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Abstract:

For the participating regions (Bavaria, North Denmark, Flanders, Basque Country), a description of the cluster competencies in Embedded Systems for Smart Cities is presented.

Includes competency maps based on poll results, an overview of public policies, and a list of cluster organisations - demonstrating the possible contributions of each region to the Smart City vision.

Keyword list: smart cities, embedded systems, ecosystem, competencies, competency map, public policies, cluster, cluster initiative

Table of Contents

INTRODUCTION	4
1 MAIN INITIATIVES ALREADY IN PLACE	5
1.1 BAVARIA	5
1.1.1 <i>Bavarian Information and Communication Technology Cluster BICCnet (Munich)</i>	5
1.1.2 <i>Embedded Systems Institute ESI (Nuremberg)</i>	6
1.1.3 <i>Münchner Kreis – The Munich Circle (Munich)</i>	7
1.1.4 <i>Embedded4You e.V. (Ottobrunn near Munich)</i>	7
1.1.5 <i>Bayerisches IT-Sicherheitscluster e.V. - Bavarian IT Security & Safety Cluster (Regensburg)</i>	7
1.1.6 <i>Cluster Automotive Bayern (Nuremberg)</i>	8
1.1.7 <i>Cluster Energietechnik Bayern - Energy Technology Cluster (Nuremberg)</i>	8
1.1.8 <i>Umweltcluster Bayern - Environment Cluster (Augsburg)</i>	8
1.1.9 <i>Strategische Partnerschaft Sensorik - Strategic Partnership on Sensors (Regensburg)</i>	9
1.1.10 <i>Cluster Mechatronik & Automation e.V. (Augsburg)</i>	9
1.1.11 <i>Nürnberger Initiative für die Kommunikationswirtschaft - Nuremberg Initiative for ICT - NIK (Nuremberg)</i>	9
1.2 BELGIUM	10
1.2.1 <i>DSP Valley cluster initiatives</i>	10
1.2.2 <i>Flemish Smart City Activities</i>	12
1.3 DENMARK	13
1.3.1 <i>Cluster-like Initiatives</i>	13
1.3.2 <i>Focus networks</i>	14
1.4 BASQUE COUNTRY, SPAIN	14
1.4.1 <i>i-SARE</i>	14
1.4.2 <i>Mobility Lab</i>	15
1.4.3 <i>Smart Cities Catalogue</i>	15
1.4.4 <i>Smart Cities Canarias Congress</i>	15
1.4.5 <i>ETIC</i>	15
1.4.6 <i>Ingutech Project</i>	15
1.4.7 <i>Other Countries</i>	15
1.5 EUROPE: SMART CITY INITIATIVES	18
2 PUBLIC PROGRAMS AND POLICIES	20
2.1 BAVARIA	20
2.1.1 <i>The Bavarian State Government</i>	20
2.1.2 <i>The Town of Munich</i>	22
2.2 BELGIUM	23
2.2.1 <i>Belgium at a glance</i>	23
2.2.2 <i>Smart City policy in Flanders</i>	25
2.3 DENMARK	29
2.4 SPAIN	29
2.4.1 <i>Plan for Science, Technology and Innovation 2020</i>	29
2.4.2 <i>RIS 3 Strategy</i>	30
2.4.3 <i>Digital Agenda of Euskadi 2015</i>	30
2.4.4 <i>Euskadi – Innova</i>	30
2.4.5 <i>Nanobasque Strategy</i>	31
3 CLUSTER COMPETENCIES	32
3.1 BIRD’S EYE VIEW	32
3.1.1 <i>Smart City challenges</i>	33
3.1.2 <i>Market Segment</i>	34

3.1.3	<i>CLINES Expertise & Capabilities</i>	36
3.2	BICCNET, BAVARIA.....	39
3.2.1	<i>BICCnet, the core of the cluster</i>	39
3.2.2	<i>Bavaria at a glance</i>	39
3.2.3	<i>Region Upper Bavaria / Munich</i>	40
3.2.4	<i>Region Swabia / Augsburg</i>	41
3.2.5	<i>Smart City Competencies in Bavaria</i>	42
3.2.6	<i>Sources</i>	50
3.3	DSP VALLEY, BELGIUM	52
3.3.1	<i>Embedded Technologies</i>	52
3.3.2	<i>Smart Cities</i>	53
3.4	BRAINSBUSINESS/CISS, DENMARK	61
3.4.1	<i>Embedded Systems Technologies in General</i>	61
3.4.2	<i>Smart Cities</i>	62
3.5	GAIA, BASQUE COUNTRY, SPAIN	71
3.5.1	<i>Smart Cities</i>	71
3.5.2	<i>Smart Energy</i>	73
3.5.3	<i>Embedded Systems Technologies in General</i>	74
3.5.4	<i>Domains</i>	75
3.5.5	<i>Special Capabilities</i>	76
3.5.6	<i>Specialization Fields</i>	77
3.5.7	<i>Target customers</i>	77
3.5.8	<i>Market geography</i>	78
4	LIST OF FIGURES	79

Introduction

In the CLINES project, four European research-driven regional clusters have joined forces to bundle their experience and track record in the CLINES domain of Embedded Systems for Smart Cities:

- BrainsBusiness/CISS, North Denmark
- DSP Valley, Flanders, Belgium
- BICCnet, Bavaria, Germany
- GAIA/Tecnalia: Basque Country, Spain

The clusters are committed to stimulate international co-operation and innovation between their combined members, creating a cross-border ecosystem active in Smart Cities powered by Embedded Technologies.

As a first step towards a collective Smart Cities ecosystem, the regions each map the competencies that companies and research institutions have in the area of smart cities – in part based on a questionnaire sent out to hundreds of companies.

To complete the picture, each region collected the policies of public bodies (such as development plans) that affect Smart Cities or Embedded Systems.

Apart from the project partners, in each region there are several more cluster-like initiatives that gather experience in the field of Embedded Systems. As a starting point for later contacts, their profiles are also collected in this document.



Figure 1 - The reach of the CLINES project

1 Main Initiatives already in Place

This chapter identifies for each region, which important cluster-like initiatives centring on embedded systems or smart cities are already in place. Those networks are mostly public or privately run cluster offices that do networking work, but sometimes also loose industry networks that focus for example on marketing.

1.1 Bavaria

In Bavaria, there are a handful of well-established cluster organisations that serve as focal points for industries involved with smart cities and embedded systems. They are described in this chapter.

In 2006 the Bavarian government implemented the so-called Cluster Initiative to create 16 clusters in Bavaria that would serve as focal points for their respective domains. Many of the clusters mentioned here were kick-started or are still partly funded by this Bavarian government initiative.

<https://www.cluster-bayern.de/cluster/>

1.1.1 Bavarian Information and Communication Technology Cluster BICCnet (Munich)

The Bavarian Information and Communication Technology Cluster is the core actor within the CLINES project.

BICCnet was founded in 2007 by the Bavarian Ministry of Economics (StMWIVT). This Ministry supervises and funds BICCnet. Organisationally, BICCnet is integrated within the Technical University of Munich (Technische Universität München). The goal is to ensure the growth of the ICT industry in the region by activating and interlinking the innovation and productivity potential of the Bavarian ICT enterprises, research centres and universities. Research results need to be transformed into marketable applications as quickly as quickly.

BICCnet has considerable experience in the field of embedded systems. It was very involved in the creation of the German Research Agenda Cyber Physical Systems and the German Software Platform Embedded Systems SPES 2020.

Currently BICCnet provides 16 cooperation platforms for the cluster partners (for example Collaborative Multicore Whitepaper, Steuerkreis IT KOOP, Innovation Forum Smart Mobile Apps, Innovation Forum Embedded Systems, Working Group Multicore, Working Group Embedded Architectures Process Models, BICC Open Labs).

The following topics are BICCnet's focal points:

- Embedded systems
- Energy (smart grids, virtualisation)
- Mobility ("mobile society", multi-modal mobility, open & big data)
- Entrepreneurship
- Convergence: Apps (B2B)

- ICT services (cloud computing)
- Safety & security

<http://www.bicc-net.de>

Two BICCnet special network topics are very relevant:

1.1.1.1 Sicherheitsnetzwerk München – Security Network Munich

Approximately 350 people are involved in the Security Network Munich. They are hailing from about 140 organisations (companies, research institutions, associations etc.).

The activities of the security network are: agenda setting, organising innovation workshops, creating a competence matrix.

Numerous working groups link the participants: cloud security, mobile security, and secure industry 4.0, security of critical infrastructures, cyber intelligence, secure smart grids, and economic assessment of IT security.

<http://www.it-sicherheit-muenchen.net/>

1.1.1.2 Working Group Multicore

Prof. Dr. Andreas Herkersdorf is the technical head of the working group multicore. The participants include 120 experts from industry and research. The working group has now been established as “the place to meet” for all companies in southern Germany dealing with multicore processors. The long-term aim of this working group is to improve the anchoring of multicore (and hardware in general) in research politics.

<http://www.bicc-net.de/multicore-oekosystem/>

1.1.2 Embedded Systems Institute ESI (Nuremberg)

In 2007 the Interdisciplinary Centre for Embedded Systems was founded at the Friedrich-Alexander-University Erlangen-Nuremberg to link embedded competences. At the moment there are 15 academic chairs involved and this interdisciplinary character enables cooperation with firms from various areas.

There is close cooperation with the Fraunhofer Institute for Integrated Circuits that brings the ESI close to the application domains of embedded systems. The key areas of this work are the cross-sectional themes of processors and architectures, systematic design and realisation, reliability and system integration for embedded systems.

<http://www.esi-anwendungszentrum.de>

1.1.3 München Kreis – The Munich Circle (Munich)

As a non-profit international association at the crossroads of business, academia, public policy and society, the Munich Circle acts as an independent platform. The invitation-only group aims to guide and shape the knowledge and information-based society. It is mainly concerned with issues of technology, societal and business impacts and the regulation of information and communications technologies and media. The long-term goal is the responsible development of the information society.

The Munich Circle works by promoting dialogue and publishing roadmap documents that are grounded in research. It also addresses public policy makers, producers, service providers and all sectors of industry.

