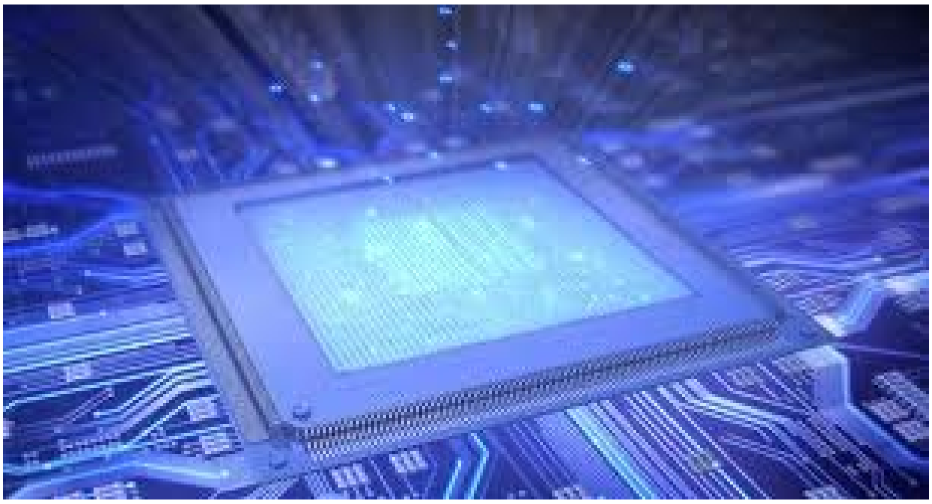
Strategies for Innovative and Effective ICT Components & Systems Manufacturing in Europe



FINAL REPORT

A study prepared for the European Commission
DG Communications Networks, Content & Technology

Digital Agenda for Europe

This study was carried out for the European Commission by

Authors : Gabriella Cattaneo, Stefania Aguzzi, Alain Pétrissans, Stéphane Krawczyk, Sebastien Lamour, Henrik Noes Piester, Malene Stidsen

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1. EXECUTIVE SUMMARY

The European electronics manufacturing industry is facing strong global competition in all parts of the value chain, even where it used to be highly competitive. Overall, Europe has a strong technological research base and global leadership in several KET application areas such as automotive, aeronautics, health and energy. [1] However, electronics manufacturing has moved to Asia and Europe is struggling to preserve small advanced manufacturing capacities. Most European IDMs (Integrated Device Manufacturers) have moved to an asset-lite or fab-lite model, but their competitiveness is challenged by their global competitors and technological innovation (including emerging technologies so called "more than Moore"). According to the European Competitiveness Report 2010, micro-electronic patent application intensities in East Asia are more than twice as high as in North America or Europe. [2] Moreover, Europe is facing an innovation challenge as global competitors are more successful in bringing research to the market in the form of new products, services or processes.[3]

European ICT components and manufacturing clusters have an important role to play to develop EU competitiveness and contribute to win the innovation challenge, by focusing on technology transfer and bringing research results to the market. This study has identified and profiled 48 European clusters, focusing on their strengths and weaknesses and their key success factors for innovation performance. A comparative analysis with 10 leading international clusters, from the US and Asia, has led us to identify the most effective mix of policies and funding measures, able to support the successful development of the clusters. The ultimate goal of the study is to sustain European leadership in this area by suggesting the best way to coordinate national/regional level policies for clusters and R&D policies, providing inputs for the strategic management of the forthcoming Horizon 2020 programme.

The focus of the study is on the electronics manufacturing value chain developing, designing, manufacturing and assembling high tech electronic devices and products. The ICT components and systems value chain includes materials, semiconductors, active components, product design and assembly of high tech devices and products.

1.1. Clusters' Key Characteristics

The study focused on 48 European clusters, of which 9 were analysed in-depth as case studies. ICT components manufacturing clusters grow following a wide variety of business and organizational models. Key considerations about the main drivers of their development are the following:

- **Ability to leverage local strengths**. The most effective world-class clusters have adopted an organisation respectful of typology of the local players, the way they interact with each other and with public organisations, leveraging local strengths (e.g. private and bottom-up initiatives in the US; local and coordinated initiatives with strong SME implications in Germany; national coordination and big R&D programs implicating multinational companies in France; coordination and cooperation between cities, foreign direct investment, and government support in China, etc.). The impact of these characteristics is strong on funding, administration of the clusters, and relationships between the players.
- **One size does not fit all, but the presence of market leaders is a strong driver of growth.** Size does not appear to be a differentiator between the European and non-European clusters, as all categories of clusters, from small to very large,

[1] European Commission (2011): High-level Expert Group on Key Enabling Technologies – Final report.
[2] European Commission (2010): European Competitiveness Report 2010.
[3] European Commission (2011): High-level Expert Group on Key Enabling Technologies – Final report.

can be found in each region of the world. However, the pressure of globalisation is driving the need for clusters to have a more international presence, which may require supporting the growth of the cluster companies, increasing the size and reach of the cluster, expanding its partnerships, investing in its knowledge development with a wider horizon. The presence of major companies within clusters makes a difference, since it makes it easier to reach a critical mass of resources and investments. European clusters are potentially disadvantaged because only 2 European players (ST Microelectronics and Infineon) rank in the top 15 semiconductor suppliers worldwide. The US clusters for example benefit from the presence of multinational companies able to sustain a strong ecosystem of partners, distributors and universities, such as Intel in Arizona, Texas Instruments in Austin Texas, IBM in the North East and Intel/Microsoft in the North West clusters.

- **Need for a highly qualified workforce**. The availability of high quality ICT skills is a key competitive factor. Clusters are paying increasing attention to the local presence of qualified people and the ability to mobilise talent for the upcoming technologies. For these reasons, the development of universities specialised in the ICT components field or the fame of its researchers are increasingly appreciated by cluster enterprises.
- **Relevant role of public funding.** Every cluster tends to have a different mix of funding sources, depending on the national/regional policy strategies and the local socio-economic context. However, cluster organisations in Europe have to deal with a more severe legislation on state aid than US or Asian competitors; this limits their ability to access funding. The experiences with the Poles de Competitive initiative in France as well as regional initiatives such as Cluster Offensive Bayern in Germany suggest that financial support for the establishment of strong cluster organisations combined with funding for collaborative R&D&I projects is a successful approach to enable the growth of strong clusters in Europe.

1.2. MAIN SUCCESS FACTORS

Every cluster is different, but performance always depends on a combination of factors related with the so-called framework conditions (the socio-economic environment, the regulatory environment, the business conditions); the strength of the cluster enterprises; and the quality of cluster management (meaning the capability of cluster organizations to coordinate and promote the activities of cluster members). The results of our survey with cluster managers and enterprises (with a total of 123 interviews in Europe and 42 in Asia and the US) confirm this view, indicating the access to high quality skills and to research and knowledge among the most relevant framework conditions. While the sample is not statistically representative of the thousands of enterprises present in European clusters, the survey covered all the EU clusters active in ICT components manufacturing, targeting key stakeholders, and can be considered qualitatively representative.

To deepen this analysis, we have compared the innovation performance of clusters (measured through an objective indicator, the number of ICT patents per million inhabitants) and the relevance of the main factors included in our analytical model (based on survey results). The analysis was focused on 4 leading clusters, selected for their achievements and their relevance: Minalogic and Systematic from France, and Silicon Saxony and Mechactronics and Automation from Germany. Based on this, the specific factors more strongly correlated with innovation performance are the following ones:

- The strength of cluster actors, meaning their market leadership and their entrepreneurial ability;
- Access to high quality human resources;

- Access to research and knowledge, meaning the presence in the cluster of leading universities and research centres;
- The quality of cluster management, meaning the effectiveness of the cooperation and networking efforts of the cluster organization.

There is nothing particularly surprising in this list, however the important consideration is that all these conditions must be present to insure the success of clusters; moreover, their implementation is not as easy and straightforward as it may seem. These factors should be prioritized by policies and initiatives aiming at developing world-class clusters in the ICT component and systems manufacturing industry.

1.3. ANALYSIS OF FUNDING MODELS

The analysis of funding and support measures has shown that there is a different mix of policy tools in each country, used to support the emergence and development of the ICT components clusters. However some common elements emerge:

Public funding is the main funding source for clusters

The two main funding sources are specific cluster programmes and R&D funding (including EU funding). Regional/state funding plays a critical, but complementary role, particularly to sustain facilities and infrastructures. The ERDF and programs such as Interreg play an important role particularly in Eastern Europe (Hungary, Romania) and for cross-border initiatives (the DSP valley for example). Tax incentives are not specific for clusters, but are foreseen for R&D expenses of enterprises in most MS.

Clusters are becoming a channel for R&D funding

Clusters are becoming a favourite channel for national and EU R&D funding, thanks to their ability to reach out to mixed stakeholder communities and to organize collaborative research, as well as offer pragmatic services. National and EU governments are also starting to leverage the clusters' capability to design roadmaps, select research priorities, and act as intermediaries for competitive funding distribution to small enterprises. This is particularly clear in France, where clusters such as Systematic even manage calls for proposals and distribute funding to SMEs.

European vs non-European cluster models

Comparing European approaches to international approaches, we find that incentives for ICT components and systems manufacturing in Europe do not match incentives in other regions. As shown by the case studies on the Yang-Tze River Delta and Chungnam in Korea, Both China and South Korea pursue regional development strategies driven by lavish public funding both for research institutions and for enterprises, even though they do not have cluster policies in the EU sense. Asiatic clusters are less specialised than EU ones and can leverage both domestic and FDI capital. State aid provides strong support, particularly in China, to factory and production lines building.

In the US state incentives to attract enterprises are much higher than usually perceived, ranging from very high tax credits, to granting land or facilities almost for free. While no specific funding measures for clusters are foreseen by federal policy, federal and national policy support technology transfer from research to the market, by supporting research centres and applied research labs, as well as R&D tax credit at federal and state level. In addition, cluster enterprises have access to the richest venture capital and risk capital market of the world, as well as to a wide variety of R&D funding programmes.

Need for joint prototyping facilities and pilot lines in Europe

In terms of EU funding, the interviews with experts and cluster managers suggested that EU in the future could best support the competitiveness and growth of the ICT components and systems manufacturing industry in Europe by providing financial support for joint prototyping facilities and pilot lines that could help Europe keep its competitive edge in advanced products and systems. Currently, the state aid regime in Europe represents an effective constraint to funding actual production lines.

Support for cluster collaboration can help create critical mass

The strategic collaboration between Silicon Saxony cluster and the Grenoble cluster constitutes a best practice case In Europe for cross-border cluster collaboration. The two clusters have strengthened their cooperation in the area of nano-electronics and nano-technologies focusing on education, research and development, industrial deployment, SME coordination, and environment. This will strengthen the competitiveness of these clusters vis-à-vis global competitors and for Europe the collaboration between the two clusters is an important and inspiring example of how a joint strategy between clusters can help create critical mass in Europe in key areas. The collaboration has now been extended to include other European cluster through their involvement in a new large project, Silicon Europe, funded through the EU Regions of Knowledge programme under FP7. The EU could continue to support such initiatives in order to increase the coordination of research and innovation efforts at cluster level to achieve critical mass at EU level.

Furthermore, the targeted collaboration between clusters specialised in nanotechnology and clusters representing relevant user-industries in the context of the Finnish Nanotechnology Cluster Programme has been very successful in promoting innovation and business collaboration. To promote innovation and business collaboration at European level, the European Union could continue to support financially existing platforms for cluster matchmaking activities, but focus activities more on matching clusters representing technology-providers and relevant user-industries in Europe and internationally.

1.4. RECOMMENDATIONS

No single policy can guarantee the success of clusters: policy makers should be aware that the most effective approach to clusters development is to select a portfolio of policy instruments, tailored to the strengths and weaknesses of the different countries, regions and clusters.

Based on our analysis, the following are the main policy dimensions relevant for clusters:

- Innovation and R&D policy are the most relevant, shaping specific cluster policies and programs and determining the general context of clusters creation and development. These policies need to be harmonized at the EU, national and regional level;
- ICT industry policy, Education and training policies and Financial policies (particularly for high tech funding) also need to be aligned with cluster policies, to make sure that cluster enterprises are not disadvantaged compared to global competition, have access to the necessary capital and to the right type of skills.

The EU and main MS already have a wide array of policies for clusters, many of whom are well designed and should continue to be implemented. Our recommendations review these main policy areas, highlighting the main gaps and weaknesses emerging from our analysis which could be improved.

Innovation policy

Europe needs to better exploit research and knowledge by promoting collaboration between industry and research, supporting spin-out activities from university and industry, and providing support for entrepreneurs. Clusters constitute a strong framework for these activities. With regard to the case studies carried out in this study, the following recommendations should be considered:

- Strengthen support for innovation and entrepreneurship in clusters
- Increase focus on demand-side measures to support innovation in Europe, for example through pre-commercial public procurement

- Continue support for European platforms for cluster collaboration, such as the Silicon Europe project
- Promote quality of cluster management, through co-funding for cluster organizations, but also through evaluation and benchmarking of cluster performance.

R&D policy

The main challenges for the ICT components industry in Europe concern the need to accelerate the commercialization of technology, improving technology transfer, capturing growth opportunities and easing the handling of IP Rights. For these reasons, the following recommendations have been suggested:

- Close the gap between Research and Innovation by combining R&D funding instruments and industrial policy measures, including more generous tax incentives for private R&D investments, as done in the US, China and South Korea;
- Establish a joint strategy between EU bodies and Member States for the ICT Components and Systems Manufacturing sector;
- Enhance the Marie Curie programme to cater for advanced manufacturing careers, as well as for research careers;
- Strengthen the attractiveness of micro and nano-electronics for European students

Financial Policy

A variety of funding instruments are already being used in EU member states to promote R&D&I and manufacturing activities. However the share of public funding (such as grants) is still much higher than private funding. A possible action could be the following one:

- Promote the use of private funding sources by engaging with the private investor community and establishing a co-investment vehicle targeting the European ICT components and systems industry.

Venture Capital and High Tech Funding Policy

Very few European clusters stakeholders have access to venture capital funds, at the same level as US or Asian clusters. With regard to these challenges, we suggest the following actions:

- Support clusters in the development of strategies focused on the commercialisation of the results of research, able to attract risk capital. This may require focusing on smart design and small improvements of ICT Components, suitable to be brought to the market with small amounts of capital.
- Develop funding measures helping universities/public labs to invest into cutting edge research for ICT components (for example in the new materials and potentially disruptive technologies such as graphene, or in next generation manufacturing of 450mm), as well as into the provision of prototyping facilities and pilot lines, providing access to local enterprises, on the basis of public-private partnerships. This may include allowing the industrial partners to buy into the equipment used, after a pre-determined time.

ICT Industry Policy

China, South Korea, and the US at state level provide substantial incentives to attract R&D facilities, as well as subsidies and tax credits to companies involved in ICT components and systems manufacturing. European clusters need to be able to match these business conditions in order to keep R&D and manufacturing activities in Europe. The High Level Expert Group Report on Key Enabling Technologies (KET HLG, 2011) for example recommended the introduction of a matching clause into general EU State Aid rules, which would allow Member States to match funding up to the maximum levels of support provided elsewhere for product development and manufacturing activities while respecting WTO rules.
For these reasons, the following recommendations have been suggested:

- Increase attractiveness of European clusters as a location for companies in entire ICT components and systems value chain, developing FDI and local development measures, suitable to attract multinational companies and support the growth of local companies
- Adapt EU State Aid rules to allow funding and benefit packages for cluster development
- Support scale-up activities and the industrialisation of emerging technologies

Education and Training Policy

World class ICT components clusters require high qualified engineers, and access to a qualified work force is one of the key success factors, especially in the case of establishing a new manufacture. For these reasons, the following recommendations have been suggested:

- Enhance collaboration between universities and ICT companies focusing on collaboration and inputs from the companies, development of shared facilities and cross-investments and on training
- Develop a European education centre of excellence on ICT Components through cross-university collaboration based on the EU University rankings established in Europe 2020;
- Favour the development of specific training/education programs related to some key issues for the success of ICT Components clusters.

1.5. BACKGROUND

This is the Final Report (D4) of the study "Strategies for Innovative and Effective ICT Components and Systems Manufacturing in Europe" entrusted by the European Commission DG Connect to IDC and FORA. The profiles of 48 European clusters and 10 international clusters are presented in a separate Annex report. The study was carried out from January to December 2012, including desk research, a web survey, and a telephone survey, resulting in 165 interviews to 70 clusters in total.

2 INTRODUCTION AND BACKGROUND

This is the Final study report (D4) of the Study "*Strategies for innovative and effective ICT Components & Systems Manufacturing in Europe*". This study is entrusted by the European Commission Directorate-General Connect, Components Unit (A4) to IDC and FORA.

The main goal of this study is to provide recommendations to the EU's policy makers for strengthening the competitiveness of European electronics manufacturing, with a focus on development of European ICT components and systems manufacturing clusters. The ultimate goal is to sustain European leadership in this area by suggesting the best way to coordinate national/regional level policies for clusters and R&D policies, feeding into the strategic management of the forthcoming Horizon 2020 programme. To do so, the study identified and investigated the main ICT components manufacturing clusters, analysed their main success factors, reviewed their funding and governance policies, and compared them with those of selected initiative outside the EU.

2.1 POLICY CONTEXT OF THE STUDY

Europe 2020 — the European strategy for smart, sustainable and inclusive growth — constitutes the main reference point for the EU in the years to come. The strategy identifies innovation as a key driver for global competitiveness and economic growth in the EU, and calls for stronger collaboration between Member States and regions to avoid duplication of efforts and help create critical mass in Europe to meet the challenge of increasing global competition in all parts of the value chain. The importance of European clusters is explicitly mentioned in three of the flagships initiatives under Europe 2020: "Innovation Union", "An industrial policy for the globalisation era", and "Digital Agenda for Europe". For instance, the "Innovation Union" flagship initiative calls for more efforts to support the emergence of world class clusters as well as increasing trans-regional cooperation, and the "Digital Agenda for Europe" mentions innovation clusters along with stronger e-Infrastructures as strategic elements in the building up of Europe's innovative advantage in key areas.

The importance of clusters for innovation, growth and regional attractiveness was also recognised by the Competitiveness Council (May 2010), which stated that "the efforts need to be continued to remove barriers to trans-national cluster cooperation and to encourage the emergence and consolidation of world-class competitive clusters across Europe".[4] Finally, the importance of clusters in regional smart specialisation strategies has been emphasised in the recent Communication on "Regional Policy contributing to smart growth in Europe 2020" (COM(2010) 553 final).[5]

More specifically, the importance of manufacturing clusters in Europe for innovation and competitiveness in the ICT component and systems manufacturing industry was highlighted in the recent report "Exploring the potential of ICT Components and Systems Manufacturing in Europe" by the VDIVDE and CEA Leti. With regard to main policy recommendations, the study identified a need to:

- Close the gap between research and innovation through a well-coordinated set of targeted support measures and smart incentives
- Develop a joint European strategy on electronics manufacturing
- Support all parts of the value chain and increase collaboration between actors along the value chain

These recommendations also find support in a 2011 study on the deployment of key enabling technologies (KETs), including micro- and nanoelectronics. This study addresses

[4] http://www.consilium.europa.eu/uedocs/cms_Data/docs/pressdata/en/intm/114637.pdf

[5] European Commission (2010), http://ec.europa.eu/regional_policy/sources/docoffic/official/communic/smart_growth/comm2010_553_en.pdf

the challenges facing the EU with regard to KETs and concludes that EU member states needs to develop a joint strategy for KETs which aligns and prioritizes resources to achieve sufficient scale and critical mass in Europe, that there is a need to support technology transfer and late-stage innovation processes (demonstration and commercialisation activities), and increase access to risk capital as well as increase support for all parts of the value chain.[6] .

2.2 CLUSTERS' DEFINITION

For the purpose of the study and in order to identify national and regional clusters for electronic manufacturing in Europe, we have based our research on the definition of innovation clusters as "*groupings of independent undertakings — innovative start-ups, small, medium, and large undertakings as well as research organisations — operating in a particular sector and region and designed to stimulate innovative activity by promoting intensive interactions, sharing of facilities and exchange of knowledge and expertise and by contributing effectively to technology transfer, networking, and information dissemination among the undertakings in the cluster."*
In more general terms, clusters can be defined as a group of firms, related economic actors, and institutions that are located near each other and have reached a sufficient scale to develop specialised expertise, services, resources, suppliers and skills[7]."
A common element of most cluster definitions is the geographical concentration of one or more sectors within a given region as well as the emphasis on networking and cooperation between companies and institutions.
Based on this definition, several kinds of clusters have been identified:

- Immature clusters: this category refers to emerging or potential clusters
- Mature clusters, which refer to national or world-class established clusters
- In transition clusters: this category refers to declining clusters or clusters that need to deeply redefine their strategy, goals or objectives

As this study aims at selecting and studying best practices, we have mainly focused on mature clusters and excluded "in transition" clusters.

2.3 FOCUS AND SCOPE

The focus of the study was on European and international ICT components manufacturing clusters. The clusters targeted belong to the electronics manufacturing industry and they are active in one or more of the following market segments:

- Materials: selected clusters focus mainly on nanotechnologies research and development.
- Semiconductors: selected clusters focus mainly on nano-electronics and micro-electronics.
- Active components: selected clusters focus mainly on photonics and sensors.
- Products design and assemblies: selected clusters focus mainly on Mechatronics, software / embedded system and systems design.
- Electronics high tech device and products: selected clusters focus mainly on computers, peripherals, servers, storage, networking, telecommunication products but also automotive, medical/health and industrial products integrating electronic components.

The study team identified a long list of 1,307 EU clusters, of which 114 operate in the ICT industry. A web research selected 46 clusters (plus 2 in Switzerland) as falling within the

6 European Commission (2011): Cross-sectoral Analysis of the Impact of International Industrial Policy on Key Enabling Technologies, http://ec.europa.eu/enterprise/sectors/ict/files/kets/ket-report_en.pdf
7 Community Framework for State Aid for Research and Development and Innovation

specific scope of the study, plus 10 international clusters from the US, China, Taiwan and South Korea.
A survey carried out in two waves in May and October 2012 achieved a total of 165 interviews from these clusters, which complemented with desk research provided the basis for the cluster profiles and the analysis of funding and support measures.
The following clusters were singled out for in-depth analysis in Europe:

- Cambridge Cluster, UK
- Cluster Mechatronik Automation, Germany
- Mi-Cluster (Corallia), Greece
- Me2C, Austria
- PrintoCent cluster, Finland
- Systematic Paris Region, France

The following international clusters were analysed in depth:

- Silicon Forest in the US NorthWest
- Yang-Tze River Delta in China
- Chungnam & Daejeon in South Korea

2.4 STRUCTURE OF THE REPORT

This report is structured as follows.

Chapter 1 – Executive Summary

This chapter briefly summarizes the key findings of the study:

- Key characteristics of clusters
- Key success factors for EU clusters
- Analysis of funding schemes
- Recommendations

Chapter 2 — Introduction and Background

This chapter illustrates the policy context of the study, the main goals and scope, and the key definitions used in the study.

Chapter 3 — General approach

This chapter illustrates the main characteristics of the electronics manufacturing market and the main challenges faced by the semiconductor industry in the research, development and education fields.

Chapter 4 — Identification of national and regional clusters for electronics manufacturing in and outside Europe

This chapter presents an overview of the ICT components clusters and provides the main results of our survey on the clusters about their structure and organisation, their specialisation, their background and economic importance.

Chapter 5 — Key success factors for European electronics manufacturing clusters

This chapter analyses in detail which main factors have the highest relevance for the success of clusters.
Chapter 6 — Analysis of funding schemes and other support instruments behind the clusters

This chapter provides a qualitative mapping of funding and support measures used by the leading clusters and their relative importance for the clusters operations and activities.

