Enabler: Low unit labour costs; barrier: skills shortages and structural mismatches in the labour market			Enabler: FDI (major driver of innovation concentrated on specific sectors); barrier: performance of the R&D system is currently well below the EU average	Enablers: expansion of medium- and high-tech manufacturing industries via FDI; sectoral specialisation; significant labour productivity growth			Barrier: Low ranking on the ease of doing business on a worldwide scale

Competitiveness factors **Cases**	**Human capital/ labour**	**Capital, access to finance**	**Inputs and infrastructure**	**Technological progress**	**Production and value chains**	**Access to markets**	**Firm creation and growth**	**Admin. & regulatory framework conditions**
4. Eindhoven – enablers for Technological Progress				Enabler: R&D collaboration			Enabler: triple helix collaboration	
5. SMEs in Spain / Italy –access to capital		Barriers: SME access to finance		Enabler: specific SME financing instruments Horizon 2020- including funding measures			Enablers: Stability in bank loans and credit mechanisms	National SME financing policies
6. Changing skills supply and demand	Barrier: mismatch between skills level and available jobs	Sustainable Funding models		Challenge: Automation changes skills demand	Global labour mobility- offshoring		Skills utilisation- Policies which focus on the soft side of innovation	Lifelong learning policies

Competitiveness factors **Cases**	**Human capital/ labour**	**Capital, access to finance**	**Inputs and infrastructure**	**Technological progress**	**Production and value chains**	**Access to markets**	**Firm creation and growth**	**Admin. & regulatory framework conditions**
7. ICT and productivity	Barriers: ICT practitioner skills, ICT user skills, e-leadership skills; organisation of labour under the conditions of increasing automation and real-time oriented control systems		Barrier: pertinent high bit rate broadband infrastructure		ICT/and automation proxy of efficiency-increasingly pre-condition to becoming a strategic sub-supplier	Opportunities to diversify services to different market segments	Contributes to productivity and resource efficiency. If not accompanied by skills investment, and realignment of business processes ICT investments can have a negative impact on productivity	Barriers: Appropriate standardisation to address the increasing complexity of ICT based solutions; appropriate legal environment e.g. as to the protection of company specific data, the handling of personal data, liability; address the issue of potential trade restrictions (e.g. regarding cryptographic components)

Competitiveness factors **Cases**	**Human capital/ labour**	**Capital, access to finance**	**Inputs and infrastructure**	**Technological progress**	**Production and value chains**	**Access to markets**	**Firm creation and growth**	**Admin. & regulatory framework conditions**
8. Construction materials –barriers for an internal European market			Barrier: energy costs			Barrier: Localised markets Competition with 3rd countries in- and outside EU		Enabler: EU regulation Barrier: national admin. burdens, EU regulation Barrier: Ineffective market surveillance
9. Mechanical engineering (ME) sector	Barrier: lack of both highly qualified engineers and workers employed in the actual assembly of the goods manufactured	Barrier: (non-) availability of credits (particularly crucial in Southern Europe)		Enabler: Focus on high-end market segments and cooperation with client industries inherently leads to innovativeness and innovations	A priori barrier: Relatively low (sectoral) labour productivity compared to the ME sector outside Europe; Enablers: production focused on high-end and mid-end ME manufacturing requiring a high intensity of pre- and post-sales service provision; intensive and long-term cooperation with partners along the value chain	Barrier: Non-tariff barriers (e.g. regarding certification systems in other countries)		

Competitiveness factors Cases	Human capital/ labour	Capital, access to finance	Inputs and infrastructure	Technological progress	Production and value chains	Access to markets	Firm creation and growth	Admin. & regulatory framework conditions
10. Technical textiles – transition of a traditional industry	Enabler: presence of specialised skills Barrier: emerging shortage of skilled labour			Enabler: R&D-driven specialisation				

NOTES

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