<http://www.muenchner-kreis.de/>

1.1.4 Embedded4You e.V. (Ottobrunn near Munich)

Embedded4You e.V. is a registered association of innovative companies dedicated to advancing embedded technologies and synergistically pooling their expertise.

Since 2007 small and medium-sized companies from the German-speaking area have joined together in this organisation. They link their competences and combine their technologies in a flexible way. By using the know-how of partners, each participant concentrates on his own basic competence but can use the expertise of other members at any time. Through the collaboration of the SME partners, E4Y can now offer a seamless value chain. A key element of the association is the eclipse-based tool chain.

<http://www.embedded4you.com>

1.1.5 Bayerisches IT-Sicherheitscluster e.V. - Bavarian IT Security & Safety Cluster (Regensburg)

The Bavarian IT Security and Safety Cluster is made up of companies from the IT branch, businesses which make use of security technologies, universities, further education institutions and law firms. Founded officially in May 2006, the Bavarian IT Security and Safety Cluster initiates and promotes cooperation, keeps members informed about IT security risks and solutions, offers an opportunity for members to demonstrate their expertise in IT security and training and also integrates newly formed businesses into the network. As of 2014, it has over 80 member companies, and many institutional partners.

Focus topics: IT Security, legal questions on IT security, security in automotive systems, security engineering, privacy, industrial IT security, security technology (physical security).

The cluster is integrated with the local start-up centre IT Speicher.

<http://www.it-sicherheit-bayern.de/itsecurity/>

1.1.6 Cluster Automotive Bayern (Nuremberg)

When the Cluster Initiative started the cluster automotive was integrated within the host organisation Bayern Innovativ in Nuremberg.

This cluster concentrates on the following innovation areas: Advanced driver assistance systems, e-mobility, vehicle safety and production efficiency and flexibility.

The services offered include cluster meetings at companies and at research institutes, moderating working groups and workshops as well as organising joint projects.

The automotive cluster consists of about 730 companies and institutes from the automobile sector and all areas that are relevant for the automobile domain. Close contact with the automobile industry is relevant for CLINES as vehicles must be prepared for integration in smart cities.

<http://www.bayern-innovativ.de/cluster-automotive/>

1.1.7 Cluster Energietechnik Bayern - Energy Technology Cluster (Nuremberg)

As part of the Cluster Initiative, this cluster was integrated within the host organisation Bayern Innovativ.

The cluster offers cooperation forums, meetings with companies and institutes, studies on current problems and the identification and initiation of business-relevant joint projects involving supra-regional partners.

The activities concentrate on the following topics: renewable energies (solar energy, wind power), energy efficiency in power generation (power plants, cogeneration), consumption (industrial and building technology) and on energy storage systems and transmission and distribution networks in power supply.

<http://www.bayern-innovativ.de/cluster-energietechnik>

1.1.8 Umweltcluster Bayern - Environment Cluster (Augsburg)

As part of the Cluster Initiative, this cluster was founded as an independent organisation to link companies that are active in environmental technology. As of 2014, it has over 100 paying member companies, and many institutional partners.

The Bavarian Environment Cluster links Bavarian competences in these fields: recycling and waste management, water and wastewater treatment, alternative energy production (especially from waste and biomass), air pollution prevention and noise protection and materials flow management. These topics are especially relevant for CLINES as they all need to be addressed in any smart city concept.

<http://www.umweltcluster.net/en/>

1.1.9 Strategische Partnerschaft Sensorik - Strategic Partnership on Sensors (Regensburg)

As part of the Cluster Initiative, the cluster was installed in the city of Regensburg, and as of 2014 has around 50 member companies. There are innovative medium-sized companies as well as renowned global players (Infineon, Continental, Krones, OSRAM, Micro-Epsilon, Dallmeier electronic).

The cluster offers a range of professional services, such as:

- Building and simulating physical models
- Developing innovative sensor concepts and sensor systems
- Miniaturising sensors & sensor systems
- Researching literature and patents

<http://www.sensorik-bayern.de/>

1.1.10 Cluster Mechatronik & Automation e.V. (Augsburg)

As part of the Cluster Initiative, the cluster was installed in the city of Augsburg, and as of 2014 it has 130 member companies and member institutions.

In over 50 projects cluster members have already obtained comprehensive knowledge about the entire development and production processes for mechatronic products as well as helping to develop new mechatronic products.

The core competencies of the member companies are within the fields of:

- Mechatronic components
- Mechatronic production and services
- Machines
- Robotics
- Automation
- Micro-mechatronics
- Intelligent materials

One of the challenges identified by the cluster is the convergence of mechatronic systems with IT systems (bundled in the working group “organisation development”). This issue is obviously relevant to CLINES as well.

<http://www.cluster-ma.de/>

1.1.11 Nürnberger Initiative für die Kommunikationswirtschaft - Nuremberg Initiative for ICT - NIK (Nuremberg)

The ICT cluster was founded in 1995 as an industry initiative, today the cluster office has 5 employees, and the network more than 100 members.

NIK is active in several CLINES-related projects, for example:

- **SMASH** (smart assisted secure home): The goal is to implement an association of device and service providers, irrespective of individual manufacturers, from the sectors house automation, facility and energy management as well as IT supported health supervision / Ambient Assisted Living (AAL).
- **Seamless City** – This involves the development of applications for mobile devices. These applications will enable people to use various means of transport in an intelligent, environmentally friendly, timesaving and low-cost way by implementing a common system for searching, routing and booking. This system will also include indoor navigation options.

<http://www.nik-nbg.de>

1.2 **Belgium**

1.2.1 **DSP Valley cluster initiatives**

The mission of DSP Valley is to stimulate open innovation and entrepreneurship in the field of smart electronic systems, involving the triple helix of companies, research institutions and government organizations. DSP does this for the broad field of smart systems and embedded technologies, but also focuses on specific subdomains or application markets. Our main activities are:

- **networking and matchmaking:** DSP organises around 40 events a year to bring together our members and other players in the field of smart electronic systems in order to build or reinforce partnerships; our events related to Smart Home, Smart Health and Smart Vehicles all contribute to the topic of Smart Cities (as explained in the previous section)
- **road mapping:** DSP Valley develops roadmaps for subfields of the smart systems domain, either for short- to mid-term (1 to 5 years) business opportunities or for mid- to long-term (5 to 10 years) business and research opportunities:
 - In the context of the Interreg TTC project (2011-2014), DSP Valley developed a Smart Home business roadmap together with its project partners in the ICT Working Group; it is clear that this is an important building block to address the challenges of the Smart City.
 - In the context of the Regions of Knowledge EU project “Silicon Europe” (2012-2015), DSP Valley is working on roadmaps for future smart silicon.
 - In the context of the Flemish IWT project for roadmaps on Key Enabling Technologies (KETs) (2013-2014), DSP Valley (with imec as a partner) is developing a roadmap on the KET “micro- and nano-electronics” for Flanders, which is also relevant to the general field of embedded technologies; although the application fields are not in focus for this roadmap, it is important to secure the future of the underlying technologies.
 - DSP Valley is also in the process of submitting project proposals to work on a roadmap for the combination of micro/nano-electronics with bio-technology (“nanotechnologies for health”) to address new challenges on the intersection of these two fields, with Smart Health as the obvious application domain; to the extent that Smart Health (and Wellbeing) are an important challenge of Smart Cities, these intended road mapping exercises are also relevant to CLINES.

- **Representation and lobbying** One of DSP Valley’s goals is to stimulate the creation of alliances and partnerships among members (and selected invited participants) to explore opportunities for new business, project proposals, etc. DSP Valley represents its members on several local and international fora to support the creation of the right setting for those partnerships and alliances to flourish.
- **local inter-cluster co-operation:** DSP Valley does not only have individual companies or research institutions (including Strategic Research Centres such as imec, VITO and iMinds) among its full and associated members, but also other clusters with similar or complementary activities; it is interesting to see that they complement the competencies related to Smart Cities:
 - Smart Grids Flanders (associated partner) is a cluster of organizations focusing mainly on the Smart Grids domain (but also on Smart Home and Smart (electric) Mobility/Vehicles); so, whereas DSP Valley focuses on the home/building (“up to the smart meter in the home”), Smart Grids Flanders focuses on the outside energy grids (“beyond the smart meter in the home”). (<http://www.smartgridsflanders.be/>)
 - Flanders’ Bike Valley (associated partner) is a newly (2013) created cluster focusing on everything related to the biking experience, which has a strong link to the DSP Valley Smart Vehicles application domain, and also fits perfectly in the Mobility challenge of Smart Cities. (<http://www.flandersbikevalley.be/>)
 - Flanders Bio (plain partner) is the Flemish cluster of biotechnology companies; DSP Valley works together with the cluster in the context of “Nanotechnologies for Health” as a potential Smart Specialization for the region of Flanders; the collaboration focuses on “red” biotech in particular, related to the health of human beings (as opposed to “white” (industrial) or “green” (plant-related) biotech), so it fits with the Smart Health application domain (and its relevance to Smart Cities). (<http://flandersbio.be/>)
- **International inter-cluster co-operation:** Whereas DSP Valley’s operations already have a cross-border nature, in the Leuven (Belgium) – Eindhoven (the Netherlands) region, DSP Valley has an even larger international horizon. DSP Valley’s networking is extended internationally in Europe, through cooperation with partner clusters.

In the context of European Interreg 4A-programs, DSP Valley has a cross-border cooperation with the IT-clusters Infopole (Wallonia - Belgium) and Regina (Aachen region – Germany) in the neighbouring regions. The ambition of this cooperation is to stimulate cooperation for businesses and academia, in cross-border innovation projects. Ideas for cross-border innovation projects are sought in the domains of multidisciplinary domains with embedded systems as enabling technology for energy applications and health applications.

DSP Valley also played a leading role in setting up a European network of networks (or a network of clusters) in the embedded systems areas. Main partners are the French pôle de compétitivité Systematic (Paris – France), the Electronics Technology Network (Cambridge – Edinburg – UK), BICC-Net (Munich – Germany) and PointOne (Eindhoven – the Netherlands, nowadays called High Tech NL). Together with these partner clusters, DSP Valley has organized several inter-cluster B2B matchmaking events, with interesting resulting cooperation in new innovation projects. This European network of network has been set up in the contact of Innovation Express (part of the European INNO-Nets).