Chapter 7 — Recommendations

This chapter draws the final conclusions of the study and presents the main recommendations for the policy mix best suited to drive the development of ICT components clusters and improve the competitiveness of the EU electronics manufacturing industry.

Annexes

The Annex integrated with this final report present:

- List of Main references
- The glossary of main terms, acronyms and abbreviations
- Methodology of Data Collection

A separate Annex report presents:

- In-depth profiles of 6 European and 3 international clusters
- Short, standardised profiles of 46 EU, 2 Swiss and 7 international clusters

3 GENERAL APPROACH

3.1 CHARACTERISTICS OF THE ELECTRONICS MANUFACTURING MARKET

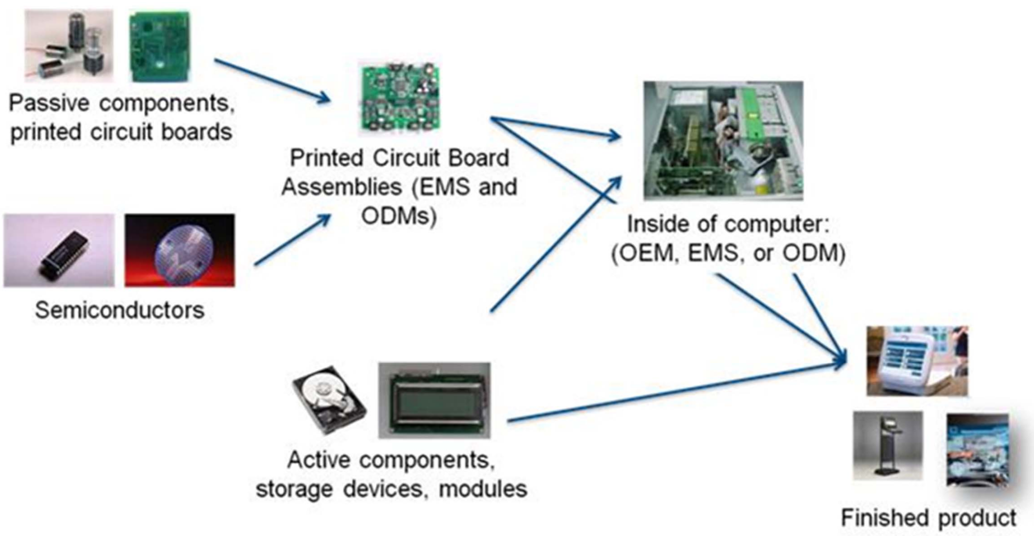
3.1.1 Definition and value chain

Our working definition of electronics manufacturing industry is:
"The Electronics manufacturing industry is the manufacturing value chain developing, designing, manufacturing and assembling High Tech devices and products."
The electronics manufacturing value chain includes a high number of actors, interacting with different roles and responsibilities. The two main actors to be considered in this study are the following:

- EMS providers (Electronics Manufacturing Services): Previously known as contract manufacturers who provide outsourcing services that may include new product introduction (NPI) services, manufacturing and assembly services, a variety of after-market services and logistics and supply chain services. (Examples: Flextronics, Sanmina-SCI, Celestica, Solectron.)
- ODM (Original Design Manufacturers): Manufacturers who provided design services, support and products for OEMs. Many ODMs provide both design and manufacturing services and may also sell their own branded products. (Examples: Quanta, Compal, Arima, BenQ, ASUSTeK.)

The Electronics Manufacturing Value chain can be represented as following:

Figure 1 - The Electronics Manufacturing Value Chain



Note: IDC 2011 Annual exchange rate of 0.71897 Euros per dollar is assumed for the forecast period.

Source: IDC, 2012

The EMS products sectors include:

- Client and Consumer devices:
    - Computers: Mobile PC, Desktop PC, Thin Clients

    - Peripherals Copiers, Facsimiles, MFPs, Printers
    - Consumer Devices : Digital entertainment, Digital camcorders/ cameras, Digital home, Gaming devices, Handsets/mobile phones, Tablets, eReaders
- Enterprise and Infrastructure Products
    - Servers and Storage: Servers/workstations, Disk & tape storage systems
    - Networking: LAN switches, Routers; Wireless LAN (WLAN)
    - Telecommunications: Mobile wireless infrastructure, Broadband and CPE, Traditional & IP telephony
- Emerging Products
    - Automotive: Automotive control modules, Automotive modules/subsystems, Infotainment
    - Medical: Class I, II, III medical devices, Medical Instrumentation/systems
    - Industrial: Industrialized control systems, Semiconductor equipment, Test, measurement, etc., Aerospace/Defence, Retail Systems, Clean Tech

3.1.2 Market forecasts

For 2012, IDC is expecting the EMS industry to grow by 4%, due to weak growth across most segments, especially PCs. The one bright area is tablets. Other consumer opportunities have been mixed throughout the year, with increased outsourcing for smartphones and TVs but weakening demand. The EMS sector should see 4% growth in 2012, largely due to growth in tablets and smartphones, increased outsourcing for TV production, and growth in the automotive segment. The ODM segment should fare a little better, growing by 6% thanks to growth in consumer products. The ODM sector in the PC segment was reduced slightly to account for tablet products that were formerly included in the PC segment.

Beyond 2012, consumer devices will become the largest of the nine product segments. This is driven by the growth of tablets and the expected growth in outsourcing rates for smartphones and TVs. However, once these new product ramps are completed, growth rates should slow to reflect end market growth. We also expect to see increased outsourcing in Emerging Product segments for a variety of reasons, including increased use of EMS/ODMs. The EMS industry CAGR for 2011 through 2016 should reach 6%.

Macroeconomic conditions are still weighing on the market, and while fears of a major default in Europe are easing somewhat, Europe will remain weak through 2013. The U.S., now past the elections, is still facing significant pressures from fiscal policy uncertainty and enterprises are expected to decrease their spending.

OEMs are also becoming aware that poor working conditions at EMS/ODMs can negatively affect their brand images, such as Apple following several reports on Hon Hai. Also, costs continue to rise in China, which is putting pressure on OEMs to accept higher pricing.

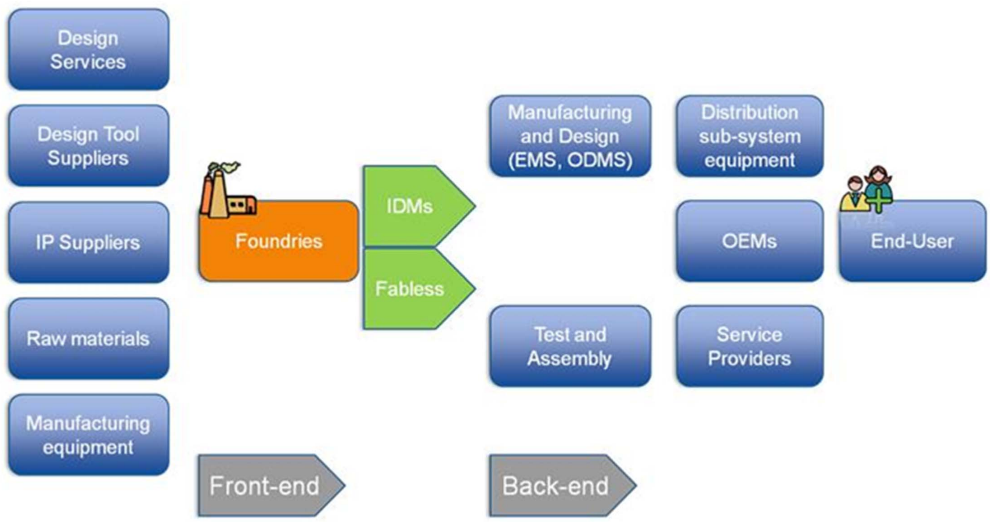
ODMs are selling directly to large datacenter owners for servers and to a lesser extent storage systems. The consequences of this move are starting to emerge, as OEMs threaten to pull orders.

3.2 SEMICONDUCTORS: A KEY SEGMENT OF THE VALUE CHAIN

3.2.1 A growing market

Semiconductors are at the heart of every major electronic system driving a rapid cadence of investment and innovation. The semiconductor value chain is represented hereunder:

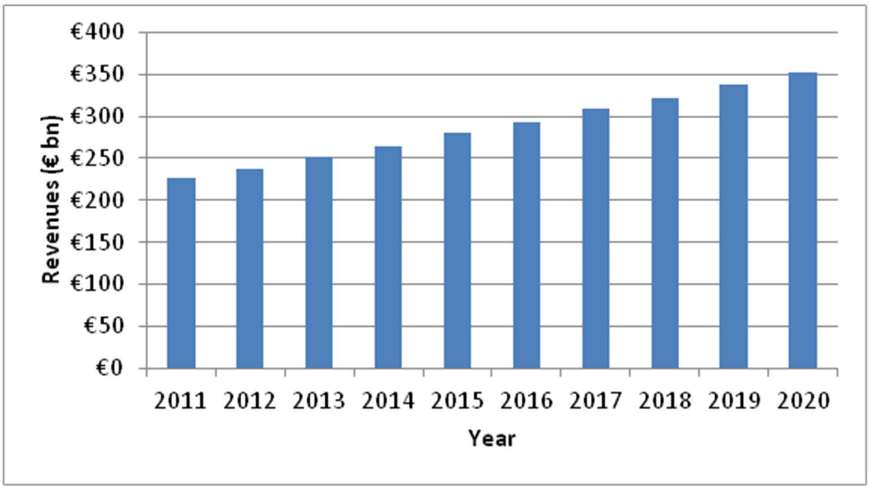
Figure 2 - The Semiconductor Value Chain



Source: IDC, 2012

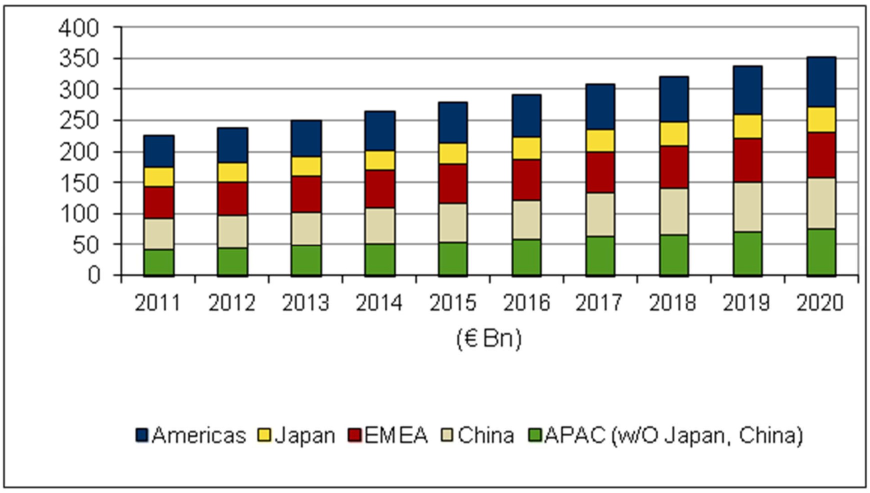
In 2011, the industry surpassed €227 billion for the first time in history. In the period to 2020, we expect the semiconductor industry to add an additional €123 billion to the top line; reaching €350 billion (**Error! Reference source not found.**).

Figure 3 Worldwide Semiconductor Revenue Forecast 2011–2020 (€B)



Note: IDC 2011 Annual exchange rate of 0.71897 Euro per dollar is assumed for the forecast period.

Figure 4 Worldwide Semiconductor Market Revenue Forecast by World Region, 2011-2020 (€B)



Note: IDC 2011 Annual exchange rate of 0.71897 Euro per dollar is assumed for the forecast period.

Source: IDC, 2012

Moore's law has been instrumental in predicting the pace of performance and integration for over 40 years in the semiconductor industry and has enabled billions of transistors on a single chip possible in today's designs. IDC expects that Moore's law will continue to dictate the pace of technology innovation over the next decade for leading semiconductor suppliers. However, the key barrier to overcome will continue to be the growing cost of process technology and cost to build a leading edge fabrication which today stands at about $5 billion (€3.59 billion). By the second half of this decade, this cost is expected to double, reaching nearly $10 billion (€7.19 billion), when the industry introduces 450mm wafers in commercial volume. Only a handful of companies will be capable of investing at these levels by the end of this decade.

The market trends by world regions are forecast in **Error! Reference source not found.**. The Asia/Pacific region, with Japan and China, is expected to continue to grow faster than the others, with a share of worldwide semiconductor revenues increasing from 42% in 2016 to over 45% in 2020. The market share of the EMEA region (which includes the EU, the other European countries, Africa, the Middle East, and the former Soviet Union) is expected to decrease slightly, even though market revenues are expected to increase to $90 billion by 2020.

Despite the ongoing global macroeconomic uncertainties, such as the Eurozone crisis, lower global GDP growth, and economic slowing in the BRIC countries, current demand remains strong for semiconductors in applications such as smartphones, media tablets, and automotive electronics. Further, there are high expectations for the launch of Microsoft's Windows 8 operating system and next-generation smartphones later this year, which will accelerate semiconductor revenue growth in 2013 and beyond.

As IDC forecast earlier this year, the cyclical semiconductor downturn that started in the middle of last year reached bottom in the second quarter of 2012.

Supply constraints on semiconductor products, such as smartphone applications processors, and PC discrete graphics processors based on the most advanced process technologies, are easing as foundries are bringing more capacity online. Also, the semiconductor industry has recovered from the flooding in Thailand in 2011 that held back the supply of hard drives and PCs. Leading-edge 22nm at Intel is ramping fast now, while foundries and memory companies are getting ready to move to 20nm technology node.

While all these point to strong semiconductor growth, IDC notes that near-term growth will be slower than that of past semiconductor cycles due to macroeconomic weakness.

Regionally, Europe continues to be weak across the board. In the U.S., consumer and automotive markets are showing strong semiconductor demand. Although GDP growth has slowed in China, India, and Brazil, demand for smartphones, tablets, and notebooks remains strong.

3.2.2 A market creating and destructing value

Even though the semiconductor market is a growing market, and contributes a lot to the global productivity of the worldwide economy, only a few players benefit from it and generate economic value (i.e. net profits). Several factors can explain the challenges ICT components manufacturers have to face and the fact that the industry destroys more value for itself than it creates:

- **Cyclicality**: historically, the semiconductor industry has shown strong cyclical behaviour. During a typical upturn of one to two years, most companies generate profits, which they use to sustain their operations during the downturn. In addition, many players use their strong performance during an upturn to attract investors in the public markets or get new loans to fund capital investments; in many cases, governments subsidize this refinancing. But precisely because investment runs ahead of market demand in the upturn, the period is followed by a longer downturn or a very slow growth period, during which poor performers struggle. Even though this characteristic is moderating, it remains true in many cases.
- **Rising costs in R&D**: chip makers invest heavily, driven to meet the expectations of Moore's Law. Costs have naturally risen along with the ever-increasing complexity of the chips. In addition, the investment hurdle for building a state-of-the-art chip fab continues to rise.
- **Costs pressure**: In response to these higher costs, many semiconductor companies have resorted to "fab lite" strategies, outsourcing an increasingly large fraction of their chip production to dedicated manufacturing foundries. Although this has resulted in an overall net reduction of capital expenditure in the industry, it has also led to intense cost pressure on chip makers that continue to handle all their manufacturing in-house. The shift of manufacturing to Asia has created additional cost pressures on those that have yet to transfer operations to lower-cost locations. Prices also remain under pressure in the industry as consumer applications become the main force driving the semiconductor market. The much higher elasticity of demand as prices decline has further accelerated the erosion of average selling prices. All these pressures are intensified by the shift in the end-user market to Asia.

3.3 *GENERAL CHALLENGES IN RESEARCH, DEVELOPMENT AND EDUCATION*

Research and development is the lifeblood of the semiconductor industry, so it is no surprise that R&D tends to be the highest-pressure corner of this high-intensity business. Much of this pressure results from the fact that time to market is a crucial metric for semiconductor makers: speed, specifically on-time delivery, is a key success factor in a market characterized by tight design-in windows, shortening product life cycles, and relentless price deflation. Two parallel challenges have been identified:

- Moore's Law still sets the industry's pace; ever-rising investments and technology challenges, such as rising chip complexity, are also a factor.
- The second core challenge is mastering system design, which involves integrating hardware and software blocks, as well as various films, coatings, and layers, and ensuring they are customized to reflect customer and end-consumer preferences. Indeed, a number of leading-edge wireless semiconductor players now employ twice as many software engineers as traditional hardware engineers.

A Very Intensive Industry for R&D

The impact on the industry is significant: for the top 20 semiconductor players, R&D costs have continuously risen and now account for more than 20% of revenues. The ratio of product life cycle to product-development time in semiconductors is half that for a mobile phone and a third that for an automobile. And for the growing ranks of "fab lite" or fabless players, R&D excellence is the key differentiating factor.

3.4 CONCLUSIONS

More Moore

"More Moore" technologies require leading edge R&D and manufacturing. Europe is still hosting leading edge 300mm fabs with Globalfoundries, Intel and STMicroelectronics. No new advanced fabs are planned in Europe for the next technology nodes (22nm and below). The control of this advanced manufacturing is a key point for the future of Europe on "More Moore" applications. Except Globalfoundries (until 32/28nm), there is no advanced foundries on European soil. With the concentration of advanced manufacturers (Globalfoundries, Samsung, TSMC) one can wonder what will be the negotiation power of European IDMs and fabless with those foundries. Strategy has to be set up to support advanced fabs in Europe. There is no plan from European IDMs to build new 300mm leading edge fabs as it requires too high capital expenditure. Nevertheless, alternative strategies like having pilot lines or lab-fabs to master the advanced process can be investigated as a first step to support and sustain European advanced know-how.

More than Moore

Europe is better positioned on "More than Moore" activities. Europe hosts several 200mm fabs adapted for "more than Moore" manufacturing. So far Europe seems to have enough capacity to answer emergent market needs. But the high growth of these markets (e.g. Automotive with sensors and power devices) will require new manufacturing capacities in a near future. ICT MAN study revealed two challenges that Europe has to face to keep a leadership on "more than Moore". First, continue to rapidly develop innovative systems and to be the first on markets. Second, be able to fill the future needs in volume manufacturing. These two challenges are closely linked considering than mastering manufacturing is essential to develop smart systems. R&D requires less capital expenditure than "more Moore" and research institutes can provide strong innovations to the industry. Pilot lines or lab-fabs are considered essential to perform a fast technology transfer from lab to fab. Competitive manufacturing will then be indispensable to avoid the transfer of technology to Asia or other locations for volume manufacturing.

4 ANALYSIS OF CLUSTERS

4.1 Overview

4.1.1 Selection criteria

The study was focused on ICT components and systems manufacturing clusters, partially or exclusively working on the ICT market. Independently of the market segment addressed, each cluster can be specialized in one part or all parts of the value chain. As a reminder, the ICT components value chain is composed of 6 different activities:

- IC (Interface Circuit), MEMS (Micro-electromechanical systems) & Sensor Design.
- Front-End (Production, Process & Equipment).
- Back-End (Packaging & Equipment).
- Assembly & Test.
- Industrial products and systems solutions.
- Other (includes activities that are directly related to the manufacturing value chain, but that cannot be precisely classified with the 5 previous categories)

The following criteria were used to qualify clusters:

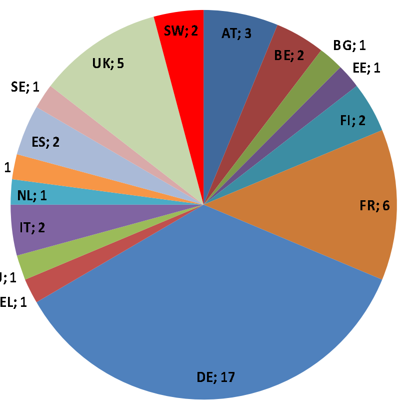
- Involvement in the related industries: materials, semiconductors, active components, products design and assemblies, high tech device and products
- Involvement in ICT components manufacturing activities.
- The services provided by the clusters were also qualification criteria.

We selected clusters which are active in the domains of funding, promoting and coordinating R&D and innovations initiatives and programs for their members.

4.1.2 European Clusters

The study identified **46 EU clusters and 2 in Switzerland** (Figure 5) responding to the selection criteria, as shown in Figure 5 below. Since Switzerland is part of the EEA we have included these clusters in the elaboration of the following data. The cluster profiles are presented in detail in a separate Annex report.

Figure 5 - Number of European Clusters analysed by country (EU + Switzerland)

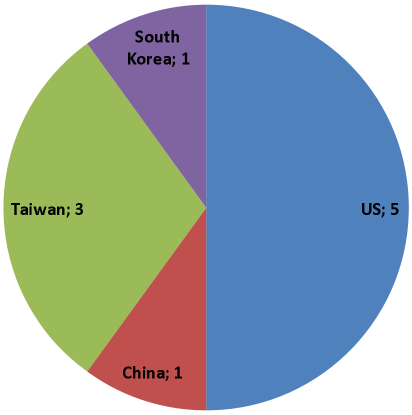


Source IDC/FORA 2012

4.1.3 Non-European clusters

The study identified and interviewed 10 ICT components clusters outside Europe clusters Based on the above criteria, 10 clusters were interviewed and are presented in the Cluster Annex.

Figure 6 Number of non-European Clusters analyzed per Country



Source IDC/FORA 2012

4.2 STRUCTURE/ORGANISATIONS OF CLUSTERS, BACKGROUND, ECONOMIC IMPORTANCE

The analysis below is based on the results of the desk research and clusters survey, collected in a database profiling the 58 selected clusters.

4.2.1 European clusters characteristics

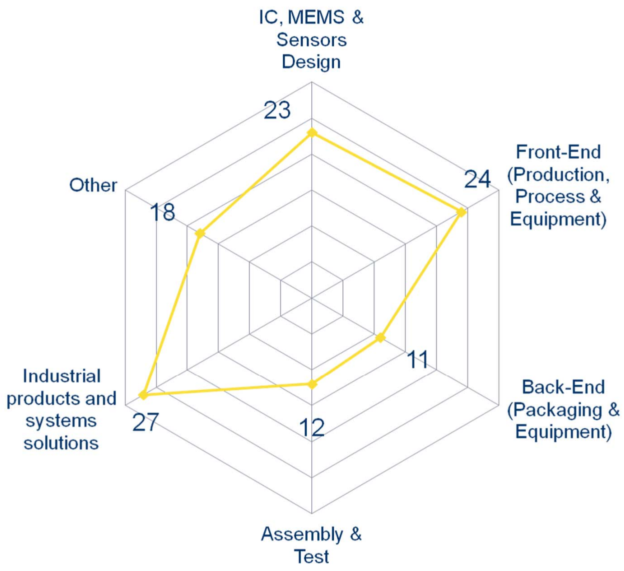
Based on our analysis, these are the main characteristics of European clusters:

- **Creation date**: Only five clusters were created before 1998 in Europe (first wave). 22 were created between 1999 and 2005 (second wave) and 21 clusters after 2005 (third wave). As a comparison, most of the worldwide clusters analysed outside Europe (e.g. US, Taiwan, and China) were created in the 80s. This difference in maturity has an impact on their scope and activities. The European clusters created in the 1st wave tend to address all segments of the value chain (and beyond). The second wave saw the emergence of more specialized clusters focused on specific segments of the value chain. The more recently created clusters are active in new areas of research such as organic electronics, printed intelligence, and nanotechnologies for ICT components.
- **Size**: all categories of clusters, from small to very large, can be found in Europe. More important than the size is the composition of the clusters' membership, between SMEs, multinational companies, universities and research centres. Indeed, since Europe has only two European players (ST Microelectronics and Infineon) ranking in the top 15 semiconductor suppliers worldwide, the average size of EU semiconductor companies is not large. While large enterprises play an important role, European clusters are not usually dominated by a single dominant company driving a strong ecosystem, with a long tail of sub-suppliers, partners and research centres (this is for example the case of Intel in the US NorthWest "Silicon Forest").