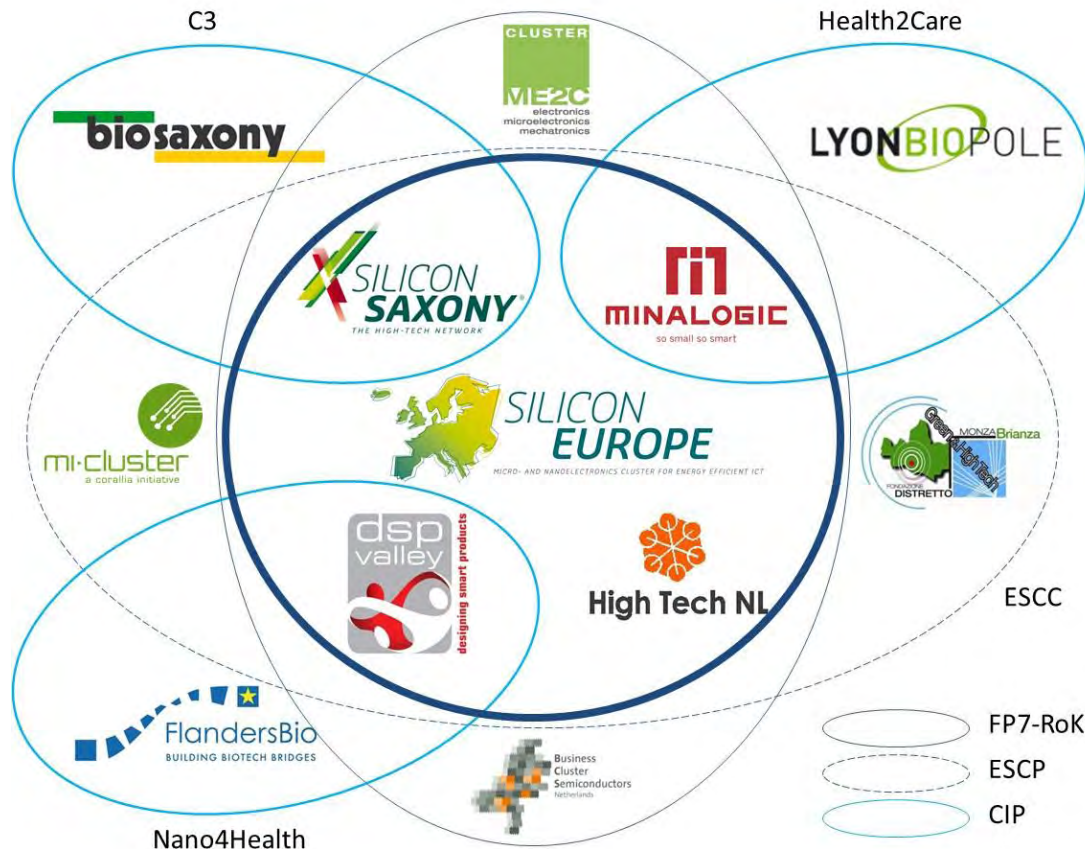


Figure 2 - The partner network of Silicon Europe

A similar cooperation of networks is being built in the semiconductor area, with Silicon Saxony (Dresden – Germany) and Minalogic (Grenoble – France) as main partners. Other partners include Arcsis (Aix-en-Provence – France), NMI (UK-wide) and Silicon Southwest (Bristol-Bath – UK). Small scale B2B events have already been organized with Silicon Saxony (Arbeitskreis “IC Design”) and Arcsis.

DSP Valley is also broadening its intercluster cooperation to clusters from other domains, for example the biotech sector. DSP Valley is together with Flanders Bio involved in the CIP project Nano4Health. Part of this project is to set up cooperation with similar projects (C3, Health2Care) that bridge micro-electronics with biotech.

Outside Europe, DSP Valley has a cooperation agreement with the Indian Semiconductor Association.

1.2.2 Flemish Smart City Activities

- Agoria Smart Cities:** Agoria is a Belgian sector organisation federating about 1700 technology companies. The Agoria Smart Cities project brings all smart city stakeholders together in a coherent ecosystem, the Agoria Smart Cities Community, to cooperate on themes such as mobility, energy, communication, buildings, etc. The ultimate goal is to create the smart city of the future. (<http://www.agoria.be/nl/Smart-Cities>)

- **Smart Grids Flanders:** is a platform supporting all companies and organisations and stakeholders involved in the development of smart energy grids and smart energy solutions. (<http://www.smartgridsflanders.be/>)
- **Energyville:** EnergyVille unites the Flemish research institutes KU Leuven, VITO and imec for research on sustainable energy and intelligent energy systems. Our researchers deliver expertise to industry and cities on energy efficient buildings and intelligent networks – such as smart grids and advanced heat nets. EnergyVille strives to become one of the top five European institutes in innovative energy research. For that reason the centre was embedded in big national and international networks from the start. It gathers research, development, training and innovative industrial activities under one name and in close collaboration with local, regional and international partners. Energyville is responsible for 'Smart Energy Cities' within the European KIC InnoEnergy. (<http://www.energyville.be/>)
- **Linear:** The Linear project(<http://www.linear-smartgrid.be/>) studies ways in which households can tailor their electricity consumption to the amount of solar and wind energy available, both in terms of technology and user interaction. Some key questions that this research is designed to address:
 - How do households and industry stand to benefit from a change in behaviour?
 - How will the costs and benefits be divided among the parties involved?
 - Which solutions will provide enough motivation and convenience to prompt a change in behaviour?
 - To what extent will households be able and willing to change their behaviour?
- **Quadratic:** Builds on the lessons learned of Linear and has as objective to set up Living labs of next generation integrated energy networks and solutions, built on large city renewal projects in Flemish cities.
- **Smart Cities partnership:** The general aim of this Interreg IV b project is to create an innovation network between governments and academic partners leading to excellence in the domain of the development and take-up of e-services, setting a new baseline for e-service delivery in the whole North Sea region. (13 partners around the North Sea; lead partner is Belgian: vzw Leiedal from Kortrijk) (<http://www.smartcities.info/>)

1.3 **Denmark**

1.3.1 **Cluster-like Initiatives**

The organizations in Region Nord are involved in a number of Cluster-like initiatives which are related to Smart Cities and Embedded Systems:

- **InfinIT** (http://www.infinit.dk/dk/infinit_in_english/infinit_in_english.htm) is a nationwide innovation network for ICT coordinated by CISS. The network coordinates a number of interest groups for companies, e.g. on 'Embedded Software Systems' and 'Smart Cities'. Also, a number of minor industrial development projects are organized by the network.
- **EnergyVision** (<http://www.energyvision.dk/about-energyvision.aspx>) has the purpose of building on existing energy initiatives, create synergies across sectors and create a joint

foundation for developing the business area and thus, in the long term, form the basis of a North Denmark energy cluster through knowledge-sharing, innovation and branding.

- **VE-NET** (<http://english.ve-net.eu/>) is a national cluster on renewable energy having a number of companies from Region Nord as members. It emphasizes the Danish energy model by connecting the different energy technologies and contributes to drawing the picture of the future energy system and the innovation necessary to get there.
- The region and the city of Aalborg has invested quite some effort in the development of a Life Science cluster BioMedCommunity (<http://www.biomedcom.dk/about/>) which also includes a number of companies active within the health technology area.

1.3.2 Focus networks

As part of the BrainsBusiness cluster, a number of more focused networks are formed on specific topics of relevance for Smart Cities¹. These include

- **Intelligent Transport Systems:** The aim of the network is to make the traffic of the future safer, more efficient and more environmentally-friendly - however, this calls for intelligent communication among cars and between cars and infrastructure. In order to achieve this, close collaboration across the public sector and companies is required. On the one hand, equipment containing positioning and communication systems need to be installed in cars, and on the other hand, attractive services need to be developed in order to make drivers utilise the possibilities.
- **Smart Grid and Intelligent Buildings:** This network is connected to the Innovation Network InfinIT and has 1-2 early meetings on various topics.
- **ICT and wireless communications:** This network is strongly connected to the centre CTIF (<http://www.ctif.aau.dk/>) and has two early meetings between researchers and companies.

1.4 Basque Country, Spain

In Basque country, there already exist initiatives fostering Smart Cities. A brief explanation of their focus is provided here.

1.4.1 i-SARE

The objective is to deploy a smart micro grid that is efficient, sustainable and safe to serve as a testing ground to develop and evaluate the status of different generation and storage technologies (renewable energy, electric car, etc.).

To do so, an experimental infrastructure has been developed in Gipuzkoa (Basque Country) for the development of the smartisation of various components that make up the intelligent power networks and their integrated management.

<http://www.i-sare.net/pages/quees.html> (only in Spanish)

¹ Unfortunately, the home pages are mostly in Danish

1.4.2 Mobility Lab

This project allows optimising infrastructure management and efficiency of vehicles traffic mobility.

The Vehicles Flow Management system allows easing the condition of roads, reducing accidents and travelling times, the economic costs involved for drivers, increase the performance vehicles use and minimize environmental impact.

1.4.3 Smart Cities Catalogue

Development of a catalogue that contains the definition and concept of Smart City as well as in individual tabs, the products - services / scope of action of GAIA companies that have solutions for the Smart environment.

Shortly, it will be available on-line.

1.4.4 Smart Cities Canarias Congress

A Congress was held in the Canary Islands (Spain), where in addition to participation by different members from the government where action policies on the concept of smart city were introduced, various company product solutions were also presented.

1.4.5 ETIC

ETIC (Smart Cities Innovation Center) is a non-profit business service co-operative specialised in the development of products, services and applications within the context of Smart Cities. By virtue of a framework agreement, it operates as a Microsoft Innovation Center. GAIA is member of ETIC.

ETIC is registered as R+D entity in the Industry Department and as business R+D unit in the Basque Net of Science, Technology and Innovation (RVCTI). ETIC takes part in European projects, but also in national and regional projects.

<http://www.embedded-technologies.org/>

1.4.6 Ingutech Project

This project is developed by four regional Clusters (Basque Country) towards the detection of opportunities for the development of integrated and technologically advanced solutions for sustainable management and protection of natural spaces.

1.4.7 Other Countries

There are several cluster-like initiatives in Europe that are not yet part of CLINES, but have a fitting topic focus:

- High Tech NL: The Dutch microelectronic sector is mainly clustered in the Southern and the Eastern parts of the Netherlands. The cluster High Tech NL, together with the associated partner Business Cluster Semiconductors Netherlands (BCSNL), covers all aspects of

microelectronics; from process/technology research and production tools/equipment to electronic components and end-user products. Additional major concentrations of microelectronic activity are found in the western part of the Netherlands, around Delft and in the northern part around Assen. All these ecosystems are very well connected to each other. Most of the East and South of the Netherlands micro- and nanoelectronics clusters are concentrated around a few cities; Eindhoven, Nijmegen and Enschede, always close to innovation campuses, such as the High-Tech Campus in Eindhoven, the HighTech Factory in Enschede and the NovioTech Campus in Nijmegen and the universities. This concentration in relatively close kernels is a clear advantage for Dutch researchers and engineers who successfully follow efficient multi-disciplinary open innovation principles in the technology and product development process over the complete region. (<http://www.hightechnl.nl/>)

- MinaLogic: Mastering three of the Key Enabling Technologies (micro-/nanoelectronics, nanotechnologies and photonics), and maximising on solid, complementary skills in information technology and software, Grenoble in the Rhône-Alpes region is a strong hub for innovation. The Minalogic cluster represents the whole value chain for microelectronics, from materials to manufacturing; from component design to fabrication, and also benefits from a high-tech, industry-oriented business environment as well as of the excellence of its first class education system. Key strengths include design and manufacturing of components, digital imaging, and embedded software. CEA Leti is also a key member of Minalogic: focusing on creating value and innovation through technology transfer to its industrial partners, this world famous research organisation specialises in nanotechnologies and their applications, from wireless devices and systems, to biology, healthcare and photonics. NEMS and MEMS are at the core of its activities. (<http://www.minalogic.com/>)
- Silicon Saxony: Thanks to a smart settling policy and well-designed funding schemes in combination with a very strong collaboration between industry and administration, “Silicon Saxony” is now Europe’s largest microelectronics site and a real triple helix managed high-tech region. When it comes to technology, this region in the triangle of the German cities of Dresden, Freiberg and Chemnitz is one of the most innovative ICT clusters in the world. Here is where one finds a unique agglomeration of enterprises and research institutes with know-how in the fields of micro- and nanoelectronics, telecommunications, photovoltaics, information technology, organic and printed electronics, energy-efficient systems, smart systems, sensor networks and next-generation mobile technologies. The local industries benefit from the collaborative environment of science, industry and administration that has grown over the last 20 years and today is the base for leading-edge research and successful collaboration across organisational borders resulting in future technologies ‘Made in Saxony’. (<http://www.silicon-saxony.de/>)
- ME2C: For decades, electronics, microelectronics and mechatronics have been and still are the main economic-technological drivers for employment and progress in Austria’s industry. On the basis of a well-settled landscape of small and medium enterprises, a range of internationally operating leading companies and a well-established R&D-sector, Austria became a centre for innovation in core fields of technology in the heart of Europe. Located in the city of Villach, the ME2C-Cluster is a high-tech platform representing competencies in electronics, microelectronics and mechatronics in the region and enhancing a cross-sectorial approach towards innovative solutions. This is additionally fostered by collaborations with other application clusters such as automotive clusters as well as the joint technology initiatives in Austria. Thus it is a vital part of Austrian microelectronics that focuses on semiconductor equipment, the design and manufacturing of semiconductor

devices, the integration of components into systems, assembly technologies and testing tools. (<http://www.me2c.at/>)

- Arcsis: ARCSIS is the trade association for the microelectronics and semiconductor activities in the Provence-Alps-Riviera (PACA) region, in France. It participates in assuring sustainability, full economic development and enhanced competitiveness of the regional microelectronics and communicating objects industry. Its 52 members include industries as well as research centres and universities. (<http://www.arcsis.org/>)
- Electronics Technology Network: The goal of ETN is to support the electronic design community across the UK, driving innovation to maintain our excellence for innovative electronic design. It groups UK organisations or a companies that supports the design community, or its value chain. Whether you are involved at the technology, component, circuit, software, system or product level, you could be part of the network. (<http://www.techuk-e.net/>)
- InfinIT: InfinIT is a Danish network for innovative utilization of IT. Our goal is to convert the infinite possibilities that technology offers into concrete collaborations between research and industry. Therefore, we invite researchers and enterprises working with or using IT to participate in collaboration projects and the exchange of knowledge, thus creating a forum where we can work together to generate exactly the knowledge that Danish industry and society needs – whether in terms of embedded systems, mobile technology, pervasive technologies, future internet or something else entirely. (<http://www.infinet.dk/>)
- IT Security: The Bavarian IT Security and Safety Cluster in Regensburg is made up of companies from the IT branch, businesses which make use of security technologies, universities, further education institutions and law firms. Founded officially in May 2006, the Bavarian IT Security and Safety Cluster initiates and promotes cooperation, keeps members informed about IT security risks and solutions, offers an opportunity for members to demonstrate their expertise in IT security and training and also integrates newly formed businesses into the network. (<http://www.it-sicherheit-bayern.de/>)
- The National Micro Electronics Institute: The National Microelectronics Institute (NMI) is the premier trade association representing the semiconductor industry in the UK and Ireland. Its objective is to help build and support a strong micro and nano-electronics community by acting as a catalyst and facilitator for both commercial and technological development. A not-for-profit organisation funded by its members, the NMI has a membership that spans the supply chain and includes fabless semiconductor manufacturers, IDMs, foundries, design services, IP providers, business associates, research and academic institutions. (<http://www.nmi.org.uk/>)
- Silicon South West: The Silicon Southwest network is the organisation that provides regular networking events, news and national and international promotion for the South West of England's microelectronics sector. Silicon South West is managed by Bath Ventures. (www.siliconsouthwest.co.uk/)
- Systematic: “World class” French Cluster, SYSTEMATIC PARIS-REGION brings together 480 key players in Paris area. Each of them working in the field of software-dominant systems with a strong social dimension. At the heart of the digital revolution, the goal of SYSTEMATIC PARIS-REGION is to develop the regional economy, boost the competitiveness of local companies and support employment growth by leveraging innovation, training and partnership opportunities. (<http://www.systematic-paris-region.org/>)

- **Wklaster:** Wielkopolska ICT Cluster is a triple helix body in the form of a legally registered association. It was founded in 2008 by Poznan Supercomputing and Networking Center (Polish Academy of Science), Poznan City Hall and ICT companies from the region. According to Deloitte benchmarking of Polish clusters, Wielkopolska ICT Cluster is "The leading ICT cluster in Poland". NGPexcellence Benchmarking by VDI/VDE has verified that Wielkopolska ICT Cluster has the highest level of R&D; engagement in cluster activities Europe wide. In 2011 European Cluster Excellence Initiative awarded Wklaster Bronze Label for excellence in cluster management. The cluster creation was supported by the project "Wielkopolska ICT Research-Driven Cluster" in the 2008-2010 edition of FP7 Regions of Knowledge. The project resulted in a detailed competence map of cluster members. Now, the cluster consists of three types of ICT-oriented entities: over 50 companies including state-owned energy management agency, 3 R&Ds; and a local government. It has a variety of funding sources, including member fees and is becoming self-sustainable. Cluster members enriched the region's strategy "Poznan 2030" by a strategic program on ICT which consists of 8 tasks in line with the European Digital Agenda. (<http://wklaster.pl/>)

1.5 Europe: Smart City Initiatives

- **European Innovation Partnership for Smart Cities and Communities:** The European Innovation Partnership on Smart Cities and Communities (EIP-SCC) brings together cities, industry and citizens to improve urban life through more sustainable integrated solutions. This includes applied innovation, better planning, a more participatory approach, higher energy efficiency, better transport solutions, intelligent use of Information and Communication Technologies (ICT). (<http://ec.europa.eu/eip/smartcities/>)
- **Smart Cities Stakeholder Platform:** The Smart Cities Stakeholder Platform initiated by the European Commission (<http://eu-smartcities.eu/>) with the dual aim of i) identifying and spreading relevant information on technology solutions and needs required by practitioners and ii) providing information for policy support to the High Level Group and the European Commission. It is both a web-based and physical Platform open to anyone who registers on it. Backbone is the contributions by stakeholders in a bottom-up way, owned by the stakeholders. The Platform is one of the two governance bodies of the Smart Cities and Communities European Innovation Partnership (EIP). (<http://eu-smartcities.eu/>)
- **Energy Cities:** European Association of local authorities (<http://www.energy-cities.eu/>) in energy transition has as objective:
 - To strengthen your role and skills in the field of sustainable energy.
 - To represent your interests and influence the policies and proposals made by European Union institutions in the fields of energy, environmental protection and urban policy.
 - To develop and promote your initiatives through exchange of experiences, the transfer of know-how and the implementation of joint projects.
- **SET(IS) Strategic Energy Technologies (Information System)** The European Strategic Energy Technology (SET)-Plan aims to transform energy production and use in the EU with the goal of achieving EU worldwide leadership in the production of energy technological solutions capable of delivering EU 2020 and 2050 targets. The move towards a low-carbon Europe

requires innovative research, effective strategic planning and an emphasis on timely and appropriate action. (<http://setis.ec.europa.eu/>)