- **Origin**: only a few European clusters were launched by private initiatives, but they are relevant and successful (for example, the DSP Valley in Belgium and Silicon Saxony in Germany). Most European clusters were launched by public initiatives, leveraging existing enterprises, universities and research centres in a specific geographical area, with the goal to reinforce their cooperation and build their competitiveness. In many cases the creation of the clusters was driven by national cluster programmes (as in France, Germany, Greece), in other cases the leading force is the regional government (as in Austria). The national/regional policy environment strongly shapes the profile and structure of the clusters, as analysed more in detail in chapter 6.
- **Type of structure and management model**: most of the European clusters analysed by IDC/FORA are run by a professional cluster organisation. Within the cluster organisation, the presence or not of a large company can have a significant impact. As a reminder, in Europe, 40 out of 48 clusters include large companies (over 250 employees), and in 27 clusters they play a dominant role in the cluster organization. The impact of the presence of large companies is significant for two reasons:
    - Because the global activity of the cluster can be centred on this large company. The impact can be positive if a number of partners/distributors take advantage of this position but also a brake for innovation if the partnership conditions are too restrictive.
    - Because the large company can invest more in the development and marketing activities of the cluster.
- **Position in the value chain:** As a reminder, the ICT components value chain is composed of six different segments (IC / MEMS & Sensor Design / Front-End / Back-End / Assembly & Test / Industrial products and systems solutions / other). We have assessed the positioning in the value chain of all the 48 clusters as follows:
    - The 48 clusters cover 115 market segments
    - 7 clusters cover the whole value chain, that is, they have players active in each of the 6 market segments;
    - On average, the clusters cover 24 activities within the value chain;
    - The front-end market segment is addressed by 24 clusters (50%) but half of these clusters are from Germany.

Figure 7 shows the number of clusters present in each segment of the value chain.

Figure 7 Number of Clusters per segment of the ICT components value chain



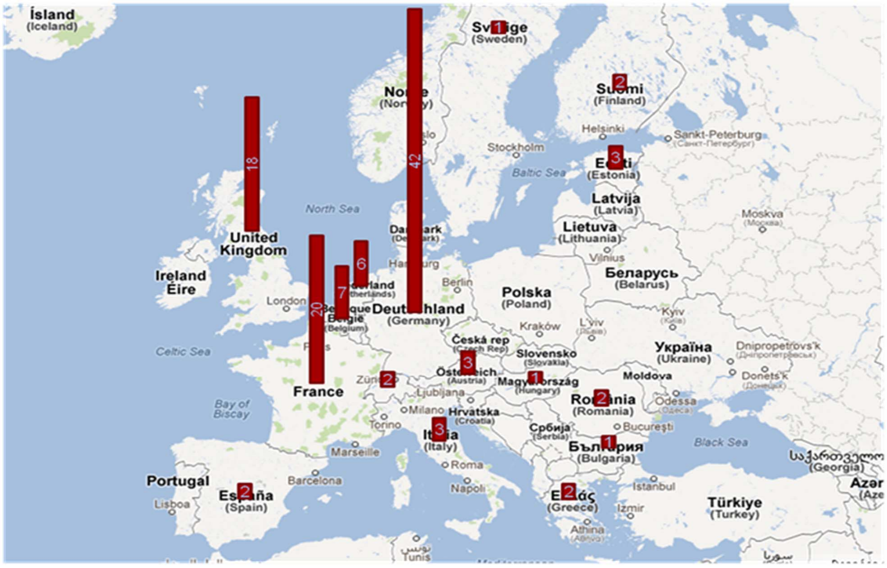
Source IDC/FORA 2012

The Figure 7 shows that European clusters tend to be specialized and follow a rather strong vertical disintegration strategy, with players trying to compete on sub-segments, rather than on large and growing but very competitive segments. As opposed to integration, in which production occurs within a single organization, vertical disintegration means that the production process is broken into separate companies/clusters (which can be outside Europe), each performing a limited subset of activities required to create the semi-conductor finished product. This is mainly due to the competition of emerging countries with lower manufacturing costs and other cost-related factors.

Figure 8 shows a mapping of the clusters activity per country in Europe. The columns represent the results of the number of clusters within the considered country multiplied by the number of market segments covered by each cluster (breadth x depth).

At a European level, the result is a cluster concentration with 3 countries (France, Germany and the United Kingdom) covering 71% of the market segments.

Figure 8 Distribution of Clusters by type of activity and country



Source IDC/FORA 2012

4.2.2 US Clusters Characteristics

The analysis focused on the following clusters:

- **US Northwest Silicon Forest Cluster** (in-depth profile)
    - Located in Washington state, Oregon and Idaho, driven by Microsoft, Intel and ON semiconductor
- **Arizona ICT Components Cluster:**
    - Located in Phoenix, driven by Avnet (a global electronic components distributor) and Intel, Freescale, ASML, ON Semiconductor
- **Austin Texas ICT components cluster:**
    - Located in Austin, driven by Texas Instruments, Freescale, Samsung (formerly Austin semiconductor), and Texas University.
- **Northeast ICT Components Cluster:**
    - Located in New England-New York. Key role of Ivy League universities, particularly MIT. Currently specialised in low volume, specific use components that are required for military electronics. Major companies are IBM, General Dynamics, Raytheon, BAE, and L3 Communications. Cooperation is mainly focused on quality and manufacturing standards enforced by the Department of Defense.
- **Southern California ICT Components Cluster:**
    - Located around Los Angeles. Driven by TowerJazz Semiconductor, Qualcomm, Vizio. Strong specialisation in telecom components. Qualcomm is the largest fabless company in the world specialised in wireless components.

These clusters have different specializations and different mix of research/ production/ distribution activities, but they are all driven by private industries.
In the United States, clusters firstly refer to sectorial and geographical concentrations where players are linked through business networks, mostly spontaneous. The most dynamic clusters can mobilise their members in a volunteer and collaborative approach. The clusters' dynamics are strongly linked to the quality and intensity of their social networks, allowing cooperation, competition (the balanced combination of cooperation and competition) and spill over effects.

These networks lead towards a common vision of the project and allow confidence between the different players. Sometimes local or regional authorities launch initiatives to reorganise efforts for business development in a timely manner and on a sector basis (e.g. Oregon in 2003 with a mapping of the main clusters). However, most of the time, local or regional policy-makers use funding and networking promotion as the main instruments, but without a strong top-down approach.

Even though the American clusters do not have a specific legal entity dedicated to their governance, even associative, a lot of distinctive organisations with various typologies have a strong acting and federative role promoting and supporting partnerships. The role of these organisations is to maintain a strong manufacturing leadership.

Innovation (and more important its valuation), diversified and continuous sources of funding as well as identification and mobilisation of talents are the main key success factors for the American clusters.

Though all clusters have to face the funding continuum, American clusters pay close attention to identifying competencies reservoirs for the upcoming needs. A lot of initiatives are also launched to support young entrepreneurs and to develop cluster visibility and attractiveness.

Finally, the most relevant initiatives launched to support cluster development are focused on the main issues of each cluster: allowing the emergence of new companies and consolidating the development of existing ones.

4.2.3 Asian Clusters Characteristics

The analysis focused on the following clusters:

- **Chungnam and Daejeon, South Korea (in-depth profile)**
  - Largest manufacturing centre and R&D areas in the country. The development of this cluster is driven by private industries and the Technology parks created by the government.
- **Yang Tze River region, China (in-depth profile)**
  - Located around Shanghai and driven by the City coordination committee of 16 major cities mayors. The area includes major international industries (HP, Intel, Infinenon, and Lenovo), factories, universities and high tech parks, particularly the Shanghai Zhangjiang Hi-Tech Park.
- **Central Taiwan Science park (CTSP)**
  - This Science Park, founded in 2002, drives the technology development of central Taiwan's industries and hosts the world's most concentrated 12-inch wafer plants cluster.
- **Hsinchu Science and Industrial Park (HSIP)**
  - Inspired by the Silicon Valley, this Park was founded in the 80's to bring to Taiwan the university-industry collaboration model, as well as venture capital. It played a key role in the development of the electronics industry in the island. Currently it hosts more than 200 semiconductor companies.
- **Southern Taiwan science-based industrial park (STSIPA)**
  - Created in 1996 with the goal to drive the economic revitalization of the area, its development was driven by Chi Mei Optoelectronics, one of the world's largest manufacturers of TFT-LCD, and its ecosystem. The main specialisation is optoelectronics.

Because of its size, the diversity of its countries in terms of maturity, culture, development policies, and the quickness of their evolution, cluster organisation in Asia offers very different realities and cannot be analysed as only one entity. However, several trends and practices can be raised:

- **State-led development:** The main common characteristic in the industrial development of the Asian clusters is state-led development, albeit to different degrees and with differing approaches. The business systems in all of these economies have been significantly influenced by the government.
    - In Taiwan for example, the proactive policy of industrial development, based on public subsidies for research and development and the establishment of industrial parks, allowed manufacturers to successfully develop key positions in the world for IT and electronics. Science parks symbolize this conversion. Hsinchu Park which opened in 1980 served as a model for the two other island parks.
    - In China, since the late 1980s, the government has made efforts to build an indigenous semiconductor industry by providing financial incentives, developing talent and technology, and crafting alliances with global players. But though the country has assumed a central role in the manufacture of many computing and consumer-electronics products, its role in the semiconductor sector has remained limited compared to other Asian countries.
- **Governance:** three major forms of cluster governance were found in the Asian clusters:
    - Multinational companies dominated and government coordinated governance (South Korea)
    - State-controlled governance (Taiwan)
    - Local intermediary institution-coordinated governance. However, in the last form, one of several different types of local intermediary institutions may be dominant in cluster governance (i.e. a specialised research institute, an industry association or even an emerging informal network) (China)
- **Role of the universities:** the main Asian clusters are composed of world-renowned universities, with a mass critical size, allowing them to be classified among the best universities and give their clusters a very strong labour force as well as a strong technological identity. These strong universities have been crucial for the implementation of multinational subsidiaries for semi-conductors manufacturing and are now a strong contributor to the construction of local companies thanks to several recent trends:
    - Some universities have high financial capacities, useful for recruitment and facility management but also investment. Some of them are taking part within the newly created start-ups, getting in return technology transfer or other kind of payback, such as equipment or facility renting;
    - A lot of entrepreneurs are coming from these universities but even more notable is the fact that spin-offs are financed by the universities.

While it is difficult to provide specific statistics, it is clear that all the Asian clusters benefit from direct funding from the state for manufacturing facilities as well as for R&D.

4.3 CONCLUSIONS

The analysis of the different cluster development models is interesting from both an academic and a political or economic point of view, because of the clusters' potential contribution to local and global development. Our research confirms that ICT components

clusters, like other clusters, take on different forms and are far from being homogeneous, but contribute strongly to local growth.
Based on the analysis illustrated above we can draw the following conclusions:

- **Importance of local characteristics in the cluster organization.** The most effective world-class clusters have adopted an organisation respectful of the typology of the players, the way they interact within each other and with the public organisations (e.g. private and bottom-up initiatives in the US; local and coordinated initiatives with strong SMEs implication in Germany; national coordination and big R&D programs including French multinational companies in France; coordination and cooperation between cities, foreign direct investment and government support in China; etc.). The impact of these characteristics is strong on funding, the administration of the clusters and the relationships between the players.
- **One size does not fit all, but the presence of market leaders is a strong driver.** Size does not appear to be a differentiator between the European and non-European clusters, as all categories of clusters, from small to very large, can be found in each region of the world. However, the pressure of globalisation is driving the need for clusters to have a more international presence, which may require supporting the growth of the cluster companies, increasing the size and reach of the cluster, expanding its partnerships, investing in its knowledge development with a wider horizon. The presence of major companies within clusters makes a difference, since it makes it easier to reach a critical mass of resources and investments. European clusters are potentially disadvantaged because only 2 European players (ST Microelectronics and Infineon) rank in the top 15 semiconductor suppliers worldwide. The US clusters for example benefit from the presence of multinational companies able to sustain a strong ecosystem of partners, distributors and universities, such as Intel in Arizona, Texas Instruments in Austin Texas, IBM in the North East and Intel/Microsoft in the North West clusters.
- **Access to a high quality workforce.** The availability of high quality ICT skills is a key competitive factor. Clusters are paying increasing attention to the local presence of qualified people and the ability to mobilise talent to deal with upcoming technology innovation. For these reasons, the development of universities specialised in the ICT components field, and/or the fame of its researchers are increasingly appreciated by clusters.
- **Type and sustainability of funding.** Every cluster tends to have a different mix of funding sources, depending on the national/regional policy strategies and the local socio-economic context. However, the duration and sustainability of funding (rather than one-off grants) is absolutely relevant, in order to allow for successful research and its longer term planning. Our research shows that national governments are paying more and more attention to the clusters development, particularly as a channel to distribute more efficiently and effectively R&D funding, making sure that research drives innovation. Concerning ICT components manufacturing, a key factor is the provision of funding for applied research and pilot lines. An interesting approach is the use of universities as the main investment vehicle as it can be done in Asia.

5 KEY SUCCESS FACTORS

5.1 IDENTIFICATION OF KEY SUCCESS FACTORS

Developing an evidence based cluster policy for the ICT components and systems manufacturing clusters in Europe is a key priority for the European Commission. However, in order to develop effective cluster policies at regional, national and EU level, it is imperative to understand the key success factors of clusters in the ICT component and systems manufacturing industry.
In order to assess the key success factors, IDC and FORA have collected data on:

1. Innovation performance of leading ICT component and systems manufacturing clusters in Europe;
2. Cluster characteristics such as strength of cluster actors, cluster-specific framework conditions and quality of cluster management.

By exploring the correlations between these two aspects, we can investigate which cluster characteristics are connected with and have a positive impact on their innovation performance. This will help policy makers focus their efforts on specific domains that are important to cluster emergence and growth, while also providing inputs to a somewhat theoretical yet very important question: Why do some clusters perform better than others?

Innovation Performance Index

To measure innovation performance by cluster we selected an indicator based on objective data (rather than the opinions of the cluster respondents) taken from the European Cluster Observatory.
The specific indicator used for innovation performance is Number of patents (ICT) per million inhabitants.
This indicator is chosen over other potential regional performance indicators for the following reasons:

- The indicator relates to the specific sector (ICT)
- The indicator takes into account structural differences between regions (number of inhabitants)
- The data is relatively up to date (2000-2009)
- The data is available for the different regions in which the main European ICT components and systems manufacturing clusters are located.

The value of the regional innovation performance indicator for each of the clusters analysed in-depth (plus the Dublin cluster in Ireland) is presented in **Error! Reference source not found.**.
If we consider that the average number of ICT patent applications per million inhabitants in the EU in 2007 was 34[8] , all the clusters in the Figure 9 appear to be good innovation performers. Interestingly, the Dutch region which is home to a part of the cross-regional cluster DSP Valley is outperforming the other European clusters in terms of ICT patents. Part of the explanation may be the presence of ASML and Philips in the Netherlands, companies who — according to a 2010 study on patent applications in Key Enabling Technologies — are both among the leading European patent applicants in microelectronics[9].

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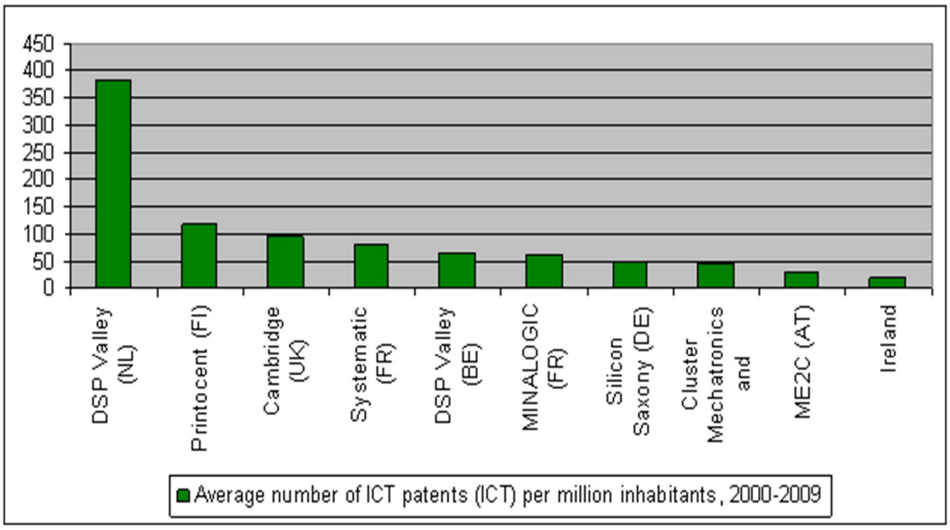
8 "Performance of ICT RTD" IPTS- JRC Scientific and Technical Reports EUR 24934 EN - 2011
9 ZEW/TNO (2010): European Competitiveness in Key Enabling Technologies.

Figure 9 Innovation Performance of the main European ICT components and systems manufacturing Clusters



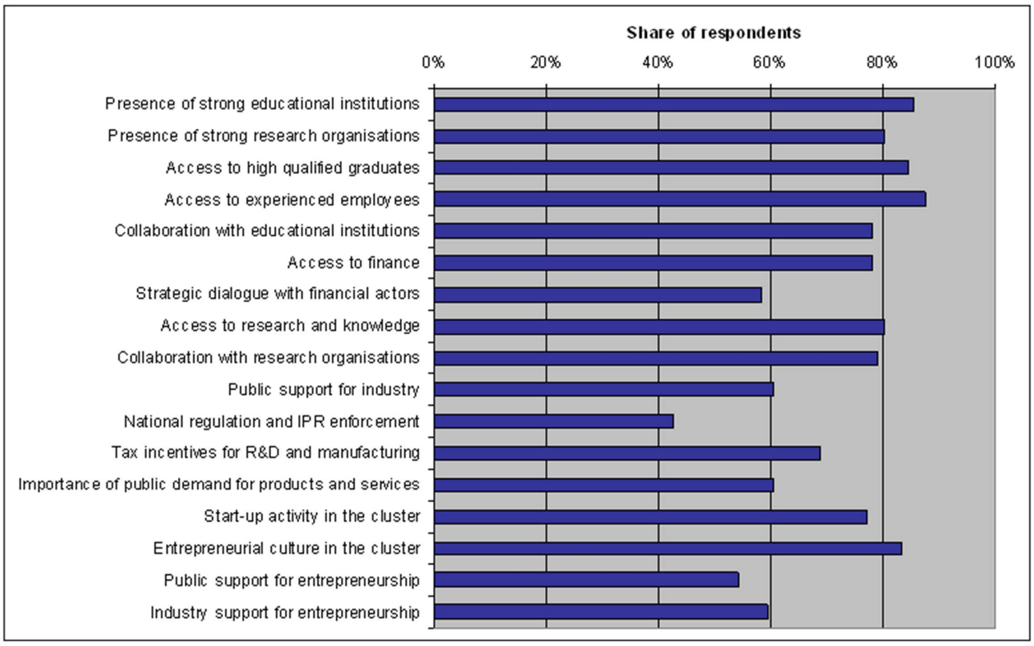
Source: Own calculations based on data from European Cluster Observatory. The scores for each cluster are calculated as the average number of ICT patents per million inhabitants in the years 2000-2009.

To allow comparison, we transformed this indicator into an **Innovation Performance Index**, measured on a scale from 0 to 100, where 100 is the best performer score (in this case, the cluster with the highest average number of ICT patents in the considered period). The other clusters are measured based on their distance from the best performer, using the simple formula: cluster score / highest cluster score x 100.

The Cluster Characteristics Index

The survey of cluster companies provides information on the strength of cluster actors, framework conditions and quality of cluster management, as well as other factors, based on average scores (on a scale of 1 to 5). In order to allow comparison, we have transformed these scores into an Index on a scale measured on a scale from 0 to 100, where 100 is the best performer score (in this case, the cluster with the highest score), similarly to the Innovation Performance Index. The other clusters are measured based on their distance from the best performer, using the simple formula: cluster score / highest cluster score x 100. We have calculated the Index for each of the main characteristics to compare it with the Innovation Performance Index, as shown in the following tables.
The survey respondents were asked to assess the importance of the different factors included in the analytical model for economic development and innovation activities of their companies. **Error! Reference source not found.** below provides the ranking of the different factors based on the survey results.

Figure 10 Ranking the importance of the factors included in the analytical model



Source: EC Cluster Survey FORA/IDC, 2012. Note: Ranking based on the share of respondents considering the specific factor to be important to the innovation activities and growth. Number of respondents = 156.

Overall, respondents rank most of the factors included in the analytical model as important for their companies' economic development and innovation activities, confirming the validity of the model. This shows that success does not depend on a single factor, but on the combination of positive framework conditions and market factors. However, there are some differences.

The factors leading the ranking, considered important by over 80% of respondents are access to high level skills (highly qualified graduates and experienced employees), entrepreneurial culture in the cluster, and the presence of strong educational institutions, closely followed by the presence of strong research organizations (which implies closeness with and easy access to research and knowledge resources). These factors are examined more closely in the following paragraphs.

Representativeness of the survey

The validity of these considerations is based on the coverage of the survey, which included all the clusters active in Europe in ICT components manufacturing, corresponding to the universe of the clusters falling within the scope of the study. The international sample covers a good selection of the most relevant international clusters. The survey includes representatives of all the managing organizations and of the key stakeholders of most clusters; therefore it provides a good qualitative representation of the characteristics of the clusters interviewed, even if it cannot be considered statistically representative of the thousand of enterprises members of the clusters.

Selecting clusters for the analysis of key success factors

A first step in the analysis of success factors is to carry out an assessment of each of the clusters with regard to the availability of data on innovation performance and the number of respondents from each cluster.

On the basis of this assessment, we have selected four clusters that can form the basis of the analysis of success factors for their high performance and relevance in the EU:

- Silicon Saxony, Germany
- MINALOGIC, France

- Cluster Mechatronics and Automation, Germany
- Systematic, France

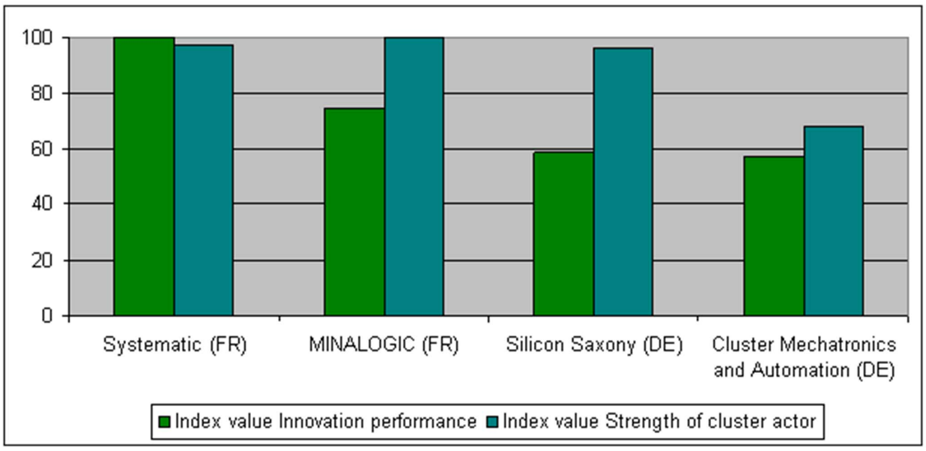
Unfortunately, we have not been able to carry out the same in-depth analysis for the other clusters listed in Figure 9, because of the limited number of respondents and the lack of comparable data.
In the following sections, we will analyse in more depth the importance of the different factors for the innovation performance of the clusters as a whole.

5.2 ANALYSIS OF KEY SUCCESS FACTORS

5.2.1 Strength of cluster actors

The presence of market and technology leaders in a cluster is important for the emergence and growth of a cluster. In particular, the market and technology leaders can make the cluster more attractive to other companies, investors and talent.
The cluster case studies carried out as part of this study provide illustrative examples of the importance of strong cluster actors, In the microelectronics cluster at Villach in Austria, the presence of Infineon Technologies has been a driving force in the emergence and development of the cluster. A key focus of the cluster organisation has been to develop a strong local supply chain for Infineon, facilitate strategic partnerships between key cluster actors and promote strong framework conditions for instance in the form of access to human resources and research. These efforts have in turn made the cluster attractive to other companies in the ICT component and systems sector such as Intel and Lantiq, and have also resulted in the creation of a number of innovative start-ups.
In Cambridge, the academic excellence at the University of Cambridge has been a key success factor for the cluster. The university has had 86 Nobel Prize winners throughout the years, which is more than any other institution. This creates an environment that is interesting for world-class researchers within the academic world, as well as for multinationals within the corporate world. The university has also contributed to the cluster's development through strong university industry links and successful technology transfer from the university to industry. In particular, the University of Cambridge has a strong focus on spinning out companies from the university. These spin-out activities have been nurtured by a liberal IPR policy at the university: IPRs are not automatically assigned to the university, but the academics can claim ownership of their own inventions. This policy has granted significant independence to scientists in negotiating IPR with industrial sponsors and engaging in research commercialisation.
In the survey of cluster companies, the respondents were asked to indicate if market and technology leaders were present in the cluster. Overall, most respondents in the survey consider that market and technology leaders are present in the cluster. This is most notable in MINALOGIC, Systematic and Silicon Saxony and to a lesser extent in the Cluster Mechatronics and Automation.
Error! Reference source not found. provides a comparison of the four clusters with regard to the strength of cluster actors and overall innovation performance of the cluster.

Figure 11 Importance of Strength of Cluster actors



Source IDC/FORA 2012

The data suggests that the strength of cluster actors has an impact on the innovation performance of a cluster. This indicates that clusters emerging on the basis of strong cluster actors, or cluster able to attract such actors will benefit from their presence in terms of a relative higher innovation performance compared to other clusters. The link between strength of cluster actors and the innovation performance of a cluster is perhaps not surprising as market and technology leaders will contribute directly to the overall innovation performance of a cluster with their in-house R&D activities.

The importance of market and technology leaders as a basis for developing strong clusters and strong industries is reflected in the industrial policies of a number of countries. In Europe, Ireland has attracted global ICT hardware players such as Intel, Apple, IBM, Hewlett-Packard, Dell and a large number of market leaders in the software sector through a FDI-orientated development strategy. A key feature in this strategy was the adoption of a zero tax rating on profits derived from manufactured exports, making Ireland a key export platform for sales into Continental Europe.10 Countries such as Taiwan, China, the Philippines and Malaysia are also providing financial incentives for global companies in the ICT component and systems manufacturing sector to set up manufacturing and R&D activities.

Case: Investment incentives for the global electronics industry in Malaysia

The Malaysian electronics industry started in the 1970s with a focus on simple components and semiconductor parts assembly, but has since then evolved into a capital intensive and knowledge based industry focusing on high value added products and activities including R&D, IC and system design and wafer fabrication. International companies involved in R&D and design in Malaysia include Intel, Freescale Semiconductors, and Infineon. The Malaysian electronics industry has also introduced a number of home grown companies including SyMMID (IC design), Silterra (wafer fabrication) and AIC (semiconductor) to the global electronics industry.

There are numerous financial incentives for electronics manufacturing in Malaysia. The granting of Pioneer Status to a company implies an income tax exemption ranging from 70% to 100% of statutory income for a period of 5-10 years. Manufacturing companies are also exempted from import duty and sales tax on raw materials, components, machinery and equipment and may qualify for an investment tax allowance for a period of 5-10 years and a re-investment allowance for 15 years.11

The Malaysian government has succeeded in creating a vibrant electronics industry through a proactive policy on attracting FDI in strategic high tech sectors. These efforts have resulted in the creation of regional electronics manufacturing clusters, including Penang (semiconductor back-end) and Kedah (semiconductor front-end and back-end). Semiconductors aside, the Malaysian government is also focusing efforts on establishing strong solar ecosystems (solar wafers/cells) and LED ecosystems (wafer fabrication) in the country.

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10 Braunerhjelm, Pontus and Maryann Feldman, eds. (2009): Cluster genesis. Technology-Based industrial Development.

11 Malaysian Investment Development Authority

5.2.2 Cluster-specific framework conditions

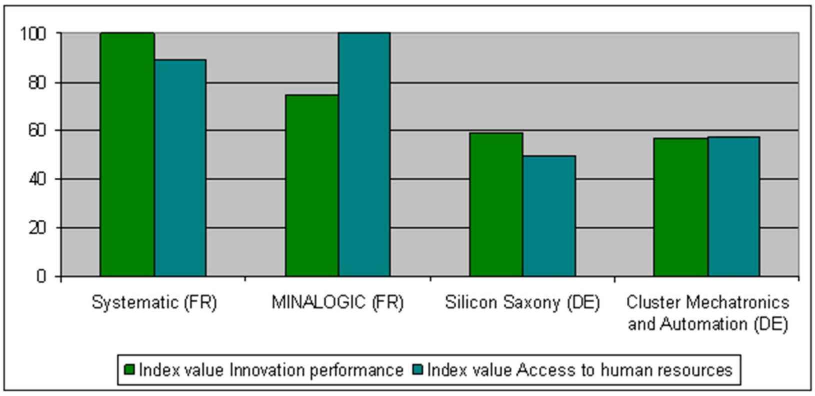
The basic assumption for the analysis of cluster-specific framework conditions is that these conditions may have an impact on the innovation performance of a cluster.
The five dimension of cluster-specific framework conditions are:

- Access to human resources
- Access to finance
- Access to research and knowledge
- Public demand
- Conditions for entrepreneurship

5.2.3 Access to human resources

Access to highly qualified graduates and experienced employees is considered an important factor for the innovation activities and competitiveness of companies. The access to human resources in a specific cluster may therefore play an important role for the innovation performance of a cluster. One example of the importance of a highly qualified workforce is the development of 'Silicon Wadi' in Israel. The first hi-tech firms in Israel began to form in the 1960s, and since then major international technology companies have established research and development facilities in the region, including Intel, IBM, Google, Hewlett-Packard, Philips, Cisco Systems, Oracle Corporation, SAP, BMC Software, Microsoft, Motorola and CA. A key success factor for the emergence and development of the Israeli high-tech sector has been the influx of scientific expertise as a result of the immigration from the former Soviet Union in the beginning in 1989. Many of the immigrants had scientific and engineering backgrounds, effectively transforming Israel into a "superpower in mathematics". Overall, the Israeli population is characterised by a high concentration of engineers or scientists compared to other OECD countries, which is a significant strength in the high tech industry.12
In the survey, the respondents have been asked to assess their access to highly qualified graduates and experienced employees. A composite indicator has been developed to summarise their responses. **Error! Reference source not found.** provides a comparison of the four clusters with regard to the access to human resources and the overall innovation performance of the cluster.

Figure 12 Importance of Access to Human Resources



Source IDC/FORA 2012

12 de Fontenay, Catherine and Erran Carmel (2002): Israel's Silicon Wadi:
The forces behind cluster formation, http://www.mbs.edu/home/defontenay/IsraelSiliconWadiJune2002.pdf

The data suggests a link between the access to human resources and the innovation performance of a cluster. As a result, policy makers should consider policies aiming at increasing the access to human resources in the form of highly qualified graduates and experienced employees when designing support measures for clusters in Europe. In particular, dedicated efforts are required to ensure a high quality of the education and training offers provided by research and educational institutions.

Case: Promoting high quality research and education — the role of the Microelectronics Support Centre
The Microelectronics Support Centre at the Science and Technology Facilities Council's (STFC's) Rutherford Appleton Laboratory near Oxford in the UK is recognized as an established centre of excellence with a 25 year history in supporting the microelectronics industry. The Centre consists of a group of experienced microelectronic specialists who support research and educational activities at more than 600 academic institutions across Europe, for instance in the form of technical consultancy and train-the-trainer courses.[13]

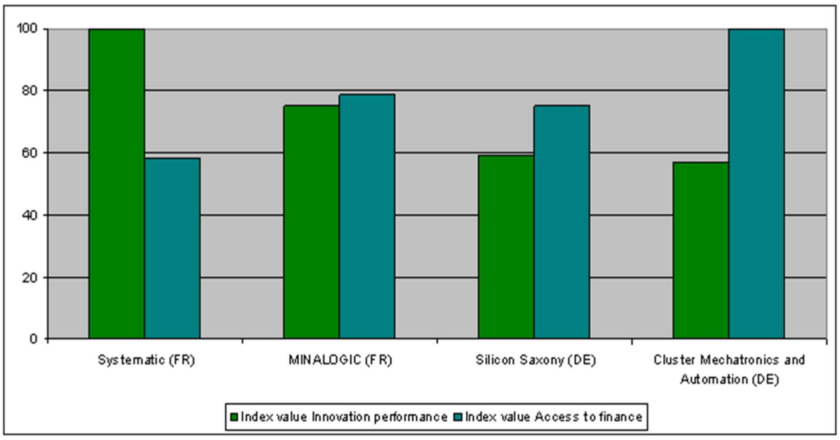
Specific support measures at cluster level could also include facilitation of stronger collaboration between companies and educational institutions as well as measures to recruit talent to ICT components and systems companies from within the cluster as well as outside the cluster.

5.2.4 Access to finance

Access to finance is a major challenge for the ICT components and manufacturing industry due to large investment needs, and the financial crisis has made financing opportunities extremely scarce. Moreover, and perhaps as a result of the financial situation in Europe, European companies seem to be investing too little in R&D compared to main competitors. Clusters providing good access to finance are therefore considered to better support the innovation capacity and competitiveness of cluster companies than clusters with a less favourable access to finance.
In the Cambridge cluster, business angels and seed companies such as Cambridge Capital Group and Cambridge Angels have provided funding for new start-ups. Similarly, the policy-led development of a strong venture capital market in Israel is considered a key driver for the national ICT components and systems sector.14
In the survey, the respondents were asked to assess their access to finance in the cluster. **Error! Reference source not found.** provides a comparison of the four clusters with regard to the access to finance and the overall innovation performance of the cluster.

13 Microelectronics Support Centre, http://www.msc.rl.ac.uk/msc/index.html
14 Braunerhjelm, Pontus and Maryann Feldman, eds. (2009): Cluster genesis. Technology-Based industrial Development.

Figure 13 - Importance of access to finance



Source IDC/FORA 2012

The data does not indicate a link between access to finance and the innovation performance of a cluster. This does not however imply that access to finance is irrelevant for the innovation performance of cluster companies, but we did not find any evidence for considering access to finance a key success factor for the clusters.

There are several cluster-specific initiatives aiming at increasing access to finance and remove financial strains on companies, in particular high-tech start-ups. One example is a new investment scheme launched by University of Cambridge to help support new companies connected to the University.

Case: Improving access to finance for early stage companies — the Seed Enterprise Investment Scheme fund

University of Cambridge has in 2012 launched its own Seed Enterprise Investment Scheme (SEIS) fund. The fund is managed by a private investment firm with investment advice provided by Cambridge Enterprise, the University's institution for commercialization of research. The University is aiming to raise £1 million to establish the SEIS fund, which will work alongside existing University seed funds. The SEIS fund is expected to increase the University's ability to spin out successful companies, and enable individuals to invest alongside institutional funds in order to maximise returns.

The SEIS fund was announced by the British Government in the 2012 Budget as part of its strategy for stimulating economic growth in the UK. In addition to providing individual income tax relief of 50% of the amount invested, any gains on shares held for three years under the scheme are free from capital gains tax (CGT). In addition, during the 2012/13 tax year, gains realised on other investments that would otherwise be liable to CGT will also be exempted from that CGT if they are reinvested in SEIS.[15]

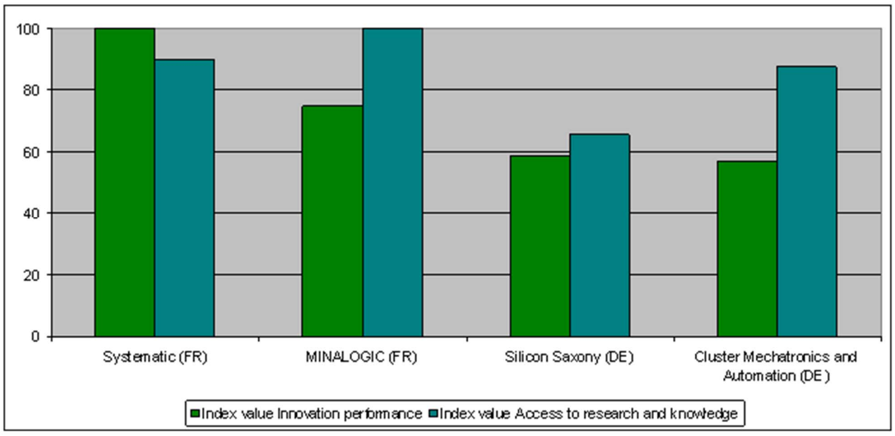
5.2.5 Access to research and knowledge

Access to research and knowledge is considered a key innovation driver for companies. Clusters and regions with strong and specialized research and knowledge institutions will attract companies to the cluster or region which is home to such clusters and regions. The creation of strong linkages between cluster companies and specialised research and knowledge institutions is also a key element in making the cluster and cluster companies innovative and globally competitive.

In the survey, the respondents were asked to provide an assessment of the access to research and knowledge in the cluster. **Error! Reference source not found.** below provides a comparison of the four clusters with regard to the access to research and knowledge and the overall innovation performance of the cluster.

15 University of Cambridge, http://www.enterprise.cam.ac.uk/news/2012/5/university-cambridge-launches-new-investment-schem/

Figure 14 Importance of access to research and knowledge



Source IDC/FORA 2012

The data indicates a link between access to research and knowledge and the innovation performance of a cluster. As a result, policy makers should consider approaches to facilitating stronger collaboration between companies in the cluster and research and knowledge institutions.

Case: Kick-starting collaborative research in cutting-edge clusters — the German Spitzencluster initiative

15 cutting-edge clusters in Germany have been selected through a competitive audition process under this initiative, each receiving €40 million to fund collaborative and cutting-edge research projects involving research organisations and companies in the selected clusters. The federal contribution must be matched by business and private investors.[16]

Among the clusters receiving funding through the Spitzencluster initiative are Forum Organic Electronics which aims to make Germany the world's leading research, development and production location in the field of organic electronics, and Cool Silicon which aims to make communications more climate-friendly and to become one of the world's leading locations for energy efficiency in electronics.

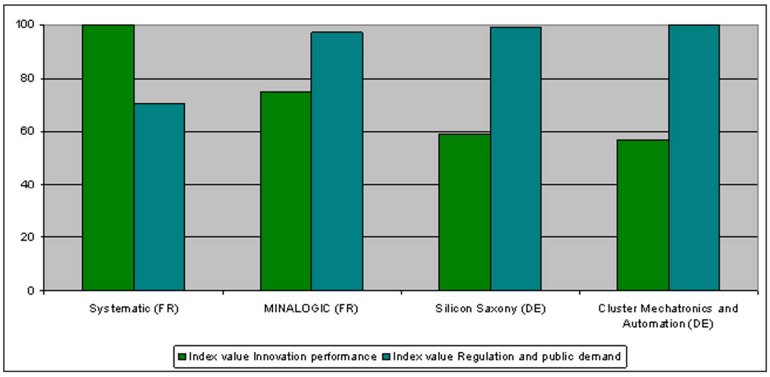
The funding for such collaborative research projects is extremely important for the development of strong clusters as these projects will both promote innovation performance of clusters as well as nurturing cluster dynamics by establishing strong networks and social trust among the cluster actors involved in the projects.

5.2.6 Regulation and public demand

The public sector can play an important role in supporting the establishment and development of clusters, for instance by facilitating the establishment of public-private partnerships within a region and providing funding to cluster organisations. The public sector can also drive the provision of innovative products and services through intelligent public demand[17]. One example is the use of new regulation and standards to accelerate the uptake of innovative products and pre-commercial public procurement. These demand-side measures may help drive innovation in the ICT components and systems manufacturing industry.

Figure 15 Importance of regulation and public demand

16 Information on the Spitzencluster initiative is available at http://www.bmbf.de/en/10726.php
17 FORA (2009): New Nature of Innovation. Input to the OECD innovation strategy 2010.



Source IDC/FORA 2012

In the survey, the respondents were asked to provide an assessment of the importance of regulation and public demand. **Error! Reference source not found.** above provides a comparison of the four clusters with regard to the assessment of regulation and public demand and the overall innovation performance of the cluster.
There is no evidence of a link between regulation and public demand and overall innovation performance of a cluster. However, this does not exclude that regulation and public demand can have a positive impact on the overall innovation performance of a cluster.

5.2.7 Entrepreneurship

Entrepreneurship is considered to play an important role for the performance and growth of a cluster. This gives institutions that support entrepreneurship in clusters a key role in the development of strong clusters. In fact, a key element in explaining the success of Silicon Valley is the unique institutions that nurture new firms in the cluster: Silicon Valley is host to a number of institutions that are specialised in supporting firms, in particular technology firms. These institutions are often referred to as an ecosystem, a social structure of innovation, or an incubator region [18]. Initiatives supporting the development of entrepreneurship skills and an entrepreneurial culture among students, researchers, employees and company managers in the cluster as well as support for entrepreneurial activities and new firms are therefore important to consider when developing measures aiming at supporting clusters.
The cluster case studies carried out of the European clusters do not indicate that support for entrepreneurship is a key component in the development of the clusters. Only the Cambridge cluster seems to have developed a strong ecosystem for entrepreneurship. A leading actor in this ecosystem is Cambridge Enterprise, which is responsible for the commercialization of research at University of Cambridge. Cambridge Enterprise provides technology transfer services, consultancy services to University staff, and pre-seed and seed stage investments to help commercialise innovative research through the creation of new ventures. Also, the Printocent cluster in Finland has established a strong basis for the creation of startups based on the access to test and demonstration facilities as well as a strong network of public and private actors that are able to support startups financially and provide strategic advice.
In the survey, the respondents have been asked to provide an assessment of the conditions for entrepreneurship in the cluster. **Error! Reference source not found.** provides a comparison of the four clusters with regard to the assessment of the conditions for entrepreneurship and the overall innovation performance of the cluster.

Figure 16 - Importance of Entrepreneurship

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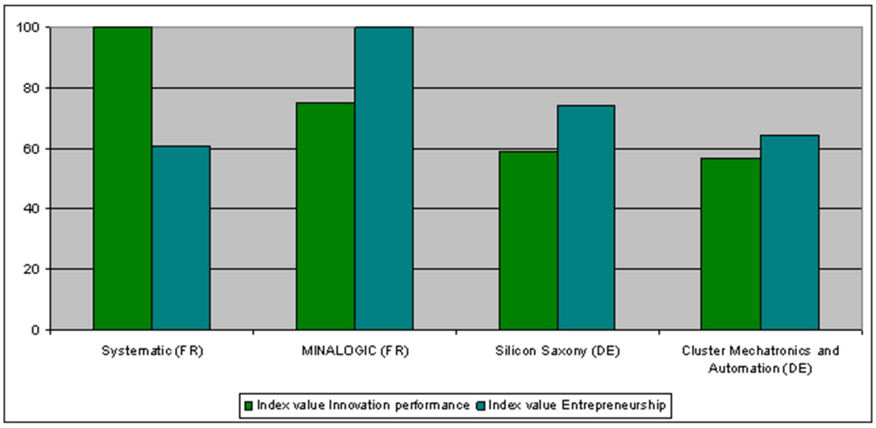
18 Braunerhjelm, Pontus and Maryann Feldman, eds. (2009): Cluster genesis. Technology-Based industrial Development.



Source IDC/FORA 2012

There is no evidence of a link between entrepreneurship conditions and innovation performance of a cluster. This does not however imply that conditions for entrepreneurship are not important. Although we cannot conclude that conditions for entrepreneurship has been a key success factor when it comes to innovation performance of a cluster, the cluster case studies suggest that the clusters are currently lacking strong ecosystems for entrepreneurship, and new initiatives in this field could help increase the competitiveness and growth of the clusters. One example of cluster-specific support measures is CIBIT Accelerace Invest.

Case: Promoting entrepreneurship at cluster level — the CIBIT accelerator programme in the Danish Capital Region

Copenhagen International Business Information Technology Hub (CIBIT) is an ICT cluster in the Danish Capital Region. In order to promote entrepreneurship and innovation in the cluster, a number of cluster actors have established an accelerator programme with a total budget of €13.3 million. The accelerator programme was established in 2009 and is co-funded by the ERDF.

The entrepreneurs participating in the programme have been selected by a jury consisting of experts in ICT, market developments and business development. A total of 150 entrepreneurs will participate in a dedicated business development programme lasting for 6 — 8 months in which they receive training and advice from experts. A key feature of the programme is that some of the entrepreneurs participating in the programme may qualify for a loan to help them reach the market.

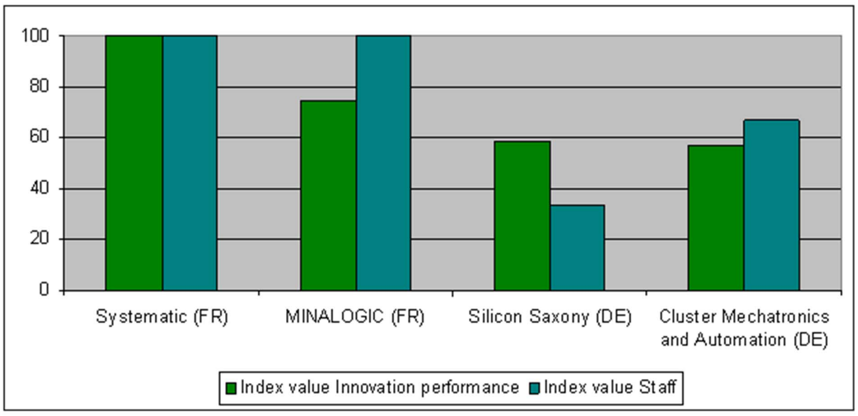
The ultimate target of CIBIT Accelerace Invest is to create at least 100 high-growth companies in the region and increase regional employment in the ICT sector with 5000 people by the end of 2014. So far 50 of the entrepreneurs participating in the programme have managed to raise pre-seed capital for their companies.

5.2.8 Quality of cluster management

The importance of high-quality cluster management for the performance of clusters has received increased attention at European level. For instance, in 2009 the European Commission launched the European Cluster Excellence Initiative to promote excellence in cluster management. Cluster management is expected to have an impact on the development of the cluster as a whole as well as the performance of cluster companies, for instance by developing and driving the implementation of a long-term strategy for the cluster, by connecting actors within the clusters as well as externally, and by providing specialised, professional services to cluster companies.

IDC and FORA have collected data on the cluster organisations in Europe, including their number of staff. This provides an indication of the resources of the cluster management to actively support the development of the cluster.

Figure 17 - Importance of Cluster Management



Source IDC/FORA 2012

The data suggests that the cluster management can have a positive impact on the innovation performance of a cluster, for instance by facilitating collaboration between companies and research organisations. This suggests that support for cluster organisations is a relevant measure to consider when designing policies to support cluster emergence and growth.