- **JRC Institute for Energy and Transport** : The JRC's Institute for Energy and Transport mission is to provide support to European Union policies and technology innovation to ensure sustainable, safe, secure and efficient energy production, distribution and use and to foster sustainable and efficient transport in Europe. (<http://iet.jrc.ec.europa.eu/>)
- **ECSEL** (<http://ec.europa.eu/digital-agenda/en/time-ecsel>) is a partnership between the private and the public sectors for electronic components and systems. ECSEL will be operational as of 2014 and will run for 10 years, replacing the previous ENIAC and ARTEMIS JUs in the fields of nanoelectronics and embedded systems. ECSEL will:
 - maintain semiconductor and smart systems manufacturing capability in Europe and help it grow
 - secure a leading position in design and systems engineering
 - provide access for all stakeholders to a world-class infrastructure for the design and manufacture of electronic components and embedded and smart systems
 - foster the development of ecosystems involving innovative SMEs, strengthen (and create) clusters in promising new areas Ecsel continuation of ENIAC & Artemis (EpoSS is member of Ecsel);
- **KIC InnoEnergy**: KIC InnoEnergy SE is a European company fostering the integration of education, technology, business and entrepreneurship and strengthening the culture of innovation. Our vision is to become the leading engine of innovation in the field of sustainable energy. It has been designated as a one of the first three Knowledge and Innovation Communities by the EIT's Governing Board on 16 December 2009 in Budapest. KIC InnoEnergy addresses sustainable energy as its priority area. KIC InnoEnergy is a world class alliance of top European players with a proven track record. The Consortium consists of 27 shareholders and additional 100+ partners - companies, research institutes, universities and business schools covering the whole energy mix. They are organised around six offices: France, Benelux, Germany, Iberia, Poland Plus and Sweden. (training as Master of Energy for Smart Cities...) under EIT (European Institute of Innovation & Technology), includes strong training component. (<http://ec.europa.eu/digital-agenda/en/time-ecsel>)

2 Public Programs and Policies

This chapter identifies for each region, which public programs and policies are already in place to support the embedded systems and smart cities sector, and how relevant those policy frameworks are for CLINES.

The financial aspects of those programs will be analysed in the Deliverable D2.4 on Funding Sources.

2.1 *Bavaria*

The following chapter outlines the general framework of Bavarian public programs and policies which are intended to support the embedded systems sector. In each case the direct impact on CLINES is assessed.

2.1.1 The Bavarian State Government

Together with the Bavarian industry the Bavarian State Government has set itself an overall political, technological and research goal as regards the proportion of costs for research and development of the GDP for this legislature period and beyond. For this legislature period the proportion will be increased to 3.2 % and to 3.6 % by the year 2020. It is also absolutely essential to strengthen research and development in companies as they make up 80% of R&D expenditure in Bavaria.

The Bavarian State Government's strategy for research, technology and innovation

In the next few years the Bavarian policies for research, technology and development intend to concentrate on the here mentioned application and technology areas as they are especially important to address social challenges, and promote company growth and the creation of jobs in Bavaria:

- Life Sciences; especially biotechnology und system biology,
- Information and communication technologies
- Efficient production technologies, mechatronics, automation, robotics
- New substances, intelligent materials, nanotechnology and micro technology
- Cleantech – resource-conserving technologies for energy, traffic and the environment as a whole, Renewable raw materials (including biofuels), electromobility
- Innovative, technology-based services

As well as the key question of energy production the focus here is also on the areas of transport and energy storage (chemical storage, new substances, smart grids) and the efficient use of energy (efficient buildings, smart homes. These questions will be part of the energy concept being presented by the responsible organisation, the Bavarian Ministry of Economics, in May 2014. Follow-up plans for the climate program 2020 and agreements made then are also expected.

<http://www.stmwi.bayern.de/technologie/technologiepolitik/>

http://www.stmwi.bayern.de/fileadmin/user_upload/stmwivt/Publikationen/Forschungs_und_Technologiestrategie.pdf

The overall strategy is extremely relevant for CLINES. Amongst other things, transport, cleantech, smart grids and efficient buildings are specifically mentioned.

2.1.1.1 Bayern Digital / Bavaria Digital

The digitalisation of the economy is the innovation motor of the 21st century. Progress in the information and communication technology sector and the rapid development of the internet and its applications lead to fundamental changes in the economy and the society we live in. Digitalisation means new value chains, which the Bavarian economy – from the small craftsman to the global player – can turn into new products and services.

The aim is to create and expand areas of competence in connection with digitalisation. These are extremely important for the innovative development of the Bavarian economy. This is happening within the framework of preliminary research projects about areas of competence such as the security of mobile end devices and mobile applications, security-related data analysis and the security of complex and networked production plants (“Industry 4.0”).

<http://www.stmwi.bayern.de/technologie/bayern-digital/>

In this context it is the development and promotion of basic smart city technologies, especially in the IT security area, which is extremely relevant for CLINES.

2.1.1.1.1 Networked Mobility

The integrated networking of mobility and traffic is becoming increasingly important. This creates enormous challenges for the automobile industry, infrastructure providers and traffic carriers such as local public transport, rail, airport operators and airlines as well as the logistics sector.

A decisive factor in achieving success in these areas is to shorten the gap between research and application. This policy is being followed by the “Centre for Networked Mobility” which is playing a leading role at the Fraunhofer Institute for Embedded Systems and Communication Technologies (ESK) in Munich, in close cooperation with the Fraunhofer Institute for Integrated Circuits (IIS) in Erlangen. Implementing this concept is taking place in close cooperation with the Bavarian economy. Here the focus is on Bavarian automobile manufactures and commercial vehicle manufacturers, suppliers, especially small and <medium-sized companies as well as companies in the communication and mobile phone technology and infrastructure providers.

In addition to its location in Munich it is intended to create additional branches of the “Centre for Networked Mobility” in Erlangen/Nuremberg and Augsburg. There will also be participation by companies in Ingolstadt, Regensburg, Erlangen, Munich, Rosenheim or Wurzburg.

This focus is exceedingly important for CLINES, smart transportation is an integral part of smart cities.

2.1.1.1.2 Digitalised Production

The Bavarian economy needs to be made ready for digitalised and internet-based production. This happens through support in the development, implementation and use of digitalisation technologies such as Cyber-Physical Systems (CPS), sensor platforms and industrial software in the production process.

In the “Centre for Digitalised Production” the Fraunhofer IIS in Nuremberg cooperates closely with the Fraunhofer Application Centre in Coburg, the University of Bamberg and the Fraunhofer ESK in Munich. The centre is supported by the “Sensorics Application Centre” at the University of Regensburg, which is working together with companies on the development of intelligent sensors and sensor platforms for process control. It is also being assisted by the activities of the Industry-Software Application Centres at the University of Amberg-Weiden, which supports small and medium-sized companies with the introduction of industrial software.

“Industry 4.0“ is relevant for CLINES because sensors, actuators and highly available embedded technologies lead to the design of components for smart cities.

2.1.1.2 Bavarian Growth Funds

Start-ups embody the future of Bavaria as an economic location.

To provide young promising start-ups in Bavaria with more venture capital in future the Bavarian Ministry for Economics intends to establish a Bavarian Growth Fund of up to 100 million euros. This fund is to serve private venture capital organisations as a neutral cooperation partner to help finance growth.

In this way it could provide up to 250 million euros to encourage investment in growth for young start-ups in Bavaria.

<http://www.stmwi.bayern.de/service/foerderprogramme/wachstumsfonds-bayern/>

The stipulations of the fund have not been finalized yet, but it will be relevant for CLINES if these stipulations include support for smart-city technologies.

2.1.2 The Town of Munich

The “Munich Perspective” is the strategic concept for the development of the Bavarian capital city. It has been in development since 1998. It provides the framework for the future development of Munich with its key ideas and guidelines.

When we talk about the development of the town we are not only talking about the architectural and spatial components of town planning but also about social, economic, cultural, and ecological developments.

"Perspective Munich" decides the thematic guidelines for essential strategic fields of activity for the development of the town.

From the guidelines:

In order to increase the profile of Munich as an economic location it is essential to improve traffic conditions for the economy. It is necessary to extend the road system and establish goods transport

centres and goods distribution centres and to implement an interactive city logistic concept. In addition, it is absolutely indispensable to extend local public transport so that more motorists switch to public transport.

To reduce road traffic problems as much as possible it is necessary to organize automobile transport as conveniently as possible. This means measures to oversee local and regional connections as well as an increased use of telematics to direct traffic. It is also necessary to support car-sharing, carpools and taxis.

It is necessary to encourage as many people as possible, especially from surrounding areas, to switch from motorized individual transport to local public transport. With this end in mind we must further extend Park + Ride and Bike + Ride both in urban and in rural areas. In the next few years it is intended to increase the number of Park + Ride places in Munich from about 7000 today to approx. 9500. The number of Bike + Ride places is to be increased from 21300 to 26300.

<http://www.muenchen.de/rathaus/Stadtverwaltung/Referat-fuer-Stadtplanung-und-Bauordnung/Stadtentwicklung/Perspektive-Muenchen/Thematische-Leitlinien.html>

These guidelines are extremely relevant for CLINES. It is not only a question of dealing with individual private and public transport but also of dealing with goods transport in all its facets.

2.2 Belgium

A city can be defined as 'smart' when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic development and a high quality of life, with a wise management of natural resources, through participatory action and engagement. (Caragliu et al. 2009).

Based on this definition one can conclude that almost each policy domain has impact on a city aiming at becoming smart. Belgium has a rather complex state structure. Policy competences are distributed over a tangle of institutions. For this reason this non-exhaustive overview of smart city policy measures in Flanders starts with an overview of Belgium's state structure and related competence distribution. Subsequently this chapter zooms in into smart city and embedded systems policy in the Flemish Region and in Flemish communes.

2.2.1 Belgium at a glance

2.2.1.1 Belgium's state structure

Belgium became independent in 1830. Between 1970 and 1993, the country evolved into a more efficient federal structure. The power to make decisions is no longer the exclusive preserve of the federal government and the federal parliament. The leadership of the country is now in the hands of various partners, who independently exercise their authority within their domains. Belgium is a federal state, composed of communities and regions.

- Communities : The concept of 'community' refers to persons that make up a community and the bond that unifies them, namely their language and culture. As a result, Belgium today,

has three communities: the Flemish Community, the French Community and the German-speaking Community. These communities therefore correspond with the population groups.

- **Regions** : The establishment of the three regions was historically inspired by economic interests. The regions, which aspired to more economic autonomy, conveyed these interests. This resulted in the Flemish Region, the Brussels Capital Region and the Walloon Region.