5.3 CONCLUSIONS

There are many paths to success for a cluster. However, the analysis of key success factors for four of the main ICT component and systems manufacturing clusters suggest that innovation performance of clusters are linked to the following four cluster characteristics:

- Strength of cluster actors
- Access to human resources
- Access to research and knowledge
- Quality of Cluster management

Policy makers need to consider these factors when designing policies to support the emergence and development of clusters.
We cannot on the basis of the analysis exclude the importance of other factors such as access to finance, regulation and public demand, and conditions for entrepreneurship for innovation performance of a cluster. In fact, the case studies of individual clusters suggest that these factors are also important for the clusters. However, the three factors should not be considered as decisive for the innovation performance of the clusters.

6 ANALYSIS OF POLICY MEASURES AND FUNDING SCHEMES

6.1 OVERVIEW

IDC and FORA have carried out a mapping and analysis of cluster funding instruments and support schemes in Europe and outside Europe on the basis of desk research, a survey of cluster companies and interviews with experts and industry stakeholders. The mapping has covered key policies and initiatives in countries and regions with ICT components and systems manufacturing clusters.

The covered cluster policies and initiatives are not necessarily targeting ICT component and systems manufacturing clusters, but may be supporting such clusters as a part of a policy which promotes innovation networks and clusters across sectors. Examples include the German Spitzencluster initiative, Denmark's cross-sector innovation networks and the "Pôles de compétitivité" programme in France. Although these programmes and initiatives cover a wide variety of sectors, the typically include a strong focus on ICTs[19].

6.2 MAPPING OF FUNDING SCHEMES AND OTHER CLUSTER SUPPORT MEASURES

6.2.1 Policy Context

Cluster policies are among the key ICT policy priorities in OECD countries. In 2010, 18 out of 27 OECD countries indicated high priority for this policy area, making it one of the top 10 ICT policy priorities in the longer term. However, European countries do not rank it as high as countries such as Japan, Korea, Australia, Canada, New Zealand and the United States[20].

There are also substantial differences with regard to the policy focus and level of support for clusters within Europe. A number of European countries such as Germany, France and Austria have actively supported the emergence and development of clusters for almost a decade, while other European countries have only recently launched dedicated cluster policies and initiatives.

Cluster policies in Europe received a boost from the launch of the concept of "smart specialisation" strategies for regional innovation and growth, promoted by the "Innovation Union" communication, expanded by the EC Communication 'Regional Policy contributing to smart growth in Europe 2020" and backed up by OECD research[21]. Cluster policies are a natural instrument of regional smart specialisation strategies, which are focused on leveraging the strong points of the regions' economic environment with a strong role for ICT, fostering the interaction between research and innovation, and coordinating policies and initiatives to select strategic priorities[22]. In this context, EU Member States have increased national coordination of cluster programmes and many regions have launched cluster support plans.

A recent study by the European Cluster Program Benchmarking[23] found and analysed 34 cluster programs in 24 countries, of which only 5 did not provide direct funding but only

[19] OECD (2010): Information Technology Outlook 2010.
[20] OECD (2010): Information Technology Outlook 2010.
[21] See for example the Draft Synthesis Report on innovation driven-growth in regions: the role of smart specialisation, OECD, December 2012
[22] See for example the Guide to Research and Innovation Strategies for Smart Specializations (RIS 3), May 2012, by the Smart Specialization Platform Group on behalf of the EC
[23] Clusters are individuals - Volume II - New Findings from the European Cluster Management and Cluster Program Benchmarking, published by the Danish Ministry of Science Innovation and Higher Education, October 2012

technical assistance. The countries covered are: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Iceland, Italy, Latvia, Lithuania, Luxembourg, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Spain Sweden, Turkey and United Kingdom). This list is by no means exhaustive, since in many countries there is a national program as well as regional programs. In the case of Germany, for example, the study examined three national level policies (Competence Networks, Go-Cluster and Zentrales Innovationsprogramm Mittelstand – Netzwerkprojekte (ZIM NEMO), plus two at the Laender level (Cluster Offensive Bayern and Cluster Policy Strategy of Hamburg).
Cluster programmes typically include a mix of funding and support measures, with two main goals, to support networking/coordination activities of private and public stakeholders in the cluster area (enterprises, universities, research institutes) and to promote/fund cooperative R&D and innovation. The ultimate goal of course is to support and promote competitiveness, economic growth and employment.
The ICT components manufacturing clusters analysed by this study have strongly benefited from the diffusion of cluster policies. They rely on national/regional cluster programmes as well as on a wide range of other funding measures, as shown by the mapping below.

6.2.2 Mapping Funding and support measures

The level of involvement by national and regional authorities in the creation of clusters may differ greatly, but most often public authorities as a minimum help facilitate clustering efforts by providing funding to cluster actors and through other support measures. Moreover, most countries and regions seem to support the industry and clusters using a different mix of funding instruments and public support measures ranging from direct financial support in the form of state aid to public investments in infrastructure for R&D&I and funding for cluster activities and cluster organisations[24].
Furthermore, the role of public authorities and the importance of specific funding instruments and funding sources for a cluster may change over time. One example is DSP Valley, in Belgium, which was established on the basis of private funding, but in later phases has benefited from regional, national and EU funding.
Clusters also benefit from national and regional policies and initiatives that are promoting innovation and competitiveness of the regional and/or national economy as a whole. Such measures include tax policy, regulation, access to finance, education and research policies and demand side initiatives such as public regulation. These support measures may indirectly support the innovation performance and competitiveness of clusters and thus need to be considered in the context of this study[25].
Public support for cluster organisations comes in other forms than funding, for instance through capacity building measures and support for internationalisation of clusters. Support is provided at many levels. At the European level, the European Cluster Excellence Initiative (ECEI) launched by the EC was recently concluded. Follow-up initiatives include:

- The European Secretariat for Cluster Analysis (ESCA): It is the one-stop-shop for labelling of cluster organisations (www.cluster-analysis.org)
- Foundation Clusters and Competitiveness: offers courses for trainers of Cluster Management Excellence based on the ECEI curriculum and administrates the ECEI training materials (www.clustercompetitiveness.org)
- European Cluster Group e.V. (ECG): The ECG is the sustainable structure for the future of the European Cluster Managers' Club and the European Cluster

[24] European Commission (2011): Cross-sectoral Analysis of the Impact of International Industrial Policy on Key Enabling Technologies, http://ec.europa.eu/enterprise/sectors/ict/files/kets/ket-report_en.pdf
[25] It is not within the scope of this study to cover the full spectrum of relevant policies for every country. However, the in-depth case studies provide information on the policy mix in selected countries and clusters (see Annexes 0).

Collaboration Platform with strong cooperation links to the TCI Network (www.clustercollaboration.eu)

Within this context, it is very difficult to pin down the exact mix of funding and support enjoyed by each cluster, which tends to change in time.
The following Table 1 shows a summary overview of the main public funding sources for a selected number of EU clusters for which we were able to collect sufficient information.

Table 1 - Overview of Main Public Funding Sources - EU Clusters

	Specific Cluster Policies			R&D and Innovation Funding			
	Public Funding for Cluster Organisations	**National Cluster Programmes**	**Regional Cluster Programmes**	**Government funding for R&D**	**EU funding (ERDF, FP, Interreg)**	**Tax Incentives**	**Regional funding / State aid**
Austria, ME2C	X	X			X	X	X
Belgium/NL, DSP Valley					X	X	X
Finland, Printocent	X	X		X	X		X
France, Minalogic	X	X	X	X	X	X	
France, System@tic	X	X	X	X	X	X	
Cluster Mechatronik & Automation, Germany	X	X	X	X	X		X
Germany, Silicon Saxony	X	X	X	X	X		X
Greece, Corallia Mi Cluster	X	X		X	X		
Hungary, Pannon Mechatronics Cluster	X	X		X	X	X	X
Romania, Minatech-RO		X		X	X		X
Spain, PEC4	X		X		X	X	X
UK, Cambridge				X	X	X	
UK, Silicon South West				X	X	X	

Source: IDC 2013

Digital Agenda for Europe

According to our analysis, most of the clusters' funding comes from the following sources.

Specific Cluster policies

These policies tend to support the development, coordination and networking activities of the clusters, including the support of the Cluster management organisation, where it exists.
Here we see a first difference between cluster models: in the UK and Belgium/Netherlands (DSP valley) the analysed clusters' management organizations survive with membership and participation fees, and do not receive direct public funding, while in most other countries the cluster organization is sustained by the cluster programmes. The Austrian regional government provides 50% of the annual funding of Me2C management organization. The Cluster organization can be a "light structure" acting only as a facilitator of the clusters activities (as it seems the case in Corallia MI or Pannon Mechatronics) or a proactive and experienced technology transfer and marketing organization. Three of the cluster management organizations in our list (Silicon Saxony, System@tic and Minalogic) have received the Gold Label of Cluster Management Excellence assigned by the European Cluster Excellence Initiative. This gold label "*acknowledges cluster organisations that demonstrate highly sophisticated cluster management and that are committed to further improve their organisational structures and routines for the benefit of an even higher performance*"[26].
The European Cluster Benchmarking study review of 34 cluster programs found that a key success factor is to promote and evaluate the quality of cluster management organizations, linking it to the amount of funding, and also that these organizations should be encouraged to develop value-added services to provide to their members. This is also driven by increasing concerns about the sustainability of public funding, with the objective to increase the role of service and membership fees in the maintenance of cluster organizations. This is done for example by the Bayern Cluster Offensive Programme, where the public funding for the cluster organizations are gradually decreased, thus encouraging the cluster organisations to attract more funding from other sources.
The cluster programmes in France, Greece, Germany, Hungary and Romania offer many other services besides funding, including for example training and consulting services, support for networking and internationalization, support for access to venture capital funding. Some programmes offer only non-financial services, for example the Go-Cluster Programme in Germany does not offer direct funding, but technical support to achieve managerial excellence in cluster management, coordination and networking.
While the funding provided by cluster programmes is generally predefined and planned over several years, it is not by all means guaranteed. There is a growing trend to link the actual distribution of funding with the performance of the individual clusters, measured on the basis of formal evaluation and assessment programs. This is the case for example of France, which carried out in 2012 the second assessment of the Poles de Competitivité Programme, in order to launch the Phase 3 of the Programme and revise the funding policy. This is also the case of Hungary.

R&D and innovation funding

R&D is a relevant source of funding for our analysed clusters, but it depends on the clusters' ability to design and implement successful research and innovation projects, and/or to compete for funding in national and international call for proposals. There is a clear trend for clusters to act as channels of national and EU R&D funding, exploiting their ability to reach out to mixed stakeholder communities (enterprises, research institutes and other actors) as well as to offer supporting services (coordination, administration, promotion and commercialisation of research results).

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[26] Clusters are individuals - Volume II - *ibidem*

According to a recent study[27] led by OSEO (the French national organisation supporting SMEs and mid-caps development) with a group of EU leading regional innovation agencies, clusters may channel R&D funding to cluster companies. The study distinguishes between 5 levels:

- **Level 1**: Developing roadmaps, identifying priority themes for industry and promoting them to governments for priority R&D investments
- **Level 2**: Designing collaborative research project and applying for funding as a cluster or a partnership
- **Level 3**: Screening and promoting research projects designed by cluster members, providing a "cluster label" as a recommendation for funding and/or helping them to get funding:
- **Level 4**: Launching internal R&D projects, with funding by public bodies. The cluster organization designs the projects, coordinates the participants and delivers the results to the cluster members.
- **Level 5**: The cluster organization launches and manages its own R&D call in its area of expertise, using funds provided by public sources.

Based on our research, the analysed clusters channel R&D funding carrying out the activities classified as Level 2, 3 and 4, more or less formally (we have not found evidence of formal "cluster label" initiatives for example). Only the most mature and advanced clusters, operating within highly structured frameworks, seem active at level 1 and 5. This is the case for example of the French clusters Minalogic and Systematic. The Cambridge cluster plays a very important role in helping its members to access R&D funding as well as venture capital funding.
The ERDF and/or Interreg Programs, now including ICT action lines, are also well exploited. Since 2007, The European Regional Development Funds have among their key objectives the support of business networks and clusters, in order to promote regional competitiveness and employment[28]. The cluster programmes in Greece, Hungary and Romania have all had substantial support from the ERDF, including our analysed clusters in these countries. This is also the case of Silicon Saxony in Germany. The Interreg program instead played a critical role in the development of DSP valley.

Tax incentives for R&D

There are not specific fiscal policies for clusters or cluster enterprises, rather the tax incentives for R&D and/ or for innovative start-up or SMEs are considered a favourable framework condition for cluster development. Concerning the countries where our clusters are located, all of them have fiscal incentives for R&D excluding Germany, Romania and Finland (the last one is planning to introduce it from 2013)[29].
France has both a tax credit on research investments and strong reductions on profits taxation for small enterprises launched by young entrepreneurs[30]. The research tax credit (crédit impôt recherche – CIR) is a corporate tax relief measure based on R&D expenses incurred by firms operating in France. The tax credit encourages partnership research in France and Europe by making it possible to deduct expenses incurred on operations subcontracted to French and European public-sector research bodies. There are also

[27] "Channelling RDI funding through excellent clusters" by TACTICS (Transnational Alliance of Clusters Towards Improved Cooperation Support) and ECA (European Cluster Alliance), October 2012
[28] Official Journal of the European Union (2006). Regulation (EC) No 1080/2006 of the European Parliament and of the Council of July 2006 on the European Regional Development Fund and repealing Regulation (EC) No 1783/1999. (Article 5)
[29] Sources: OECD 2010: R&D tax incentives: rationale, design, evaluation; Deloitte: 2012 Global Survey of R&D Tax Incentives, September 2012; "*We're #27!: The United States Lags Far Behind in R&D Tax Incentive Generosity*" report by The Information technology and innovation Foundation, July 2012
[30] Tax credits for research, http://vosdroits.service-public.fr/professionnels-entreprises/F23533.xhtml#N10100 Tax credits for enterprises launched by students or researchers, http://vosdroits.service-public.fr/professionnels-entreprises/F31188.xhtml

limited tax exemptions for companies involved in a R&D project of a "pole de competivité" financed by government.
The UK also has a generous R&D Tax relief scheme which allows subtracting part of R&D costs from corporate taxes, with better conditions for SMEs. On the other hand, Greece has only a small R&D allowance on current expenses.

Regional funding / State Aid

The funding provided by local, regional or national governments to support innovation or ICT components manufacturing activities in the clusters indicated is often used to build facilities or infrastructures needed by the cluster. This funding is most often provided by the local or regional authorities to attract or enable manufacturing activities, often matching R&D or innovation funding. State aid combined with ERDF funds was fundamental for the launch of the ICT components clusters in Hungary, Greece and Romania, as well as in Saxony, Germany.

Private funding

Private funding is not included in the Table 1 above, but clearly it is present in all clusters and plays a critical role, since successful clusters by definition are driven by enterprises. There is a difference between private funding contributed by the enterprises members of the cluster and private funding coming from external sources. Cluster enterprises invest in R&D (independently, or matching public funds), in production facilities, in membership and participation fees of cluster organizations. In some cases, such as the Cambridge cluster, private funding is the most relevant source of funding of the cluster organization. In addition, the most innovative clusters will look for venture and risk capital to launch new enterprises and start-ups. In some cases access to this private funding is abundant (as is the case of the UK clusters). But according to our survey (see Figure 19), access to private capital is not so frequent and easy for most cluster as is access to public funding.

Final considerations

This analysis provides sufficient indication that every cluster is sustained by a mix of funding measures and support policies, related with the socio-economic and framework conditions prevalent in the region. The relevance of the key success factors identified in the previous chapter (strength of cluster actors, access to human resources, access to research and knowledge, and quality of cluster management) is confirmed by this analysis, which underlined how both cluster organizations and cluster enterprises must perform well to gain the funding needed to achieve their objectives. From the point of view of the policy makers, the mapping exercise shows the need to tailor policy and funding measures to the characteristics of the eco-system and the strong points of the main actors of the clusters, showing flexibility and adaptability in time.
In the following paragraph we analyse more in-depth the typology of funding and supporting measures of the analysed clusters. Full profiles of the clusters are in Annex.

6.2.3 Austria

Specific Cluster Programmes

A key initiative in Austria is the National Cluster Platform (NCP), which was established in 2008 on initiative of the Federal Ministry of Economy, Family and Youth. The cluster platform provides a discussion forum which actively contributes to the further development of the R&D and innovation policy in Austria and the link-up to cluster activities at European level[31].

Cluster Me2c (Micro electronics system)

[31] http://www.clusterplattform.at/index.php?id=1&L=1

Me2c is a key cluster in the Austrian ICT components and systems manufacturing sector. The cluster organisation Me2c was established in 2000 in Villach, Austria by Infineon Technologies Austria AG together with the city of Villach and the state of Carinthia, in order to promote strong framework conditions for manufacturing of microelectronics systems in the future.

Funding Measures

The total annual budget of the cluster organization in 2012 was EUR 200.000. The regional authority (State of Carinthia) provides 50% of the funding for the cluster organisation. Membership fees and income from activities such as seminar and conferences contribute with 25% of the budget, and local authorities (the city of Villach) contribute with 12.5% of the budget. The remaining 12.5% of the budget is funded through the organisation's involvement in national and European projects.

Other Funding Sources and Initiatives

In 2012, Me2C joined the project "Silicon Europe" funded by the EU Unions 'Region of Knowledge' programme under FP7 with four other European cluster organisations; Silicon Saxony (Dresden, Germany), DSP Valley (Belgium), Minalogic (Grenoble, France) and Point One (Eindhoven, Netherlands). Other important partners in the Silicon Europe project are a range of important electronics companies such as NXP, Globalfoundries, STMicroelectronics and Infineon. The European Union will provide € 2.8 million over the next three years to the project.

6.2.4 Belgium/Netherlands

Specific Cluster Programmes

The Government Agency for Innovation by Science and Technology (IWT) in Belgium runs a "Competence Centers Light Structures" programme with €19 Million funding in 2012, with the aim to fund research and innovation projects by consortia of enterprises and research centres, with a focus on SMEs. Consortia (networks) of companies or organizations representing at least 20 companies can apply. However, this programme was not the primary source of funding for DSP Valley.

Cluster DSP Valley

The DSP Valley cluster was started in 1996, as a private initiative co-founded by Philips (International Technology Centre Leuven), IMEC and K.U. Leuven. In 2005, DSP Valley decided to expand internationally through a cross-border extension from the Leuven region in Flanders/Belgium to the Eindhoven region in the southern Netherlands, supported by Philips Research and TU/Eindhoven. This expansion was co-enabled by European Interreg 3A-funding, aiming at stimulating cross-border co-operation between neighbouring regions.

Funding Measures

DSP Valley is currently supported financially by the following actors and programmes: IWT Vlaanderen, Flanders Investment and Trade, Interreg Vlaanderen-Nederland, Interreg Euregio Maas-Rijn, Province of Vlaams-Brabant, Province of Noord-Brabant, and Point.One, an association of and for Dutch high-tech companies and research centres that are involved in research and development of nano-electronics, embedded systems and mechatronics.

6.2.5 Finland

Specific Cluster Programmes

A key cluster initiative in Finland is the Nanotechnology Cluster Programme (2007–2013) initiated by the Ministry of Employment and Economy in order to promote nanotechnology based business in Finland. The Cluster Programme is co-funded by EU structural funds and combines technology companies, expertise in universities and

research institutes all over Finland, and aims at applications in industries like ICT, electronics, mechanical engineering, construction, forest, energy, environment, chemical, health and well-being.
Local micro-clusters have been established as part of the cluster programme. There are currently active microclusters in the fields of surfaces and coatings and printed electronics, and micro-clusters are also being established in the fields of photonics and optics and MEMS and Microsystems. The activities of the microclusters vary according to the needs of the members and according to the strategies of the facilitators, but common goals are business development and networking.

Printocent Micro cluster

The PrintoCent microcluster is a key cluster in the Finnish ICT components and systems manufacturing sector. It was founded in 2009 to develop the local innovation eco systems specialised in printed electronics. PrintoCent is a business and production environment for companies to manufacture components, products and solutions based on Printed Intelligent processes. PrintoCent's Pilot Factory reduces commercial and technical risk before fully commercial operation kick off. Today, there are around 180 professionals working in the PrintoCent community. The micro-cluster was founded by VTT Technical Research Centre of Finland, University of Oulu, Oulu University of Applied Sciences, City of Oulu and Oulu Innovation Ltd.

Funding Measures

The majority of PrintoCent operations are performed in specific projects, which all have their own funding structure. These projects typically have funding from government or EU sources and participating companies. PrintoCent is running the €15 million project portfolio for 2009-2012. Until 2011 the companies have invested €2 million in the PrintoCent community and €9 million in spin-offs. At EU level PrintoCent is strongly involved in the VTT coordinated COLAE –project having 17 partners from 12 countries.

Other support measures

The national cluster manager facilitates matchmaking between high-tech clusters and clusters representing potential user industries for collaborative research projects and other initiatives of innovation deployment.

6.2.6 France

Specific Cluster Programmes

The French government launched in January 2013 the third phase of the "Pôles de competitivité" Programme for the period 2013-2018, following an independent evaluation which certified the results achieved by the 71 French competitiveness clusters in the period 2009-2012 (thanks to the €2.7 billion invested by the government). The study concluded that the policy should be continued over the 2014-2020 period and recommended to increase the lead of regions in the governance of the cluster policy, as well as to reinforce the role of clusters and their impact on the SMEs innovation development.
The third phase of the programme will continue the collaborative research and innovation approach, with a greater focus on bringing research to the market (the clusters must become "factories of the future products") and supporting SMEs competitiveness. In addition, there will be greater pressure on the individual clusters to perform. For the next six years, the objectives of each pole will be specified in a contract of individual performance as well as in their strategic plans. This will detail the technological challenges and innovation as well as the associated target markets that the pole wishes to focus on. The French government will establish a special action to support the industrialization of the results of the clusters' R&D projects, with an amount of €110 million.

Programme Funding

The Programme provides direct funding for the management of clusters and co-funding for research and innovation. More specifically, funding is provided:

- Through partial financing of cluster governance structures, alongside local authorities and firms. In the second phase of the programme (2009-2011), the French government granted €50 million to fund the governance and management structures of the 71 clusters (staff, facilities, events, etc.), co-financed by regional and local authorities and by the members themselves (through membership fees).
- By allocating financial aid to the best R&D projects and innovation platforms, through calls for projects from the Single Interministerial Fund and the Investments for the Future Program (with €35 million of funding). On the basis of two calls for proposals per year, the governance of each pôle de compétitivité composed of technical experts pre-select collaborative RDI projects developed by their members that are to be submitted to the inter-ministerial fund and provides them with a "cluster label". The cluster organisation is not responsible for the management and implementation of the RDI projects, but supports the project during its development phase, searching for partners, and ensuring – increasingly – the transnational activities between clusters.
- By providing financial aid for theme-based collective actions, through the intermediary of decentralized government departments. These actions, initiated by the competitiveness clusters in a wide range of areas, involve cluster members, particularly SMEs, with the aim to promote innovation and improve their competitiveness.
- By bringing additional partners on board : the French National Research Agency (ANR) and OSEO provide financing for R&D projects carried out by cluster members; the Caisse des Dépôts et Consignations (CDC) and the Public Investment Bank support innovation platform projects;
- By helping competitiveness clusters and their member firms find the best international partners and set up technological partnerships with them focused on value creation
- By bringing to bear new resources from the Investments for the Future Program earmarked for competitiveness clusters

The balance of R&D funding in the Programme so far has been the following:

- Since 2005, the Programme has funded 1,042 R&D projects for a total investment of €5 billion, of which €1.2 billion provided by the State, €0.6 billion by other public authorities, and the rest by project participants.
- Within R&D projects, the central government contributes to companies between 25% and 45% of costs (depending on their size, with SMEs getting higher funding). For innovation platforms, public funding varies between 15% and 35% (50% for management).
- The national agency OSEO is involved in the implementation of this policy by supporting SMEs and other companies (up to 2000 employees) R&D&I activities, in collaborative research projects "labellised" by the pôles de compétitivité. OSEO has been involved in the support of more than 500 RDI projects valued at around €186 million, covering 60 of the 71 pôles de compétitivité in 2008. Since July 2009, OSEO is also responsible for managing the inter-ministerial fund on behalf of the French national authorities.