Due to this state reform, the pyramid of the unitarian state made way for a more complex three-level structure.

- At the top level, we now find the Federal State, the Communities and the Regions, all three of which are equal from the legal viewpoint. They are on an equal footing but have powers and responsibilities for different fields.
- The next level down is still occupied by the provinces (10). Provinces are supervised by all the higher government authorities, in the context of the federal, community or regional powers.
- At the bottom of the pyramid, we find the communes (589), which is the level of administration that is closest to the people. Like the provinces, they are under the supervision of the higher authorities. Depending on the powers exercised, they are supervised by the Federal State, the Community or the Region. In general, they are financed and audited by the Regions.

2.2.1.2 Distribution of competences

Federal State

Broadly speaking, the powers of the Federal State cover everything connected with the public interest. In the general interest of all Belgians, the Federal State manages the public finances, the army, the judicial system, social security, foreign affairs as well as substantial parts of public health and home affairs. So the Federal State has powers in these areas.

The Federal State is responsible for the obligations of Belgium and its federalised institutions towards the European Union or NATO. The Federal Government's powers also cover everything that does not expressly come under the Communities or Regions. The Federal State also has powers for exemptions and restrictions on the powers of the Communities and the Regions.

Regions

Regions have powers in fields that are connected with their region or territory in the widest meaning of the term. So they have powers relating to the economy, employment, agriculture, water policy, housing, public works, energy, transport (except Belgian Railways), the environment, town and country planning, nature conservation, credit, foreign trade, supervision of the provinces, communes and intercommunal utility companies. They also have powers relating to scientific research and international relations in those fields.

Communities

Since the Communities are based on the concept of "language" and language is "dependent on the individual", a number of other powers are obviously associated with the Communities. The Community has powers for culture (theatre, libraries, audio-visual media, etc.), education, the use of languages and matters relating to the individual which concern on the one hand health policy (curative and preventive medicine) and on the other hand assistance to individuals (protection of

youth, social welfare, aid to families, immigrant assistance services, etc.) They also have powers in the field of scientific research in relation to their powers and international relations associated with their powers.

Provinces

The provinces have extensive powers. They have devised initiatives in the fields of education, social and cultural infrastructures, preventive medicine and social policy. They also deal with the environment, with highways and waterways, the economy, transport, public works, housing, use of official languages, etc.

In short, the province is responsible for everything in its territory that is of provincial interest, in other words anything which needs to be done in the interests of the province and which does not come under the general interest of the Federal State, the Communities and the Regions, or under the communal interest.

Depending on competence provinces are supervised by either regions, communities or the federal state.

Communes

The powers of the communes are very extensive and cover everything that is in the "communal interest", in other words the collective needs of the inhabitants. The communes have powers relating to public works, social welfare, maintaining public order, housing, education, etc. They are mainly charged with the police forces, maintaining the registers of births, deaths and marriages, plus the registers of the population. It is also at communal level that the Public Centre for Social Assistance operates, providing social services.

Communes are subject to the supervision of the higher authorities, specifically the Federal State, the Communities, the Regions and the provinces. The communes must also perform the tasks imposed on them by higher authorities.

2.2.2 Smart City policy in Flanders

As Belgian state structure is rather complex this document zooms in into Smart City Policy and Smart City initiatives in Flanders and the Flemish communes. This analysis is not only relevant to gain more insight in policy but is also an important input for an analysis of potential funding sources.

2.2.2.1 Flemish Region

2.2.2.1.1 Policy making and policy implementation in Flanders

In Flanders, the powers of the Community and the Region are exercised by a single Parliament and a single Government: the Flemish Parliament and the Flemish Government. Each 5 year a new Flemish Parliament is elected. Based on the results of the elections a new Flemish Government is established. Currently the Flemish Government consists of 9 ministers.

- Political responsibility for policy areas or certain policy fields (= part of a policy area) is distributed amongst ministers and their competent cabinets. Each minister drafts a policy memorandum, the key strategic choices of a minister's policy for the term of office. The policy memoranda are discussed in and approved by the Flemish Parliament.

- Administrative responsibility for policy areas is assigned to departments and several agencies. A department is responsible for the preparation and evaluation of the policy and regulations. The agencies implement the policy.

2.2.2.1.2 Examples of relevant policy measures

2.2.2.1.2.1 Flanders In Action

Flanders in action is Flanders project for the future ("VIA"). By 2020, Flanders wants to stand out as an economically innovative, sustainable and socially caring society. Objectives have been laid down in the Pact 2020 by the Government of Flanders and all the major social partners. Focus is on 13 challenges, amongst them :

- **CARE - FLANDERS' CARE:** Flanders' Care wants to improve the provision of quality care and to promote corporate social responsibility in the care economy in a demonstrable and innovative fashion. The aim of Flanders' Care is to realise innovative breakthroughs in all types of care.
- **MOBILITY - SMART MOBILITY:** How do we make sure that Flanders remains easily accessible to its inhabitants and companies? What does sustainable mobility mean? How can we make optimal use of the available infrastructure to this end? Is logistics a matter of mobility or capacity?
- **ENERGY - RENEWABLE ENERGY AND SMART GRID:** The energy issue is worldwide one of the biggest societal and economic challenges. Flanders wishes to play a pioneering role in this context. Energy is a basic need and a basic right. But non-renewable energy sources such as oil, gas and coal are becoming depleted.
- **INNOVATION - STREAMLINING OF TARGETED INNOVATION POLICY:** How can we respond to great societal challenges, such as climate change, the ageing population and an efficient approach to mobility and logistics? Such comprehensive issues require innovative and 'systemic' solutions. 'More of the same' is no longer an option.
- **MATERIALS MANAGEMENT - SUSTAINABLE MATERIALS MANAGEMENT:** Preventing a shortage of raw materials through smart design and recycling. In order to face the increasing scarcity of raw materials and the rising raw materials prices and to maintain a healthy living environment, Flanders wants to excel in the field of sustainable materials management.
- **CITY - TOWARDS A SUSTAINABLE AND CREATIVE CITY:** What does tomorrow's city look like? How can we make sure that more people can live together in the same space in an agreeable way? How can a city discover and recognise the potential of its inhabitants? And how can the city act as a positive buffer against global climate change?
- **LIVING AND BUILDING - SUSTAINABLE LIVING AND BUILDING:** Flanders is facing an important challenge: how do we want to work and live together in the future? The buildings in which we live and work are often badly tailored to future changes and hardly contribute to the social fabric or the creation of living cores.
- **SPACE - SPACE FOR TOMORROW:** About one fourth of Flanders is occupied by buildings, pavements and gardens. This proportion even grows every day by a surface area of 12 football pitches! This increases the risk of flooding, and it nibbles away at the space we need for recreation and to let nature take its course. Flanders in Action wants to manage

the space efficiently so that we can keep living in a pleasant environment, without traffic jams and floods, but with preservation of nature and agriculture.

- **NEW INDUSTRY - NEW INDUSTRIAL POLICY:** Maintaining prosperity and competitiveness in a changing world by transforming the industrial activities into value chains and clusters of the future. How can Flanders safeguard its assets as a thriving and competitive region in a globalised world?

2.2.2.1.2.2 IWT – Roadmap for Key enabling technologies

Flanders is supporting the KET approach of the European Commission. For this reason IWT – the Agency for Innovation by Science and Technology - launched a call for proposals to draft technology roadmaps for each of the KETs.

Each project must start from the EU KET approach and has to translate this approach to Flanders (supply, demand, value chains, etc.). Furthermore the projects have to develop a strategy on how to connect with all European KET developments, define leading organisations and draft an implementation plan.

DSP Valley is involved in the KET road mapping project on semiconductors.

2.2.2.1.2.3 Sustainable and creative cities

By 2030, Flanders will have a million more inhabitants than it has today. This population growth poses major spatial, social and ecological challenges and opportunities for Flanders, especially for its cities.

The Government of Flanders views cities as the engine of society, places where solutions for social challenges are found innovatively. This is why the Government of Flanders' urban policy stimulates cities to evolve into sustainable and creative places.

The aim is to provide a sustainable future for everyone. Flanders stimulates its cities by providing both subsidies and expertise. It promotes innovation, knowledge development and exchange of experience between all those who are involved in building sustainable cities. The urban policy is a specific competence of the Government of Flanders, which also has a Flemish Minister for Cities.

Not only is the urban policy embedded in the general policy of the Government of Flanders, but, since 2000, it has also consisted of a specific policy for which there is a budget of EUR 147 million. Flanders forms a partnership with its cities to conduct this urban policy.

The policy mainly supports the cities of Antwerp, Brussels (by way of the Vlaamse Gemeenschapscommissie/Flemish Community Commission), Ghent, Aalst, Bruges, Genk, Hasselt, Kortrijk, Leuven, Mechelen, Ostend, Roeselare, Sint-Niklaas and Turnhout. Twenty-one smaller cities can rely on subsidies for urban renovation. More information: www.thuisindestad.be

2.2.2.1.2.4 The Flemish Climate Policy Plan 2013-2020

Building on the experience gained with previous climate plans, this third Flemish Climate Policy Plan (VKP) consists of an overall framework and two separate but closely related sections:

- The Flemish Mitigation Plan (VMP): the purpose of the VMP is to reduce emissions of greenhouse gasses in Flanders between 2013 and 2020 as a means of combatting climate change. A basis will also be laid for the further emission reductions required towards 2050.
- The Flemish Adaptation Plan (VAP): the purpose of the VAP is to understand the Flemish vulnerability to climate change and then improve its ability to defend against its effects.

Although mitigation and adaptation cannot be viewed independently, there are a number of clear differences in their time horizons, sectors and approach and hence Flanders cannot simply apply the same trajectory to the two themes. Internationally as well, mitigation and adaptation are worked out separately despite their strong interrelation. Therefore it was decided to use two different but strongly correlated sub-plans. The two sub-plans together make up the VKP and must be viewed together for a complete picture of Flemish climate policy. The two plans are tied within the Government of Flanders' broader policy framework.

2.2.2.2 Smart City policy in Flemish Communes

2.2.2.2.1 Policy making and policy implementation in Flemish Communes

Belgium comprises 589 municipalities. Policy making is comparable to the policy on other levels. Each 6 years elections for the Municipal Council are organized.