The Pôles de competitivité programme has supported the creation and development of two key clusters in the French ICT components and systems manufacturing sector, as follows.

System@tic

The System@tic cluster was formed in 2005 as part of the "Pôles de Compétitivité" programme. Activities of the cluster are focused on IC, MEMS and sensor design as well as industrial products and systems solutions. Systematic brings together more than 650 actors, including enterprises, public agencies, and research institutes, in the Paris Region area. Systematic is an association supported by local authorities, economic development agencies, the French Government and its partners. For 2011 the R&D activities of the cluster have received public funding of a total of €53.2 Million including 25% from the Single Interministerial Fund (FUI), 20% from Paris region local government, 51% from the national research agency and OSEO and 4% from European funds.

Funding Measures

In 2010, Systematic approved R&D&I projects for €341,415, of which 71% funded by partner enterprises and 29% from public funds. In 2011, the cluster approved R&D&I projects for €442 million, of which 54% from private investments (enterprises/ risk capital/ business angels) and 46% from public funds.

Other Funding Measures and Initiatives

The Systematic cluster mission is also to develop an ecosystem helping innovative SMEs to grow into ETI (intermediate size enterprises). This ecosystem brings together 1100 SMEs that represents more than 35 000 jobs in the areas of software, systems, optics and electronics. Systematic animates the action plan Ambition SMEs co-driven by the pole Optics valley and the Chamber of Commerce and Industry Regional Paris-Ile-de-France. It is supported by the European Union (ESF, ERDF), the state (Province of the Ile-de-France, DIRECCTE Ile-de-France) and the Ile-de-France. Each year, this program supports almost 200 SMEs individually around five levers of development: human resources, export, access to private financing, development strategy, "business". Within this programme, 17 SMEs have raised € 20 million, 14 EIP labels were assigned in 2012, and more than 60 SMEs accompanied to export. This is an example of cluster acting at the "level 5" of channelling R&D investments (identified by the Tactics study quoted above) by managing R&D calls.

MINALOGIC

The MINALOGIC cluster at Grenoble is specialised in intelligent miniaturized products and solutions for industry, such as micro- and nano-technologies and Embedded System on Chip. The cluster was formed in 2005. The cluster has 203 members, including 156 enterprises (83% of SMEs), 12 research centres and universities, 15 local public sector organisations, 16 Economic development organisations and four private investors.

6.2.7 Germany

Specific Cluster Programmes

Cluster policy has a long tradition in Germany at federal and regional levels, although the specific policies and initiatives are not necessarily mentioning explicitly the cluster concept. At federal level, the first policy promoting cluster dynamics was introduced in 1995 with the launch of a new funding concept, the BioRegio competition. The main purpose of the BioRegio competition was to encourage local biotech communities to interact more closely and to promote commercial applications. Since then, the federal government has implemented a number of other technology-specific or region-specific cluster schemes, like BioProfile and BioIndustrie 2021 or the initiative Entrepreneurial Regions including the programme Innovative Regional Growth Cores[32].

In 2006, the federal government presented a comprehensive HighTech Strategy, which includes a national cluster strategy encompassing measures with a widespread impact across sectors to modular, region-specific or technology-specific approaches. The Spitzencluster initiative (leading-edge cluster competition) is part of this strategy33. 15 cutting-edge clusters in Germany have been selected through a competitive audition

[32] Europe INNOVA Cluster Mapping Project (2007): Country Report: Germany

[33] Europe INNOVA Cluster Mapping Project (2007): Country Report: Germany

process under this initiative, each receiving €40 million to fund collaborative and cutting-edge research projects involving research organisations and companies in the selected clusters. They do not include the 2 clusters analysed by this study.
A key support measure for clusters in Germany is the Networks of Competence Germany initiative launched by the Federal Ministry of Economics and Technology (BMWi) in 1999. The initiative brings together the most innovative and capable national networks of competence with technological orientation. With the initiative, the BMWi wanted to improve networking between industry and research, support development of (internationally) visible clusters, and by these means market the innovative location Germany both nationally and internationally. In 2012, the initiative was re-focused to support excellence in cluster management under the name 'Go cluster'. Cluster organisations that are members of 'Go cluster' can receive funding up to €25,000 per project for developing innovative service concepts.
The analysis of funding schemes and support measures at cluster level has focused on two key clusters, Silicon Saxony and the Cluster Mechatronik and Automation.

Silicon Saxony

The 'Silicon Saxony' cluster initiatives located in the Dresden area is an example of a structured and coordinated approach to developing the capacities of the regional electronics manufacturing cluster covering key actors in the regional electronics industry and also actors from other parts of the regional ICT industry.

Funding Measures of Silicon Saxony

The cluster around Dresden has mainly been established on the basis of federal and regional funding as well as European structural funds. According to a recent report by Fraunhofer, the cluster has received a total of around €1.5 billion in subsidies for large ICT investors since the early 1990s[34]. In addition to these subsidies for investments, companies and research organisations in the cluster have received funding for R&D&I projects through for instance FP7. Silicon Saxony currently also receives funding from a number of public and private actors.

Cluster Mechatronik and Automation

The Cluster Mechatronik and Automation Association is the successor to the collaborative research project "Bavarian mechatronics competence network" (2000 to 2005) and has 109 members including the six leading Bavarian research institutions. The association was funded as part of the Cluster Offensive Bayern, a regional initiative supporting the establishment of cluster management teams in 19 sectors or technology domains that were already characterized by a cluster structure. The main task of the cluster management teams are facilitating networks and serving as a platform for collaboration between SMEs and research organisations. The Cluster Offensive Bayern is funded by the Bavarian State Government.

Funding Measures

The Cluster organization has 8 employees and a total annual budget of €500.000 in 2012. The regional government provides 60% of the funding for the cluster organisation amounting to €300.000 a year in the context of the regional Cluster Offensive Bayern initiative. Membership fees and income from activities such as seminar and conferences provides the remaining 40% of the funding. In 2015, the public share of the funding for the cluster organisation will be reduced to less than 50%.

Other Funding Measures and Initiatives

The regional government organizes a 'Club of cluster managers' for cooperation and networking.

[34] Fraunhofer ISI (2012): Regional Innovation Report (Saxony), http://www.rim-europa.eu/index.cfm?q=p.file&r=5928d89bc1c00f9b642a8d40d1a9c78a
Fraunhofer (2009): Cohesion policy at the interface between regional development and the promotion of innovation.

6.2.8 Greece

Specific Cluster Programmes

The Corallia Hellenic Technology Cluster Initiative (HTCI) was created in 2006 under the Greek Ministry of Development and the General Secretariat for R&D. The target of Corallia is the development of innovation clusters in different research areas. The HTCI is a public-private partnership, aiming at boosting competitiveness, entrepreneurship and innovation, in knowledge-intensive and exports-oriented technology segments, where Greece has the capacity to build a sustainable innovation ecosystem and can attain a worldwide competitive advantage. The Corallia initiative includes 139 organisations, including Greek innovative companies, academic labs and research institutes, and is co-funded by the European Regional Development Fund and national funds.
Following the June 2012 elections in Greece, the main responsibility for R&D investments and regional development was moved from the Ministry of Education to the Ministry of Development (which has also incorporated infrastructures, transports and networks. The new Ministry is responsible now for the research and innovation policy, the industrial policy, the coordination of public investments on all types of infrastructures and the overall coordination of the Structural Funds support. Centralization should improve efficiency and the capability to invest the EU funds.
R&D funds allocated to the regions have been increased. Based on provisional data, the total amount allocated directly to the regions for R&D measures increased from €33.5m during 2000-2006 to €613.4m for the period 2007-2015, representing 6% of the total budget of the regional Operational Programmes. The significant increase in the regional R&D budget for 2007-2015 compared to 2000-2006, is due to the transfer of part of the national budget to some of the Regional Operational Programmes.
According to the Erawatch country report 2011 for Greece, published in 2013, the funding of innovation clusters has become a promising dimension for improving the innovation climate and facilitating science-industry collaboration. For 2012, €30m are allocated to new measures aiming at creating more innovation intensive clusters.
Corallia's management body is a three member executive board that deals with the day to day management and coordination activities, assisted by 8 other employees.
In October 2010, Corallia was recognized as best practice in implementation of the European Regional Policy projects, in the special edition of the General Directorate of EU Regions. In April 2012, Corallia was the first certified organisation for the evaluation of clusters excellence.

The Nano/Microelectronics and Embedded Systems cluster

The MI-Cluster was the first cluster launched by Corallia. The cluster includes enterprises active in IC, MEMS and sensor design, and industrial products and systems solutions. The cluster was based on an existing ecosystem of companies in Greece with important research and development results in the field of microelectronics.

Funding Measures

The public co-financing of the cluster amounts to €33 million, of which €20 million (32%) come from Corrallia's own (industry) funds and €10 million (16%) from private investments. The National Strategic Research Framework (NSRF) 2007-2013 provided funding for €31 million for 59 co-funded projects by the cluster enterprises, corresponding to approximately 75-80% of total costs.

6.2.9 Hungary

Specific Cluster Programmes

The Hungarian Pole Program for cluster development and for the improvement of the business environment had a budget of €1.5 billion for the period 2007-2013. Roughly €1.1 billion was allocated for the horizontal economic development leg (the pole cities) of the Program and approx. €0.6 billion to the cluster development leg. By mid-2010 (when a new government entered into power) approx. €1 billion had been committed under the frame of the Pole Program.

The Pannon Electronics Cluster (PANEL)

PANEL was founded on 20th March 2002 by 12 public authorities, research organisations and companies, including IBM Storage Product, Siemens, Flextronics International and Videoton Holding. The cluster emerged on the basis of a project co-financed by the European Regional Development Fund and government funding from the National Office for Research and Technology. The Hungarian Pole Program also contributes to support the cluster.

6.2.10 Romania

Specific Cluster Programmes

The Romanian "Cluster" program is run by the Ministry of Economy, Commerce and Business Environment and is being implemented under the Sectoral Operational Program "Increase of Economic Competitiveness", one of the seven instruments (OPs), under the Convergence objective, for achieving the priorities of the National Strategic Reference Framework (NSRF) derived from the National Development Plan 2007 – 2013 (NDP). The aim of the Programme is the development of specific business structures (clusters) around productive activities aiming at increasing the added value of competitive products on national and international markets. The total financial allocation for the period 2007-2013 for the SOP Competitiveness is of €2.55 Billion. The Programme provides grant funding to cluster associations for innovative projects implemented by enterprises and research institutions. SMEs may be funded up to 100% of their costs, while other projects receive partial funding.

MINATECH-RO Cluster

The cluster was created in 2004 and is focused on IC, MEMS and sensor design and front-end (production, process and equipment). During 2004-2005 the cluster received institutional funding through the national INFRATECH Programme, administered by the Ministry of Education and Research (which had a total budget of €27.7 million). The activities of MINATECH-RO are complementary to CTT, the technology transfer institute of IMT-Bucharest and mostly focus on business incubation based on: technology transfer (prototypes, demonstrators or experimental models, small scale/pilot production); technological services, micro-physical characterisation, simulation and computer aided design; training, assistance and consultancy activities for SMEs, facilitating the access of Romanian innovative SMEs to European networks and partnerships.
Key actors involved are the National Institute for R&D in Microtechnologies (IMT-Bucharest), the Polytechnic University of Bucharest (PUB) and the private company S.C. ROMES S.A.

6.2.11 UK

Specific Cluster Programmes

There are no specific cluster programmes in the UK relevant for our analysed clusters. There are two key clusters related to the ICT components and systems manufacturing sector in the UK:

Cambridge cluster, UK

The Cambridge cluster is driven by the Cambridge University and is active on a wide range of high-tech sectors, from IT-telecoms to life science and green tech, as well as microelectronics. It counts 1500 companies with combined revenues of £11.8 billion and 53,000 employees. The South Cambridgeshire area is specialised in manufacturing and engineering. Among the main companies active in the area we can quote ARM Ltd, Microsoft Research, Autonomy, CSR, Domino, Frontier Silicon Ltd, and Schlumberger. ARM is currently the world leader in the design of microprocessors for mobile phones, even though it does not produce directly but licenses its design. The Cambridge cluster includes several other companies in the ARM ecosystem, specialised in chip design (the "fabless" business model, without factories).

Funding Measures

Cluster activities are coordinated by the organisation Cambridge Network, which is private and supported 50% by membership fees, 50% by service fees, with a total turnover of £1 million. The organisation was founded in 1998 and has a broad technology focus, with 1500 members. Its main activities concern organising events and networking, promoting the cluster and supporting the interaction of SMEs CEOs with potential funding partners and other enterprises in the area.

Another key actor in the cluster is Cambridge Enterprise (CE), the Cambridge university company tasked with promoting the commercialisation of Cambridge University research results. In 2012, CE had a £9.1 million income from licensing, consultancy and equity transactions, of which £7.5 million was returned to the University, academics and departments. CE supports the start-up activities in the cluster through technology transfer services, consultancy services for new businesses, and seed funding. The cluster also benefits from the presence of strong financial actors that are critical to the development of early stage companies, and providers of specialised services including technical design consultancies. The financial actors include venture capital firms and business angel networks, and Cambridge has two local VC firms. In addition, London's financial market and its proximity to Cambridge is a great benefit to the cluster.

The cluster has developed organically with minimum help from government initiatives. However, the Southeast economy which Cambridge borders on, has several important public and private sector laboratories, and has consistently received more public R&D funding than any other region in the UK.

Silicon South West

This cluster has 200 members and is managed by SETsquared, a partnership led by five leading UK research universities: Bath, Bristol, Exeter, Southampton and Surrey. Between them, the 7,400 academics working at these universities are responsible for ten per cent of the UK's Higher Education research budget.

The SETsquared Partnership develops new businesses from university research ('spin-outs') and supports early-stage, technology companies with high growth potential from the wider business community. The cluster is managed by the Bath Ventures Innovation Centre, the technology transfer unit of Bath University.

Funding Measures

Similarly to Cambridge, this cluster mainly attracts private investment and bids for public R&D funding. The cluster attracts high level of inward investments from HP Labs, Motorola, Panasonic, ST Microelectronics and Toshiba Telecoms Research Europe all of which have large R&D centres in the region. Intel, Broadcom and Infineon have premises in the region, as well as semiconductor design companies such as Wolfson and Dialog Semiconductors.

6.3 FUNDING MEASURES OF INTERNATIONAL CLUSTERS

6.3.1 Overview of Funding Measures

Industry clusters exist also outside Europe and are actively supported by public authorities, albeit to a varying degree. We have examined closely 3 main clusters:

- Silicon Forest in the US Northwest
- Yang-Tze River Delta in China
- Chungnam & Daejeon in South Korea

The following Table 2 shows a summary overview of the main public funding sources for these clusters, following the same scheme used for EU clusters.
While they do not have cluster policies in the European sense, both the Chinese and the South Korean clusters have strong government support and funding for regional development, R&D and state aid to develop manufacturing facilities. In China, a main source of funding is FDI, and the government offers very attractive conditions for the semiconductor industry in the form of tax exemptions, access to production facilities, cash inflows and subsidies for training activities.

Table 2 Overview of Main Public Funding Sources - International Clusters

	Cluster Policies		R&D and Innovation Policies		
Clusters	Gov Funding for Cluster Organizations	National/ Regional Cluster Programmes	Government funding for R&D	Tax Incentives/ R&D	Regional development funding / State aid
Chungnam South Korea	X		X	X	X
Yangtze River Delta			X	X	X
US Silicon Forest				X	X

Source: IDC 2013

6.3.2 Chungnam & Daejeon, South Korea

State Aid and funding policies

Korea's high economic growth in the last years is bound to the development of innovative sciences and technologies, impelled by its Knowledge-based Innovation Policy and Sustainable Growth Policy and a Basic Science and Technology Plan set out every five years by the government. Science and technology policies are coordinated by the National Science and Technology Committee (NSTC). South Korea encourages its researchers to participate in international research programmes and exchange programmes in the form of joint research. The establishment and partial funding of foreign research institutes in Korea has also been encouraged as a way to increase employment opportunities for Korean researchers. In the last years, the Korean policy mix aims at stimulating greater private R&D investments through a matching fund system, various financial schemes such as technological value based loans, diverse tax incentives and public procurement policies[35].

Cluster Description

Chungnam is the largest center in Korea for manufacturing advanced technologies. Daejeon is the country's major research and development area together with Asan and Cheonan, located near Daejeon. These cities control over 30% of the world market for next generation display technologies.

Funding Measures

Daedeok Innopolis is a government supported IT cluster with investments of more than €21 billion (KRW 30 trillion) over the past 3 decades. The Korean government has

[35] South Korea Mini Country Report, December 2011, special contract with INNO Policy TrendChart with ERAWATCH (2011-2012), by Youngjoo Ko and HoChull Choe, Korea Research Insitute of Chemical Technology

prided itself on steadily increasing aggregate figures for R&D expenditures and numbers of researchers.

The Chungnam Techno Park (CTP) is a public organization jointly founded by the Chungnam provincial government and the Ministry of Knowledge Economy in 1999. CTP plays an important role in developing provincial economy as a regional innovation platform, utilizing the innovative resources such as enterprises, universities, research institutes, governments, and business service agencies. It aims to promote regional strategic industries as well as to nurture technology-based enterprises. CTP operates three research and business development centres for strategic industries, and three agencies for provincial industry planning, business services, and enterprise education program. **CTP has an 80 billion KRW fund for investment and incubating services**, initial business funds support for high-tech businesses, research companies, and promising venture businesses.

Over the past decade, CTP had created over 245 new enterprises, providing 13,000 new jobs with total products of $5 billion. CTP also supported over 115 enterprises with R&D investment and commercialization, which yield 19,500 jobs and total products of $4.6 billion.

7 RECOMMENDATIONS

In this chapter, IDC and FORA present a number of policy recommendations based on the findings from the desk research, expert interviews, the survey of cluster companies and the in-depth case studies carried out. A number of recommendations concern aspects of industrial policy that can support the ICT components and systems manufacturing sector as a whole. However, there is a clear cluster dimension to these recommendations as their implementation can be used strategically to support the competitiveness of existing European clusters involved in ICT components and systems manufacturing.

As the analysis of key success factors concluded, clusters' performance depends on the right mix of success factors, building on the specific socio-economic conditions where the cluster operates. Similarly, no single policy can guarantee the success of clusters: policy makers should be aware that the most effective approach is to select a portfolio of policy instruments, tailored to the strengths and weaknesses of the different countries, regions and clusters.

Based on our analysis, the following are the main policy dimensions relevant for clusters:

- Innovation and R&D policy are the most relevant, shaping specific cluster policies and programs and determining the general context of clusters creation and development. These policies need to be harmonized at the EU, national and regional level;
- ICT industry policy, Education and training policies and Financial policies (particularly for high tech funding) also need to be aligned with cluster policies, to make sure that cluster enterprises are not disadvantaged compared to global competition, have access to the necessary capital and to the right type of skills.

The EU and main MS already have a wide array of policies for clusters, many of whom are well designed and should continue to be implemented. Our recommendations review these main policy areas, highlighting the main gaps and weaknesses emerging from our analysis which could be improved.

7.1 INNOVATION POLICY

Challenges

Europe is strong in research and development relating to specific segments of ICT components and systems, in particular electronic devices. According to European Competitiveness Report 2010, European applicants dominate the market for electronics devices patents, but are weaker in bonds/crystals and semiconductors. From a European perspective, the fact that East Asian applicants account for almost half of all EPO/PCT applications in semiconductors suggests that further efforts are needed here to keep the European semiconductor industry competitive.36 A further challenge for Europe is to build up structures supporting the industrialisation of research and knowledge in Europe. This is extremely important for supporting emerging technologies such as printed and organic electronics, where Europe has the potential to develop a competitive edge.

In terms of innovation challenges, Europe needs to better exploit research and knowledge by promoting collaboration between industry and research, supporting spin-out activities from university and industry, and providing support for entrepreneurs. Clusters constitute a strong framework for such activities. However, the case studies carried out in this study suggest that stronger efforts can be made at cluster level to support innovation activities and entrepreneurship.

Cluster organisations in Europe face a challenge with regard to funding for their activities. This limits their impact on the strategic development of the clusters. The experiences

[36] European Commission (2010): *European Competitiveness Report 2010*.

with the Pôles de competitivité programme in France as well as regional initiatives such as Cluster Offensive Bayern in Germany suggest that financial support for the establishment of strong cluster organisations combined with funding for collaborative R&D&I projects is a successful approach to the development of competitiveness. Also, the collaboration between clusters in Europe requires a strong EU platform to help ensure that Europe can develop critical mass and avoid duplication of R&D&I efforts in strategic industries such as ICT components and systems.

Policy recommendations

1) Strengthen support for innovation and entrepreneurship in clusters

- Promoting the commercialisation of research through technology transfer and spin-out activities from research organisations and established companies.
- Support the launch of accelerator programmes and the establishment of support measures for entrepreneurs at cluster level. Cohesion funds as well as the EIF can play a vital role in this regard by providing co-funding for accelerator programmes.

2) Increased focus on demand-side measures to support innovation in Europe

- Promote the use of cross-border pre-commercial public procurement and support the exchange of international best practice to promote efforts Europe.

3) Continued support for European platforms for cluster collaboration

- Provide further support to the EU initiatives and platforms promoting the collaboration between clusters, such as Silicon Europe

4) Promote quality of cluster management

- Provide co-funding for cluster organisations in clusters that are vital for increasing EU competitiveness in the ICT components and systems industry. The funding should help cluster organisations in building up in-house competences and helping them developing their activities and services to cluster members.
- Support the improved monitoring and benchmarking of cluster performance as well as promote exchange of best practices between cluster organisations in the ICT component and systems industry. Link funding to performance results of the cluster management organization and the cluster itself, as the Pôles de competitivité programme will do in the third phase after 2013.

7.2 R&D POLICY

Challenges

Our analysis of the clusters best practices on a worldwide level raised several challenges for the ICT components industry in Europe regarding R&D policy for ICT Components & Systems companies:

- Helping industry to accelerate the commercialization of technology, i.e. strong support in the later phases of the R&D value chain;
- Improve technology transfer and collaboration between R&D institutes and industry, e.g. through research and business clusters;
- A policy mix of technologically / thematically focused measures, and financial / tax incentives for R&D that follow a wider strategy or (industrial) policy;
- A need to improve the handling of Intellectual Property Rights;
- Capture growth opportunities.

It has to be noted that very often, support measures are embedded in more horizontal initiatives and not so much focused on R&D in the area of ICT component and systems.

Type of policy

According to the survey results and interviews, main identified policies on R&D relevant for our analysed clusters are:

- National ICT research programmes;
- The European Framework Programmes, especially collaborative projects and networks of excellence;
- Collaboration funding, especially between research institutes and companies or between actors in the value chain like in the Semiconductor Equipment Assessment initiative and its successors;
- Different form of cluster initiatives and technological platforms;
- JTIs;
- European Technology platforms and associations because there are perceived to support stakeholder in putting forward R&D priorities, building networks and coordinate research activities.

But overall, most clusters stakeholders named above all support measures on a national level as well as on a regional level as it is the case in cluster initiatives and innovation platform with the FUI (French Single Interministerial Fund) and OSEO funding for the "Pôles de Competitivités" initiative in France.
However, criticism was mentioned that even if there were incentives for production lines in Member States these would be blocked by DG Competition for reasons of distorting competition.

What is being done now?

Europe Horizon 2020 strategy aims at raising the level of excellence in Europe's science base and ensuring a steady stream of world-class research to secure Europe's long-term competitiveness. It will support the best ideas, develop talent within Europe, provide researchers with access to priority research infrastructure, and make Europe an attractive location for the world's best researchers.
To achieve these objectives Horizon 2020 will:

- Support the most talented and creative individuals and their teams to carry out frontier research of the highest quality by building on the success of the **European Research Council (ERC)**;
- Fund collaborative research to open up new and promising fields of research and innovation through support for **Future and Emerging Technologies (FET)**;
- Provide researchers with excellent training and career development opportunities through the M**arie Curie Actions**;
- Ensure Europe has **world-class research infrastructures** (including e-infrastructures) accessible to all researchers in Europe and beyond. As example,

What should be done?

Recommendation n°1

In most of the ICT component & Systems manufacturing activities, it seems essential for Europe to close the gap between Research and Innovation by combining R&D funding instruments and industrial policy measures. This should include more generous tax incentives for private R&D investments, as done in the US, China and South Korea;
A prerequisite for this to be manageable and efficient is a close cooperation, careful weighting of arguments and a concerted action that should be supported by all relevant Directorate Generals, in particular DG Connect, DG Research and Innovation and DG Enterprise and Industry and DG Competition.

Recommendation n°2

Europe needs a clear decision on supporting ICT Component & Systems manufacturing backed up by a joint strategy between EU bodies and Member States.

Recommendation n°3

Support and incentives should be beneficial to all actors along the value added chain. The focus could be put on addressing emerging, high growth or enabling and structuring technologies and applications to optimize the impact of support actions on the economy and the society as a whole.

Recommendation n°4

There is a need to ensure that Europe has an attractive industrial policy providing the framework to maintain and attract further manufacturing jobs in the region.

Recommendation n°5

The Marie Curie programme could be further enhanced to cater for advanced manufacturing careers, as well as for research careers.

Recommendation n°6

It is important to increase the awareness and attract students to a wide range of technological disciplines, as micro- and nano-electronics should not be considered in isolation in the context of education.

7.3 FINANCIAL POLICY

Challenges

A variety of funding instruments are being used in EU Member States to promote R&D&I and manufacturing activities in European clusters. However, a public consultation report by PWC in 2012 has listed the five 5 measures that are considered to be necessary to create, expand and keep semiconductor clusters in Europe competitive:

- Technology transfer from research organisations to companies;
- R&D&I policies;
- Tax incentives;
- Innovation and industrial policy regimes; and
- Reform of the State Aid rules in Europe

The Member States decide themselves how to best support R&D&I and manufacturing activities through national tax policy and state aid. The EU can on the other hand support clusters and companies in the ICT component and systems industry in Europe by leveraging national initiatives and by launching measures that complement national efforts.

In this study, IDC and FORA have analysed the specific funding sources for companies in the ICT components and systems industry. The analysis indicates that EU funding sources and private funding sources such as venture capital funds are not used as much as national and regional funding for the emergence and development of ICT component and systems manufacturing clusters in Europe. The European Commission can consider different actions to increase the use of EU and private funding sources.

Policy recommendations

1) Promote the use of EU and private funding sources

- Promote the use of EU funding sources through calls for proposals under Horizon 2020 that are dedicated to clusters, research organisations and companies in the ICT component and systems industry.
- Promote the use of private funding sources by engaging with the private investor community and establishing a co-investment vehicle targeting the European ICT components and systems industry.

7.4 VENTURE CAPITAL AND HIGH TECH FUNDING

Challenges

Our analysis of the clusters best practices on a worldwide level raised several challenges for the ICT components industry in Europe regarding Venture Capital and High-tech funding for ICT Components companies:

- The regulatory situation varies widely in Europe from country to country and the market is fragmented along national lines, making difficult to make European cross-borders investments
- Very few European clusters stakeholders have access to Venture capital measures in Europe compared to the US or Asia
- During the five first months of 2012, 78% of the semiconductors funding went to North America, 17% to Europe and 5% to Asia 37
- The semiconductor ecosystem is drying up fast and the venture capital sector has abandoned the semiconductor industry because too many start-ups in the past have taken too much money and took too much time to get to market. Expensive development and delayed return have compelled venture capitalists to take their business elsewhere.

Type of policy

The main policies on Venture Capital have to be part of the EU Single market initiatives and more specifically the UCITS Directive (Undertakings for Collective Investment in Transferable Securities).

What is being done now?

Europe 2020 strategy proposed in its agenda to greatly facilitate direct business access to capital markets and explore incentives for private sector funds that make financing available for start-up companies, and for innovative SMEs. With its recent Communications on Europe 2020 Strategy, Small Business Act, Innovation Union and most importantly Single Market Act, the Commission committed itself to adoption of new rules, ensuring that by 2012 venture capital funds established in any Member State can invest freely throughout the EU. Member States were invited to remove tax obstacles so that tax treatment in different jurisdictions would not lead to double taxation for cross-border VC investments.[38]

What should be done?

Recommendation n°1

Support clusters in the development of research and development strategies focused on the commercialisation of the results of research, able to attract risk capital. This may require focusing on smart design and small improvements of ICT Components, suitable to be brought to the market with small amounts of capital.

Recommendation n°2

Develop funding measures helping universities/public labs to invest into cutting edge research for ICT components (for example in the new materials and potentially disruptive technologies such as graphene, or in next generation manufacturing of 450mm), as well as into the provision of prototyping facilities and pilot lines, providing access to local enterprises, on the basis of public-private partnerships. This may include allowing the industrial partners to buy into the equipment used, after a pre-determined time.

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37 Source: Global Semiconductor Alliance, Funding, IPO and M&A Update

38 "Although the bilateral double taxation conventions between Member States should normally prevent these difficulties, they may not always cater for the complex commercial structures used in VC investment". Source: European Commission An action plan to improve access to finance for SMEs Brussels, 7.12.2011, COM(2011) 870 final

7.5 ICT INDUSTRY POLICY

Challenges

In order to achieve competitiveness, EU clusters need similar business conditions as the clusters outside the EU. As discussed above, the US and many Asian countries are providing substantial subsidies to companies involved in ICT components and systems manufacturing, and are successful in attracting R&D and manufacturing activities. EU clusters need to be able to match these business conditions in order to keep R&D and manufacturing activities in Europe. The High Level Expert Group Report on Key Enabling Technologies (KET HLG, 2011) for example recommended the introduction of a matching clause into general EU State Aid rules, which would allow Member States to match funding up to the maximum levels of support provided elsewhere for product development and manufacturing activities while respecting WTO rules.

Public and private investments in European pilot lines and joint test and demonstration facilities can provide an infrastructure for R&D and manufacturing activities that can help maintain Europe's manufacturing capabilities in ICT components and systems and ensure that Europe continues to be an attractive location for companies in this sector. Pilot lines and test- and demonstration facilities support scale-up activities and the industrialisation of emerging technologies such as printed electronics. Furthermore, the case study of the PrintoCent cluster in Finland shows that such test and demonstration facilities can have a positive effect on the start-up of new innovative enterprises.

A very relevant strategic move would be for Europe to fund the development of a 450mm joint-fab model in Europe (Eurofab450) co-funded by the EU[39]. This strategy would require a very high level of investments, which is unlikely in the current negative economic conditions. Nevertheless, the EU industry will still have to deal with the transition to 450mm, and the funding of pilot lines and test and demonstration facilities, too costly for a single company or a single cluster to develop on its own, is a key enabling condition to maintain the competitiveness of the fabless enterprises now prevailing in the EU ICT components industry (such as ARM).

Policy recommendations

1) Increase attractiveness of European clusters as a location for companies in entire ICT components and systems value chain

- A European matching clause for investment aid to match the aid packages outside Europe
- Develop FDI and local development measures, suitable to attract multinational companies and support the growth of local companies

2) Support scale-up activities and the industrialisation of emerging technologies

- Co-funding for European pilot lines and joint test and demonstration facilities targeting key enabling technologies that 1) operate on a not for profit basis and 2) provide access to all European companies interested in using the facilities. The investments in such infrastructures should be guided by a joint European strategy to avoid duplication of efforts.

Good practice case: US Regional institutes for manufacturing Innovation (IMIs)

The Obama Administration has proposed creating a network of up to 15 regional Institutes for Manufacturing Innovation (IMIs) in the fiscal year 2013. Funded by a one-time $1 billion investment this network — the NNMI — will help close the gap between R&D activities and the deployment of technological innovations in domestic production of goods[40]. Among the proposed IMIs is one on manufacturing scale up for flexible electronics[41].

IMI activities may include, but are not limited to applied research and demonstration projects that reduce the cost and risk of commercializing new technologies or that solve generic industrial

39 450mm semicon prototyping report (SMART 2010/062)

40 http://www.commerce.gov/news/press-releases/2012/08/16/obama-administration-announces-new-public-private-partnership-support

41 http://www.whitehouse.gov/sites/default/files/microsites/ostp/amp_final_report_annex_2_shared_infrastructure_and_facilities_july_update.pdf

problems, education and training at all levels, development of innovative methodologies and practices for supply-chain integration, and engagement with small and medium-sized manufacturing enterprises.
A pilot Institute for Manufacturing Innovation has already been established to provide a proof-of-concept for the IMIs. The establishment of the National Additive Manufacturing Innovation Institute (3-D printing) in Youngstown, Ohio was formally announced on August 15 2012. The consortium behind the National Additive Manufacturing Innovation Institute includes manufacturing firms, universities, community colleges, and non-profit organizations from the Ohio-Pennsylvania-West Virginia "Tech Belt." The consortium was selected through a competitive process led by the Department of Defense and will receive an initial $30 million in federal funding, matched by $40 million from the consortium itself[42].
The NNMI program will be managed by the interagency Advanced Manufacturing National Program Office (AMNPO). Participating agencies include the Department of Defense, Department of Energy, Department of Commerce's National Institute of Standard and Technology (NIST), NASA, the National Science Foundation, and other agencies. Industry, state, academic, and other partners will co-invest in the IMIs[43].

7.6 EDUCATION AND TRAINING

Challenges

Our analysis of the clusters best practices on a worldwide level raised several challenges for the ICT components industry in Europe regarding education and training:

- World class ICT components clusters require high qualified engineers
- Competition is fierce between world class clusters in ICT components and access to a qualified work force is one of the key success factors, especially in the case of establishing a new manufacture
- Careers in the semi-conductors field must be seen by European researchers and students as valuable, with strong innovation potential, as Europe may have to face with a lack of competencies compared to other regions such as the US and Asia.

Type of policy

The main policies on Education and training should take part within the Europe 2020 key initiatives, and more especially the "Innovation Union Information and Intelligence system" (I3S).
We recommend to extend what is already be done now (see below) to the specific field of ICT Components careers and to launch some other initiatives (see § what should be done?).

What is being done now?

Commitment 2-B from I3S on Knowledge Alliances and Skills for Innovation proposes to support business-academia collaborations through the creation of "Knowledge Alliances" between education and business to develop new curricula addressing innovation skills gaps (see also commitment 3 on e-skills). They will help universities to modernize towards inter-disciplinarily, entrepreneurship and stronger business partnerships.
I3S also proposes to develop training e-skills for innovation and competitiveness, based on partnerships with stakeholders. This will be based on supply and demand, pan-European guidelines for new curricula, quality labels for industry-based training and awareness-raising activities.

What should be done?

Recommendation n°1

Enhance collaboration between universities and ICT companies focusing on:

[42] http://www.nist.gov/director/pilot-082112.cfm
[43] http://www.manufacturing.gov/nnmi_overview.html

- Collaboration and inputs from the companies about the research programs that have to be developed by research institutes in order to ensure a stronger and quicker commercialisation of ICT Components products
- Development of shared facilities and cross-investments between universities and companies on ICT components infrastructures
- Training

Recommendation n°2

Develop a European education centre of excellence on ICT Components through cross-university collaboration based on the EU University rankings established in Europe 2020:

- Indicators should focus on teaching & learning, research, knowledge transfer, international orientation and regional engagement of universities on ICT Components (Silicon Europe can be seen as an example of collaboration between world-class European entities)
- The topics selected by the universities should also be in line with the main opportunities of development, as raised by the ICT Man report for example

Recommendation n°3

Favour the development of specific training/education programs related to some key issues for the success of ICT Components clusters including:

- Coaching/training for entrepreneurs and/or for researchers willing to develop spin offs
- Training for professionals responsible for cluster animation and inter-cluster coordination
- Support and training on commercialisation of products and technology in order to close the gap between research and innovation.

Example
GlobalFoundries is hiring about 100 people a month to work in Dresden, and is "looking all over Europe," including in Poland and the Czech Republic, for the "highly specialized technical and engineering skills" needed to expand the foundry's operations, said Jens Drews, a GlobalFoundries government relations executive based in Dresden. "The graduation rates for engineers in Europe are not high enough to sustain successful clusters of manufacturing," Drews said.
Ironically, the two U.S.-based companies operating in Europe, Intel and GlobalFoundries, are expanding aggressively near Dublin and Dresden, including recruitment campaigns. Intel currently has 300 Irish workers in the United States for training, preparing for a technology upgrade in Leixslip, and is recruiting in Ireland, said Leonard Hobb, engineering research manager at Intel Ireland. Given that neither NXP Semiconductors nor Infineon Technologies are likely to build 300-mm fabs again, the question is: What will STMicro do?
Source: Semiconductor Manufacturing & Design Community — March 6th, 2011

Tax Incentives

The corporate tax rate in South Korea ranges from 11% to 24.2% (dependent upon the taxpayer's tax base). South Korea offers a general tax credit for R&D expenditures, plus an additional credit for expenses incurred for investments in R&D equipment. SMEs have higher tax credits, up to 30% depending on the type of investment or program[44].

7.6.1 Yang Tze River Delta

Cluster Description

The Yang Tze River Delta (YRD) Economic Zone encompasses Shanghai municipality, 7 cities in Zhejiang province and 8 cities in Jiangsu province.
From 1997, provinces in Yangtze River Delta region started promoting the integration of the regional economy, encouraging the free flow of goods and resources within this area, in order to overcome market fragmentation and protectionism. To achieve this goal, the

[44] Source: Deloitte 2012 Global R&D Tax survey

Yangtze River Delta founded the City Economic Coordination Committee and established the joint conference system attended by 16 mayors of the city members. In 2008, the Yantze River Delta region Economic Cooperation was promoted as a national strategy.

Funding Measures

A key organization promoting innovation in the cluster is the Shanghai Zhangjiang Hi-Tech Park, located in the middle park of Pudong, a new area of Shanghai, with integrated circuits and software, bio-pharmaceutical as leading industries. Innovation is also expected to play a significant role in this high tech park. Major information technology firms have premises in this park, including HP, Lenovo, Intel, Infineon, IBM, Infosys and SAP. Manufacturing dominates the near region of Kunshan, located in the South of Yangtze River Delta.

The YRD economic zone is an attractive destination of foreign investment and takes the leading position in foreign trade in China. In terms of Foreign Direct Investment, for example, in 2008, 34.6% of the foreign funded projects in China chose the YRD economic zone as an investment location.

The development of this region is heavily relying on Foreign Direct Investment and government support:

- For the start-up phase of the cluster, the poorly developed domestic capital markets and limited domestic venture capital mean that most companies must rely on foreign capital. The foreign investments coming into the industry have generally been directed to Interface Circuit design companies but further capital is still needed to fund start-ups in other areas of the value chain such as packaging and testing.
- Regarding the later phase of the cluster development, foreign investments are still the primary source of fund. For foundries, there seems to be no lack of capital as many new foundries are being built.

Tax Incentives

China offers a host of tax and other incentives. The corporate tax rate is 25%. The R&D incentives are offered in the form of income tax deductions and reductions in enterprise income tax rates[45]. There is a "super" tax deduction equal to 150% of the qualifying R&D expenses; reduced 15% corporate tax rate for companies granted High and New Technology Enterprise (HNTE) status. HNTE status must be applied for and renewed every 3 years, and the IP must remain in China. The reduced rate of 15% also applies to qualified Technology Advanced Service Enterprises in designated cities with over 50% revenue derived from providing qualified technology advanced services outsourced by foreign entities. (This incentive is available from July, 1, 2010 through December 31, 2013.) Technology and software companies are eligible for further tax reductions.

7.6.2 The US Northwest Silicon Forest

Funding Measures - State Aid

While there is no federal cluster programme in the US, state governments compete fiercely through the provision of relocation and retention subsidies taking a variety of forms: credits for creating jobs, taxpayer-funded workforce training, property-tax abatements, assistance with land acquisition (which is often given away) and site development, tax incentives for R&D expenditures (see below), sales-tax refunds on machinery or energy used in manufacturing, credits for redeveloping brown fields or opening a business in a poor district. States can provide discretionary funds to specific companies for specific companies. According to a 2012 study by the Pew Centre46, only 13 states rigorously assess the results of tax incentives and modify their decisions on the basis of these data.

[45] Source: Deloitte 2012 Global R&D Tax survey
[46] http://www.pewstates.org/research/featured-collections/state-tax-incentives-for-economic-development-85899436144

Cluster Description

The US is home to a number of strong ICT component and systems manufacturing clusters, including Silicon Valley, the Austin cluster and Silicon Forest in Oregon. The Silicon Forest is a nickname for the cluster of high-tech companies located in the Portland metropolitan area in the U.S. states of Oregon and Southwest Washington, and most frequently refers to the industrial corridor between Beaverton and Hillsboro in northwest Oregon.

The high-tech industry in the Portland area dates back to at least the 1940s, with Tektronix and Electro Scientific Industries as pioneers. In the early days, the main products of Oregon's Silicon Forest were test and measurement instruments. In the late 1980s and early 1990s, the focus was on product diversification. Since then, the profile of the Silicon Forest has centred on silicon wafer manufacturing, semiconductor design, and display technologies. The Silicon Forest is now one of the most diverse high-technology industry clusters in the nation.

Funding Measures and Cluster initiatives in Oregon

In the case of Oregon, there is a wide array of tax incentives to attract enterprises and qualified human resources to relocate to the state, managed by the state economic development agency Business Oregon.47 For example, Intel is receiving from 2010 a tax break of $579 million in property taxes over 15 years, thanks to an investment of at least $25 billion in Oregon.

In addition, the Oregon Business Council since the year 2000 has started developing an annual Oregon Business Plan (OBC), which is a state-wide policy agenda for economic development. The OBC also launched in 2005 a Oregon Industry Cluster Network ("Cluster Network"). The Cluster Network was created to coordinate and strengthen state-wide traded sector industry clusters in order to grow the economy and create high-paying jobs and is one of the initiatives identified by the Harvard Business School "Cluster Mapping Project in the US" launched by Michael Porter[48]. The Cluster Network was active until the end of 2012 and now seems to be relatively inactive.

It is unclear to what extent the Cluster Network supported the Silicon Forest cluster, which already had a very strong momentum of its own, but it certainly contributed to create favourable framework conditions in the state.

The OBC certainly helped to improve the innovation capability of the state (which does not have highly recognized universities) supporting the creation of new R&D labs such as ONAMI (Oregon Nanoscience and Microtechnologies Institute), Oregon's first Signature Research Center. ONAMI is now a nationally recognized collection of laboratories, including the Lorry I. Lokey Nanotechnology Laboratories, one of only two such facilities in the U.S. Their researchers helped to create a new generation of companies such as Zaps Technologies in the nanotechnology field.

Tax Incentives

Tax credits are provided for qualified research expenses, i.e., the tax credit offsets federal income tax and the income tax in states offering research credits. However there are several limitations and the final amount of tax credit is never over 9%, according to Deloitte 2012 Global Survey of R&D Tax Incentives. A report by the Information technology and innovation Foundation, July 2012, complains that the US is only 42nd in a long list of countries providing tax incentives for R&D, with a low level of incentives. However, state governments may add additional tax credits on top of the federal ones.

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[47] http://www.oregonbusinessplan.org/About-the-Plan.aspx; http://www.oregonclusters.com/

[48] "Mobilizing Oregon Clusters", Prepared for the Oregon Business Council by Elizabeth Redman, Cross Sector Strategies, Fall 2012, in cooperation with the Harvard Business School "Cluster Mapping Project of the US" http://blog.lib.umn.edu/slpp/regionalities/ OregonClustersCaseStudy%20FINAL %209%2019%2012%20(4).pdf

7.7 IMPORTANCE OF FUNDING SOURCES

Access to funding is a major challenge for companies in the European ICT components and systems manufacturing industry. For policy makers it is relevant to understand the existing funding sources for the industry and explore potential funding sources that may be able to provide additional support for investments in R&D&I and manufacturing.
The survey of cluster companies analysed the type and relevance of funding sources perceived by the cluster companies, according to the following three categories:

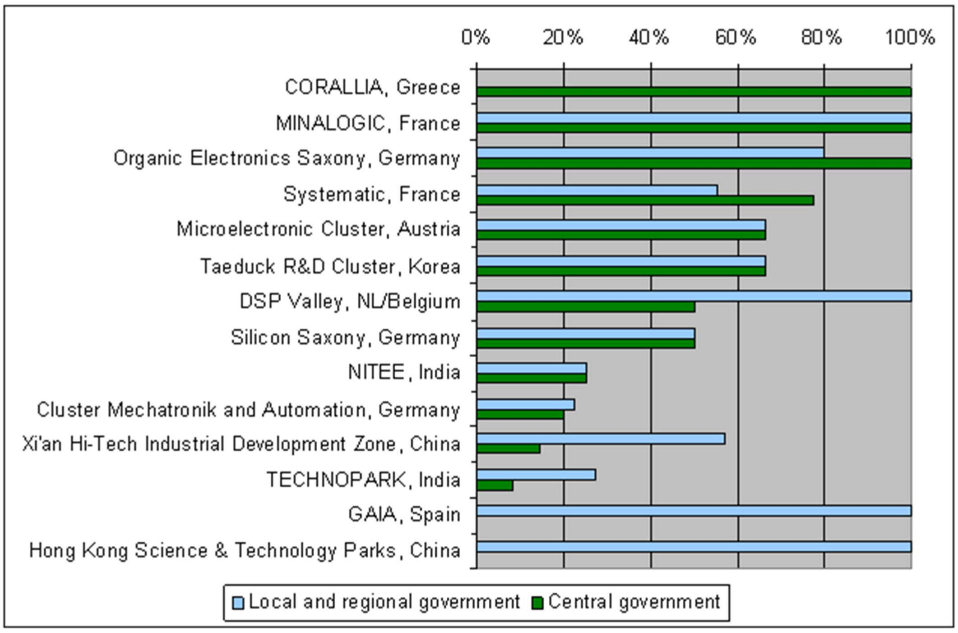
- Funding from central government or regional authorities
- EU funding sources
- Private funding sources

Although we cannot compare the total amounts received from different funding sources, the survey provided the basis for an assessment of the relative use of various funding sources.

7.7.1 Survey results on Funding sources

Government funding covers research grants and direct/indirect subsidies, while funding from regional authorities to a larger extent are provided as subsidies. The majority of respondents have benefited from both government funding and funding from regional authorities, as shown by Figure 18.

Figure 18 Share of Companies in individual clusters indicating that they have received funding from central or regional government



Source: EC Cluster Survey FORA/IDC, 2012

Among French respondents, the national innovation agency OSEO49, a key actor of the "Poles de competitivité Programme" is often mentioned as a key funding source. In Germany, the State of Saxony and in the UK, Advantage West Midlands, a regional development agency, are mentioned as regional funding sources.