The Mayor is not only the head of the municipality, he or she is also the representative of the Regional and the Federal Government at the local level. In that capacity, he or she is responsible for the execution of laws, decrees, ordinances and orders. The Mayor is also responsible for the maintenance of public order in his or her municipality. He or she chairs the College of Mayor and Aldermen or the Municipal College, depending on the Region, as well. In the Flemish Region the Mayor is appointed by the Regional Government, on the nomination of the Municipal Council, for a term of office of six years.

The executive organ of the municipality is known as the College of Mayor and Aldermen, commonly referred to as the College of Aldermen. This College is responsible for the daily administration of the municipality. It is also responsible for the preparation and implementation of the decisions of the Municipal Council.

The Municipal Council is the representative assembly of the municipality and consists of members directly elected for a term of office of six years. The number of municipal councillors depends on the number of inhabitants of the municipality, and can vary from 7 to 55. It is responsible for all matters that are of municipal interest.

Policy making is comparable to other democratic institutions. A policy memorandum and related policy measures are prepared by the College of Mayor and Aldermen and discussed and approved by the Municipal Council.

For the remainder of the project we will focus on the so-called 'centrumsteden'. Communes are categorised as 'centrumstad' when they have a central function in their region, including employment, care, education, culture and entertainment. Aalst, Antwerpen, Brugge, Genk, Gent, Hasselt, Kortrijk, Leuven, Mechelen, Oostende, Roeselare, Sint-Niklaas and Turnhout are categorized as 'centrumstad'.

2.2.2.2.2 *Examples of relevant policy measures and supported initiatives*

2.2.2.2.2.1 *Signature of Covenant of Mayors*

Mayors of 6 Flemish communes (Oostende, Gent, Antwerpen, Hasselt, Genk, Leuven) signed the Covenant of Mayors. The Covenant of Mayors is the mainstream European movement involving local and regional authorities, voluntarily committing to increasing energy efficiency and use of renewable energy sources on their territories. By their commitment, Covenant signatories aim to meet and exceed the European Union 20% CO2 reduction objective by 2020.

2.2.2.2.2.2 *Knowledge Center Flemish Cities*

The Knowledge Center Flemish is an association of the Flemish ‘Centrumsteden’ and has as objective to strengthen urbanization in Flanders. The knowledge centre focuses on knowledge gathering, development and dissemination. It facilitates interaction and knowledge sharing between the ‘centrumsteden’ and supports policy making. The Knowledge Center is a great source of information on all kind of initiatives and projects. For example, an exhaustive database of projects set up by communes is available on the website.

2.3 *Denmark*

All city councils of the Region Nord have plans for sustainability. For example, the city of Aalborg has formulated a plan involving the themes city development, mobility, energy supply, citizens, industrial development and the environment. Also, ICT is acknowledged to be the most important driver of growth in the city. This is e.g. reflected by a well-functioning on-line information system for the public transportation system. An English summary of the sustainability plan may be found at <http://www.sustainablecities.eu/aalborg-process/commitments>. Although ranked 4th in a report comparing 70 medium sized European cities on the ‘Smart City’ concept, the current strategy does not mention specific plans within the ICT area.

At the regional level, there is no specific policy involving Smart Cities and Embedded Systems. However, the region supports innovation projects within the areas, and it also recognizes ICT as the most important driver of growth within the region. This is demonstrated by the fact that the region was among the first in Denmark to implement a new nation-wide smart-card for public transportation.

At the national level, a catalogue of potential future innovation areas has recently been collected, and here the area ‘Smart Society based on Big Data’ has been selected as one out of a few to be promoted through a triple helix partnership. In the description, ICT and in particular embedded systems play an important enabling role.

2.4 *Spain*

2.4.1 *Plan for Science, Technology and Innovation 2020*

The Plan for Science, Technology and Innovation 2020 of the Basque Government gives a shared vision of the future, combining the necessary establishment of objectives and the budgetary allocation commitment from Public Institutions (top & down politics) with the contribution of the System Agents to define the specialization priorities (bottom up politics)

The push and promotion of Science, Technology and Innovation is a transversal process that concerns many aspects of social life, and in this connection, requires a full system of governance which includes all the capacities and responsibilities.

The coordinated Plan for Science, Technology and Innovation activities in the Basque Country begins by an overall vision of the developed activities by the Basque Institutions to encourage inter-institutional cooperation and collaboration and the complementarity of measures and the push of coordinated projects.

<http://www.spri.es/actualidad/noticias/euskadi-aprueba-su-estrategia-de-especializacion-inteligente-y-las-lineas-estrategicas-del-pcti-2020#>

2.4.2 RIS 3 Strategy

The Research and Innovation Smart Specialization Strategy (RIS 3) of the Basque Government (SPRI) are part of the different overall strategies developed by the EU: Europe Strategy 2020, Horizon 2020, Innovation Union, European Strategy related to Key Enabling Technologies (KETs) and Common Strategic Framework developed for the application of the Structural Funds.

RIS 3 are an indispensable condition for access to the European Cohesion Funds and could have impact in the funds related to Research, Innovation and Economic Development.

RIS 3 intend to define regional R+D+i strategies which “smart”, in the sense of contracting their resources and investments in the areas where synergies existed with existing and potential productive capacities of the region. Smart specialization means, to identify the characteristics and actives of each region, to highlight their competitive advantages and meet the participants into a shared future vision. The main objective of the whole process of RIS 3 is to support the productive transformation to create employment and social welfare in the medium-long term. For this reason, a set of starting criteria is defined to be considered in the election of the priority areas.

The Basque Government has defined 3 smart specialization criteria related to advanced manufacturing, energy and biosciences (where human health is in the main core of the activity). Besides, a series of niches have been identified with different level of maturity related to territory.

2.4.3 Digital Agenda of Euskadi 2015

The new interdepartmental plan, led by the Department of Innovation and Information Society Department of Economic Development and Competitiveness of the Basque (Euskadi) Government, is aimed at promoting and enhancing the Information Society in Euskadi with a time horizon of 2015.

<http://www.euskadinnova.net/es/portada-euskadinnova/politica-estrategia/agenda-digital-euskadi-2015/113.aspx>

2.4.4 Euskadi – Innova

Euskadi + Innova is the strategy shared by all individuals and entities involved in the promotion of innovation in the Basque Country to undertake economic transformation and to convert Euskadi as a benchmark for innovation in Europe.

Therefore, Euskadi + Innova wants to contribute to improving the competitiveness of the Basque business through initiatives that encourage the shift towards a culture of innovation, fostering an innovative environment, developing skills and management skills, promoting the introduction and use of ICT in companies and society in general.

<http://www.euskadinnova.net/es/portada-euskadiinnova/euskadiinnova/que-es/103.aspx>

2.4.5 Nanobasque Strategy

Through the nanoBasque Strategy, the Basque Department of Economic Development and Competitiveness is working to accelerate the adoption of micro-and nanotechnologies in Basque companies, notably nanoscience, micro and nanotechnologies. The four core areas are materials, micro-nano-bio convergence, facilitatory tools and techniques, and environment, health and safety.

<http://www.nanobasque.eu/aNBW/web/en/strategy/index.jsp>

3 Cluster Competencies

This is the essential part of the deliverable. It will show the core competencies and strengths of the partners, assessing which contributions each partner is especially suited to make to the vision of smart cities.

3.1 *Bird's Eye View*

The mission of CLINES is to provide a framework and a joint action plan for intercluster cooperation to unlock novel business opportunities in the domain of embedded technologies for smart cities. New business opportunities which can be the basis for sustainable economic growth and which will be enabled by key technologies, in this case embedded systems. Because technology only creates value when it meets specific (un)known market needs, the CLINES consortium decided to focus on the challenges modern cities are faced with and for which solutions can be built by leveraging on the opportunities offered by embedded systems and on the capabilities of embedded system communities.

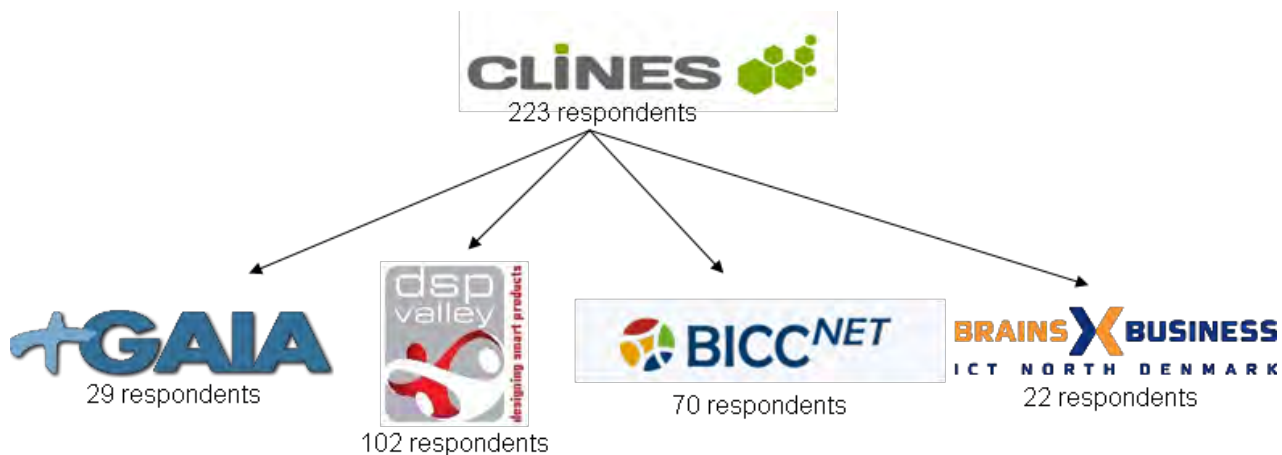


Figure 3 - Questionnaire respondents in each of the CLINES partner regions

To gather a first insight in those capabilities and concrete market needs the CLINES consortium distributed a collectively developed questionnaire amongst their cluster members. 223 respondents filled out the questionnaire. This 'Bird's eye view' looks at those results from a European viewpoint, taking all the 223 respondents from the whole cross-regional ecosystem as a whole into account. The respondents consist of 29 Spanish replies (GAIA), 102 Flemish respondents (DSP Valley), 70 German respondents (BICCnet) and 22 Danish respondents (Brains Business/AAU). For a detailed evaluation of the regional results we refer to the regional breakdowns in this document.