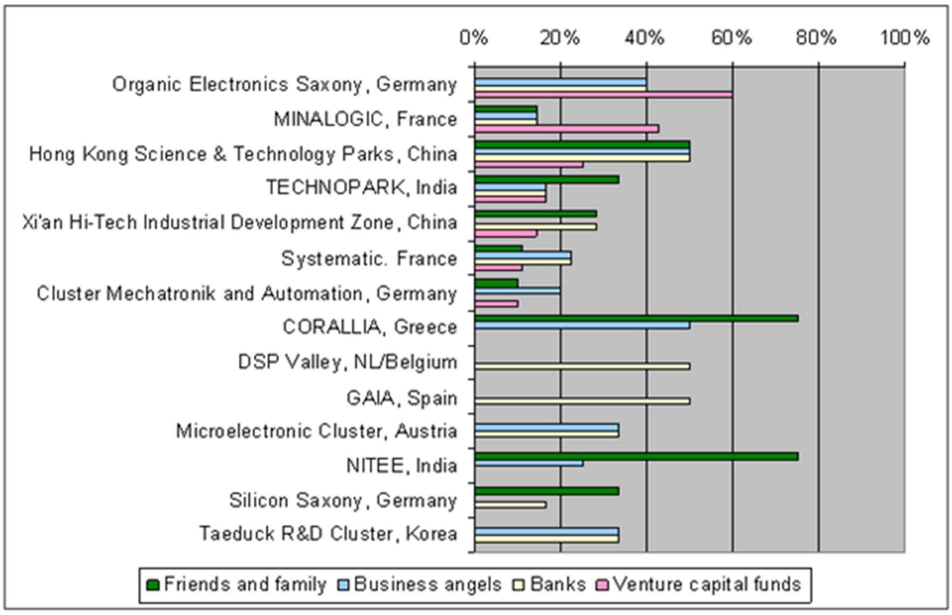
[49] OSEO was created in 2005, by bringing together ANVAR (French innovation agency) and BDPME (SME development bank), around a mission of general interest supporting the regional and national policies.

In terms of relative frequency (not amounts), EU funding is quoted less often as a funding source by companies, compared to national and regional funding. With regard to the different EU funding sources, the European Framework Programmes for Research has provided funding for companies in a number of European clusters, while the European Investment Bank is a less important European funding source for cluster companies.

The survey of private funding sources (Figure 18) indicates that they are less used by cluster companies than public funding and EU funding. Among the private funding sources, a relatively large share of respondents has received funding from banks.

Interestingly, venture capital is among the least important private funding sources. Also, the importance of venture capital varies between the clusters. This can be a result of differences in the national venture capital markets as well as differences with regard to the funding needs and investment potential of the companies in the clusters. The differences with regard to the use of funding from business angels and venture capital funds in two German clusters, Organic Electronics Saxony and Silicon Saxony, may be a result of qualitative differences between these two clusters with regard to maturity of the companies in the two clusters as well as differences in technological focus.

Figure 19 Share of companies in Individual clusters indicating that they have received private funding

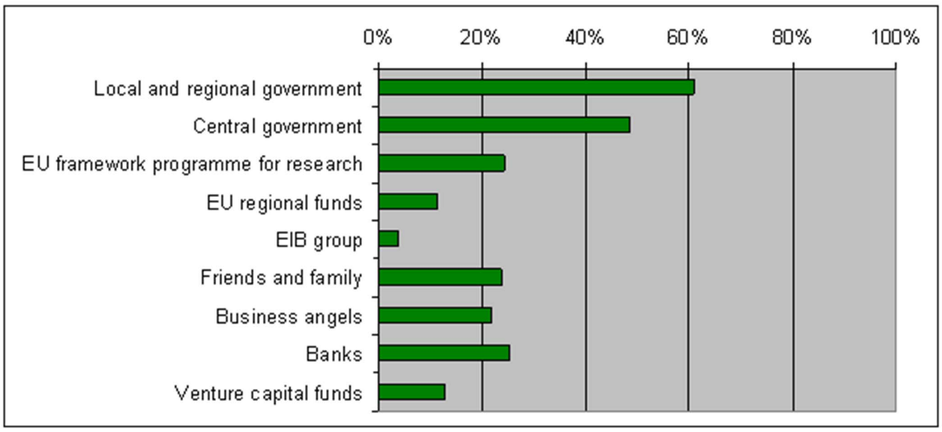


Source: EC Cluster Survey FORA /IDC, 2012

7.7.2 Ranking of funding sources

Overall, the most important funding source for cluster companies covered by the survey appears to be regional authorities followed by the central government. Other funding sources are currently less important for cluster companies. These funding sources on the other hand constitute an opportunity for companies in the ICT components and systems manufacturing industry for getting access to funding.

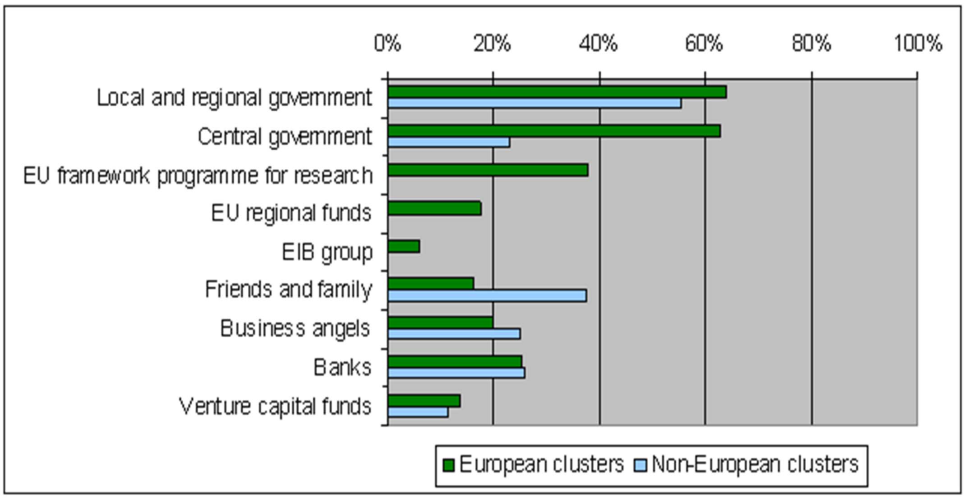
Figure 20 Average shares of cluster companies indicating that they have received funding from specific sources



Source: EC Cluster Survey FORA /IDC, 2012 *Note: Number of respondents = 78.*

Comparing European clusters with non-European clusters, we found that funding from central government is more frequently quoted by companies in European clusters than in non-European countries. For companies in non-European clusters, funding from friends and family and to some extent also from business angels plays a more important role than in the case of EU clusters.

Figure 21 Average share of cluster companies by type of funding received - EU versus non-EU clusters



Source: EC Cluster Survey FORA /IDC, 2012

7.8 Conclusions

The analysis of funding and support measures has shown that there is a different mix of policy tools in each country, used to support the emergence and development of the ICT components clusters. However some common elements emerge:

- The two main funding sources are specific cluster policies and R&D funding (including EU funding). Regional/state funding plays a critical, but complementary role, particularly to sustain facilities and infrastructures. The ERDF and programs such as Interreg play an important role particularly in Eastern Europe and for cross-border initiatives. Tax incentives generally play a complementary role, even though they exist in almost all MS.

- Most EU MS have national cluster policies providing funding and technical support; some of them are highly structured (France, Germany) and provide funding for the cluster management organization, coordination and networking activities. Only the UK and Ireland prefer a pure private-led model, providing only R&D tax credits. However, also Germany and France are putting pressure on the cluster management organizations to improve their performance and encourage them to provide value-added services in exchange for membership and participation fees (as Cambridge Network already does).
- Most ICT component clusters are industry-driven, that is industries, rather than research institutions, dominate their choices and development strategies, with a strong focus on innovation, business development and manufacturing. Nevertheless the funding models are not so different, since research-driven clusters are also focused on bringing research results to the market and fostering start-ups (Cambridge, Printocent), while industry-driven clusters have strong collaborations with universities and research institutions. Research-driven clusters are more likely to foster knowledge-based business models, for example the "fabless" companies like ARM focused on design and licensing IPRs.
- Clusters are becoming a favourite channel for national and EU R&D funding, thanks to their ability to reach out to mixed stakeholder communities and to organize collaborative research, as well as offer pragmatic services. R&D funding is always based on competitions (Spitzencluster initiative in Germany) or competitive calls for proposals (France). Nevertheless, the last evaluation of the " Poles de competitivité Programme" highlighted the need to increase the focus on bringing research results to the market, which is not happening as much as hoped. From now on the French authorities will institute a system of "contracts" with the individual clusters to specify strategies and objectives to be achieved.
- National and EU governments are also starting to leverage the clusters' capability to design roadmaps, select research priorities, and act as intermediaries for competitive funding distribution to small enterprises. This is particularly clear in France, where clusters such as Systematic even manage calls for proposals and distribute funding to SMEs.

Public funding is the main funding source for clusters

The analysis of the various approaches to supporting clusters in Europe shows that government funding and funding from regional authorities have played a major role in the establishment and development of clusters. EU funding have also been used albeit to a lesser extent, and there are only few examples of clusters in which companies are using private funding sources. This suggest that there is a funding potential that has now yet been fully explored, in particular with regard to EU funding and private funding sources.

European vs non-European cluster models

Both China and South Korea pursue regional development strategies driven by lavish public funding both for research institutions and for enterprises, to reinforce their industry clusters, even though they do not have cluster policies in the EU sense. Asiatic clusters are less specialised than EU ones and can leverage both domestic and FDI capital. State aid provides strong support, particularly in China, to factory and production lines building. From this point of view the EU is operating at a competitive disadvantage, since rules of state aid are much stricter (and more frequently implemented) than in Asia[50].
In the US state incentives to attract enterprises are much higher than usually perceived, ranging from very high tax credits, to granting land or facilities almost for free. While no specific funding measures for clusters are foreseen by federal policy, federal and national policy support technology transfer from research to the market, by supporting research centres and applied research labs, as well as R&D tax credit at federal and state level. In

[50] Interview with Dr Derek Boyd, NMI

addition, cluster enterprises have access to the richest venture capital and risk capital market of the world, as well as to a wide variety of R&D funding programmes. These US measures are particularly effective thanks to the large internal market, while the EU suffers from the incomplete development of the single internal market.

Need for joint prototyping facilities and pilot lines in Europe

There seems to be little chance that Europe will invest in full-scale fab capability for next generation 450mm microprocessors manufacturing. However, actions should be taken to maintain competitiveness of the EU industry and carefully manage the intellectual property at each stage of the ICT components and systems value chain, sustaining the competitive positioning of fabless operators. This includes making sure that EU enterprises have access to prototyping facilities and pilot lines. There is also research to be done on potentially disruptive technologies and developments in this field (such as graphene).

In terms of EU funding, the interviews with experts and cluster managers suggested that EU in the future could best support the competitiveness and growth of the ICT components and systems manufacturing industry in Europe by providing financial support for joint prototyping facilities and pilot lines that could help Europe keep its competitive edge in advanced products and systems. Currently, the state aid regime in Europe represents an effective constraint to funding actual production lines.

Support for cluster collaboration can help create critical mass

The strategic collaboration between Silicon Saxony cluster and the Grenoble cluster constitutes a best practice case in Europe for cross-border cluster collaboration. The two clusters have strengthened their cooperation in the area of nano-electronics and nano-technologies focusing on education, research and development, industrial deployment, SME coordination, and environment. This will strengthen the competitiveness of these clusters vis-à-vis global competitors and for Europe the collaboration between the two clusters is an important and inspiring example of how a joint strategy between clusters can help create critical mass in Europe in key areas. The collaboration has now been extended to include other European cluster through their involvement in a new large project, Silicon Europe, funded through the EU Regions of Knowledge programme under FP7. The EU could continue to support such initiatives in order to increase the coordination of research and innovation efforts at cluster level to achieve critical mass at EU level.

Furthermore, the targeted collaboration between clusters specialised in nanotechnology and clusters representing relevant user-industries in the context of the Finnish Nanotechnology Cluster Programme has been very successful in promoting innovation and business collaboration. To promote innovation and business collaboration at European level, the European Union could continue to support financially existing platforms for cluster matchmaking activities, but focus activities more on matching clusters representing technology-providers and relevant user-industries in Europe and internationally.[51]

[51] Interview with Dr. Eeva Viinikka, Director of the Finnish Nanotechnology Cluster Programme.

8 ANNEXES

8.1 WEB AND LITERATURE SUMMARY

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8.2 GLOSSARY

8.2.1 Electronics manufacturing industry definition

Our working definition is the following:

- The Electronics manufacturing industry is the manufacturing value chain developing, designing, manufacturing and assembling High Tech devices and products.
- The High Tech value chain includes:
    - Passive components, printed circuit boards;
    - Semiconductors;
    - Printed Circuit Board assemblies ;
    - Active components, storage devices, modules;
    - Inside of devices and products assemblies;
    - Finished product.
- High Tech devices and products include:
    - Client & Consumer Device: Computers, Peripherals, Consumer Devices;
    - Enterprise & Infrastructure Products: Servers and Storage, Networking, Telecommunications;
    - Emerging Products: Automotive, Medical, and Industrial.

Examples of High Tech devices and products are given in section "Sectors".

8.2.2 Main Actors and Stakeholders

The electronics manufacturing value chain includes a high number of actors, interacting with different roles and responsibilities. IDC understands well their strategic positioning and has an excellent network of contacts with all of the main stakeholder categories. The main actors considered in this study are the following:

- **OEMs (Original Equipment Manufacturer)**: Branded vendor who typically markets and sells products to end customers. The design and manufacturing of these products may or may not be done by the OEM. Examples: Ericsson, Nokia, Philips, Thales but also Airbus, EADS, Volkswagen which increasingly integrate electronics systems in their products in order to innovate and increase their global competitiveness.
- **EMS providers (Electronics Manufacturing Services):** Previously known as contract manufacturers who provide outsourcing services that may include new product introduction (NPI) services, manufacturing and assembly services, a variety of after-market services and logistics and supply chain services (Examples: Flextronics, Sanmina-SCI, Celestica, Solectron).
- **ODM (Original Design Manufacturers):** Manufacturers who provided design services, support and products for OEMs. Many ODMs provide both design and manufacturing services and may also sell their own branded products (Examples: Quanta, Compal, Arima, BenQ, ASUSTeK).
- **Semiconductor manufacturers**
    - **Fab**: A manufacturing plant that makes semiconductor devices. (Intel, STMicroelectronics for example)
    - **Fabless**: A semiconductor vendor that does not have in-house manufacturing facilities. Although it designs and tests the chips, it relies on external foundries (fabs) for their actual fabrication. (ARM Holdings, Qualcomm, AMD, NVIDIA for examples)
    - **Foundry**: A semiconductor manufacturer that makes chips for third parties. It may be a large chip maker that sells its excess

manufacturing capacity or one that makes chips exclusively for other companies. (TSMC, Globalfoundries, SMIC, UMC, TowerJazz for examples)
    - **Integrated Device Manufacturer (IDM)**: A company that performs every step of the chip-making process, including design, manufacture, test and packaging. Examples of IDMs are Intel, AMD, Motorola, IBM, TI and Lucent.
- **Component manufacturers:** Hitachi, IBM, Motorola, Panasonic, Phillips, Seagate, Western Digital, etc.
- **Research institutes.** They have developed a well-recognized expertise in the domains of physics, components, material for electronics systems. (Examples: CEA LETI, Fraunhofer Institutes, IMEC, etc.)
- **The clusters.** They are linked to industry, suppliers, academic organizations, and to all stakeholders in the area of ICT Components.

8.2.3 Sectors

When analysing potential opportunities and application sectors, we have segmented the market as follows, to take into account the industry specificities potentially affecting electronics industry:

- **Computer:** Mobile PC, Desktop PC, other PC such as thin clients.
- **Peripherals:** Copiers, Facsimiles, Multifunction peripherals, Printers.
- **Consumer devices:** includes Digital audio players, Digital camcorders/cameras, Digital video recorders, set-top boxes (DVRs), Digital televisions and displays, DVD players and recorders, Gaming devices, Handsets/mobile phones, Portable media players, Smart handheld devices, Home networking (NAS, media adapters, blue tooth).
- **Server and storage:** Servers/workstations, Disk storage systems, Tape drives, Optical storage, HDD/ODD.
- **Networking:** LAN switches, Routers, Wireless LAN (WLAN), other networking such as L4-7 switches, firewall/VPN appliances, etc.
- **Telecommunications:** Mobile wireless infrastructure, Broadband (DSL, cable modem), Broadband customer premises equipment (CPE), Traditional telephony (PBX, central office switches), IP telephony (media gateways, soft switches, IP PBX), Other Telecom (cordless phones, answering machines), Optical Transport.
- **Automotive:** Automotive control modules, Automotive module/subsystems Electronic control units in chassis systems, Power train electronics, body Electronics/security systems, Information and computing systems, e.g. for traffic control, and, for example, Collaborative active safety systems, Autonomous driving.
- **Medical devices:** Medical Instrumentation/systems, Patient monitoring equipment, Medical therapy equipment, Diagnostic equipment, Imaging equipment, Surgical systems, Remote patient monitoring, etc.
- **Industrial:** Aerospace/Defence systems, Retail Systems, Photovoltaic/solar systems, Industrialized control systems, Manufacturing and process controls, Motion controllers, Operator interfaces, robotics, HVAC and other controls, Semiconductor front and back end equipment, Test, measurement, etc.

8.2.4 Acronyms used in the document

Table 4 Acronyms used in the report

Acronym	Definition
ASSPs	Application specific standard product
BRIC	Brazil, Russia, India and China
CAGR	Compound Annual Growth Rate
CMOS	Complementary Metal Oxide Semiconductor
CPE	Customer premises equipment
DOE	Department of Energy
DRAM	Dynamic Random Access Memory
EC	European Commission
EMS	Electronics Manufacturing Services
ETP EPoSS	European Technology Platforms / European Technology Platform on Smart Systems Integration
HVAC	Heating, Ventilation and Air-Conditioning
IC	Interface Circuit
ICT	Information and Communication Technology
IDM	Integrated Device Manufacturer
JTI ENIAC	Joint Technology Initiative European Nanoelectronics Initiative Advisory Council
LAN	Local Area Network
MEMS	Micro-electromechanical systems
NAS	Network Attached Storage
ODM	Original Design Manufacturers
OEM	Original Equipment Manufacturer
R&D	Research and Development
SAF	Semiconductor Applications Forecaster (IDC)
TEKES	Teknologian ja innovaatioiden kehittämiskeskus (Finnish Funding Agency for Technology and Innovation)
WP	Work Package

8.3 Methodology

8.3.1 Identification and qualification of relevant clusters

The starting point of IDC's methodology of the first phase of the Study was to identify all clusters relevant to this study. The Web and literature review provided the study team with a list of 1307 European clusters. We identified a list of 114 clusters operating in the area of ICT components. Then we went through each Web site of all these clusters to qualify their relevance in the study.
Criteria used to qualify clusters were the following:

- Involvement in the following industries: Materials, Semiconductors, Active components, Products design and assemblies, High Tech device and products
- Involvement in ICT components manufacturing activities.
- The services provided by the clusters were also qualification criteria. We selected clusters which are active in the domains of funding, promoting and coordinating R&D and innovations initiatives and programs for their members.

The outcome of this phase of the work was the selection of a long list of 67 clusters within and outside Europe and a contact list of 5,382 contacts with 4,917 enterprises and national/regional development agencies across the world.

8.3.2 Web and literature review

We carried out a Web and literature review for the identification of clusters as well as the collection of data for the cluster database. The Web and literature review were carried out among national, European and international sources. The list of main sources is presented in Annex 8.1. By way of illustration when collecting data, we consulted the following sources:

- European Commission cluster related projects and initiatives:
  - The European Cluster Observatory;
  - IPTS/DG Research;
  - DG Information Society and Media.
- Exploring the potential of ICT Components and Systems Manufacturing in Europe" by the VDIVDE and CEA Leti on behalf of the European Commission.
- European Commission (2011): Cross-sector Analysis of the Impact of International Industrial Policy on Key Enabling Technologies;
- OECD Information Technology Outlook and OECD Science, Technology and Industry Outlook;
- JTI ENIAC publications;
- EPOSS publications;
- The professional and industrial associations, technology platforms, of electronics industry such as SEMI Europe, ESIA and Photonics21
- The national and regional cluster organisations;
- The national ministries sources;
- The national and regional organizations which support and fund the innovation policies;
- The academic & research organizations.

8.3.3 Cluster Survey

The chief goal of IDC's methodology of the first phase of the Study was to capture the opinions of enterprises members of a cluster and the opinion of Cluster's management on key success factors and supporting measures.
The study team developed a custom-designed questionnaire which covered the following topics:

- Qualification of the cluster (size, organisation, specialisation...)
- Human resources;
- Knowledge building and sharing;
- Entrepreneurship and eco-systems
- Public regulation and demand;
- Extent of cluster collaboration.

The cluster survey was conducted in two phases:

- A web-based survey in May-June 2012, addressed to the long list of 5,382 contacts from 67 clusters. This phase resulted in 86 interviews covering 33 clusters in the EU, 3 in Switzerland covering 2 clusters, 7 interviews outside Europe covering 6 clusters. The EU sample was also unbalanced, with too many interviews accomplished in France.

- A second phase telephone survey in October 2012, to rebalance the sample, which produced 25 interviews covering 9 clusters in the EU and 35 interviews outside Europe covering 11 clusters.
- In addition, 9 direct interviews were carried out with the leading organizations and key stakeholders of 5 clusters to complete the in-depth case studies.

In summary, the study completed a total of 120 interviews with 45 clusters in the EU, 3 interviews with 2 Swiss clusters (Table 5) and 42 interviews with 13 international clusters (Table 6). The interviews with Honk Kong, India, Malaysia, Israel and Canada were not used for the cluster profiles because these clusters were not within the scope of the study, as indicated also by the EC. It was impossible to carry out interviews with the clusters in Bulgaria, Estonia, Hungary, Netherlands and Romania.

Table 5 EU Total Number of Interviews and Clusters covered by Country

EU	Number of clusters	Number of Interviews
AT	3	9
BE	1	2
BG	0	0
EE	0	0
FI	1	3
FR	15	49
DK	1	3
DE	14	32
EL	2	6
HU	0	0
IT	2	2
NL	0	1
RO	0	0
ES	2	3
SE	3	3
UK	1	7
Total	**45**	**120**
Switzerland	2	3

Source: IDC-FORA 2012

Table 6 World - Total Number of Interviews and International Clusters covered

World	Number of clusters	Number of Interviews
Brazil	1	1
US	0	0
China	3	9
Taiwan	2	3
South Korea	3	4
Hong Kong	1	4
India	2	17
Canada	0	1
Israel	0	1
Malaysia	1	2
Total	**13**	**42**

Source: IDC-FORA 2012

8.3.4 Cluster Profiles

In the final phase the study team revised the results of the survey, selected the most relevant clusters for the study scope and produced 48 European clusters profiles (of which 6 in-depth) and 10 international cluster profiles (of which 3 in-depth). The US clusters were profiled based on the input from IDC US rather than the survey. We included the clusters in Bulgaria, Estonia, Hungary, Netherlands and Romania based on desk research to complete the geographical coverage of the EU.

Table 7 Total Number of ICT Components Clusters Profiles

N. of Profiles	Europe	International	Total
In depth profiles	6	3	**9**
Short profiles - EU	40	7	**47**
Short Profiles - SW	2		**2**
Total	**48**	**10**	**58**

Source: IDC-FORA 2012

The sample is not statistically representative of the thousand of enterprises active in the 58 surveyed clusters. However, the EU sample covers all the clusters active in Europe in ICT components manufacturing, and the survey includes a representative of the managing organization and at least one of the key stakeholders of all the clusters interviewed, in Europe and abroad. Therefore, the survey sample reflects well the characteristics and specificities of the different clusters and can be considered as qualitatively representative of the universe of European clusters.

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