This Bird's eye view does not have the ambition to draw conclusions. Although it will paint a 'high level' picture of the different regions involved, in-depth analysis of synergies between different regions will be part of other deliverables. This bird's eye view is intended to provide input and inspiration for the remainder of the CLINES project activities (such as the innovation workshops).

3.1.1 Smart City challenges

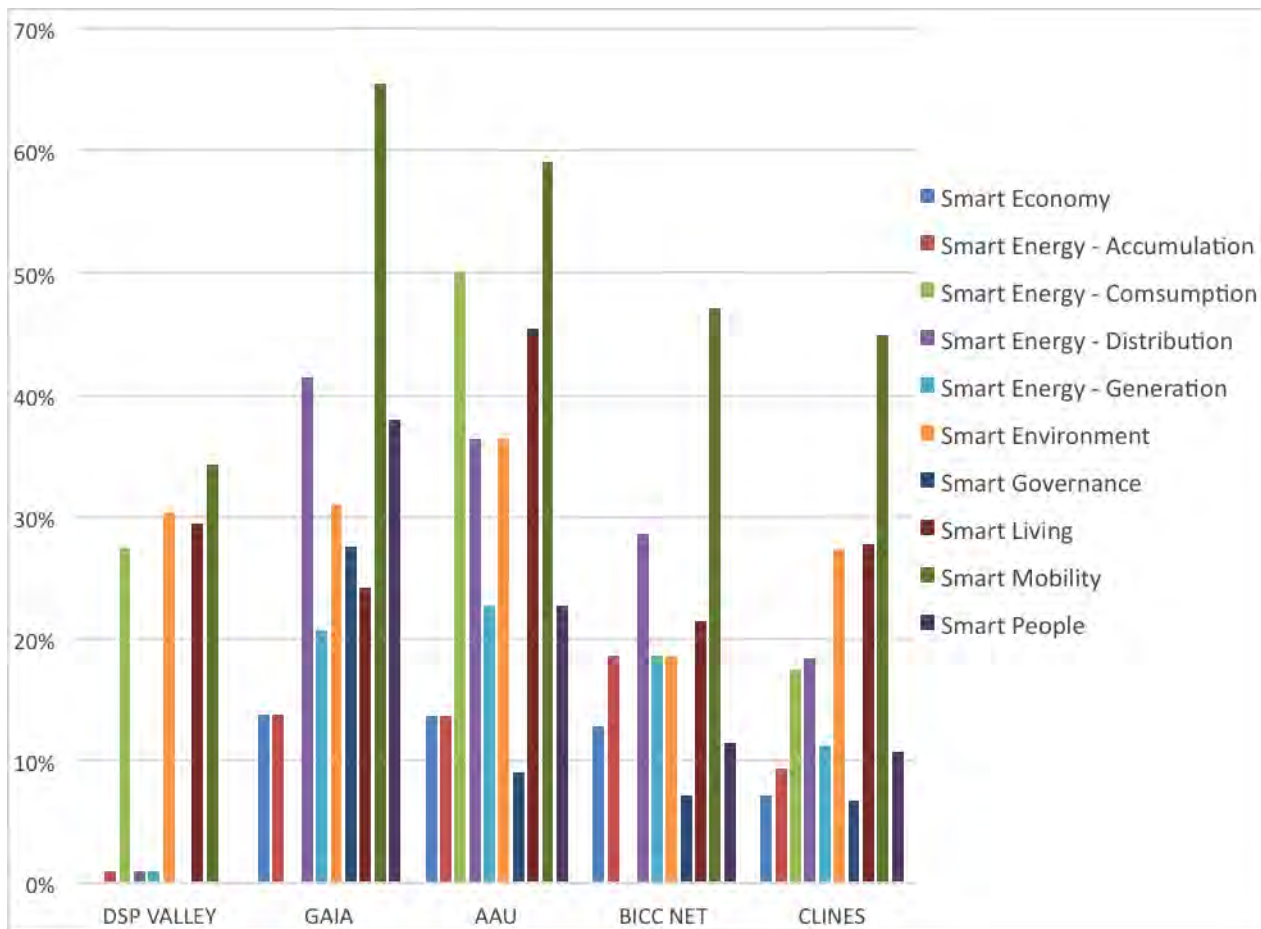


Figure 4 - Smart City priorities per region

3.1.1.1 Total CLINES Ecosystem

When focusing on the challenges cities are faced with, the respondents indicate Smart Mobility, Smart Living and Smart Environment as the top 3 challenges they have to focus on when they want to make money within 3 years.

3.1.1.2 Regional Comparison

When zooming in on the regional data, the top 3 of smart priorities differ from region to region. However, smart mobility remains a top priority for each region. The table below summarizes the top 3 smart city priorities for each region.

DSP Valley - BE	GAIA – ES	AAU - DK	BICC - GE
Smart Mobility	Smart Mobility	Smart Mobility	Smart Mobility
Smart Living	Smart Energy Distribution	Smart Energy Consumption	Smart Energy Distribution
Smart Environment	Smart People	Smart Living	Smart Living

3.1.2 Market Segment

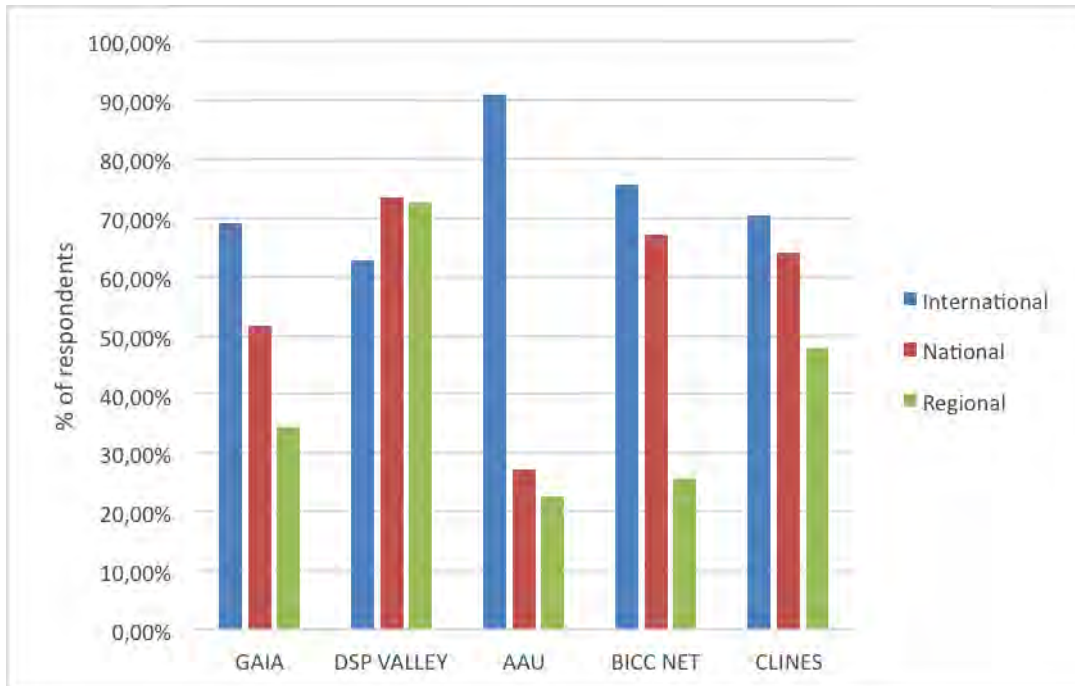


Figure 5 - Geographic focus

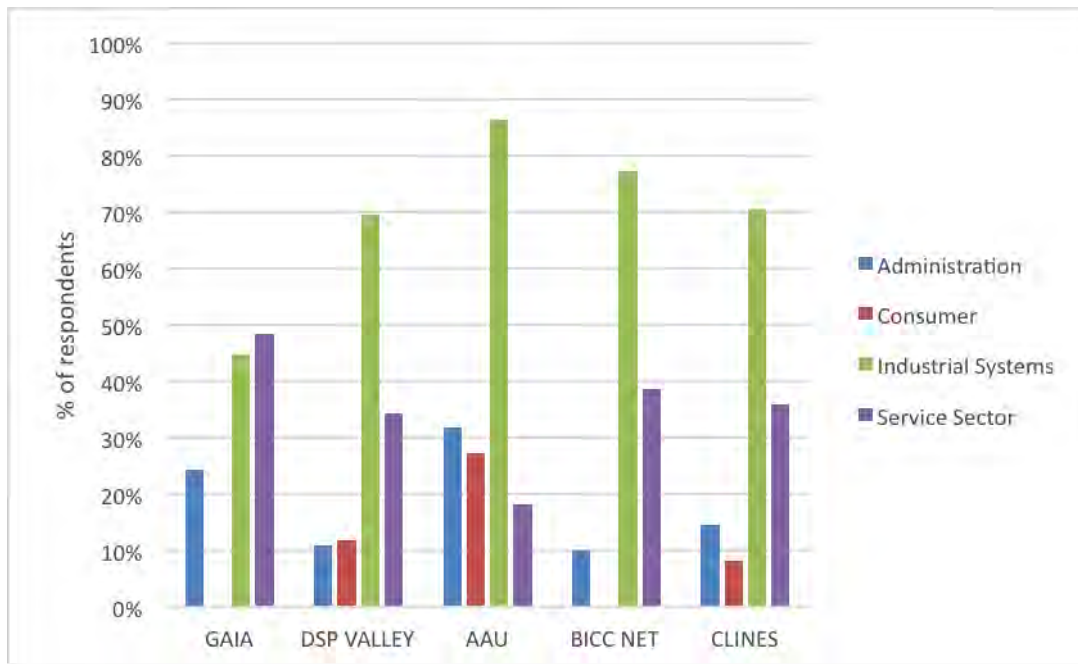


Figure 6 - Business sector

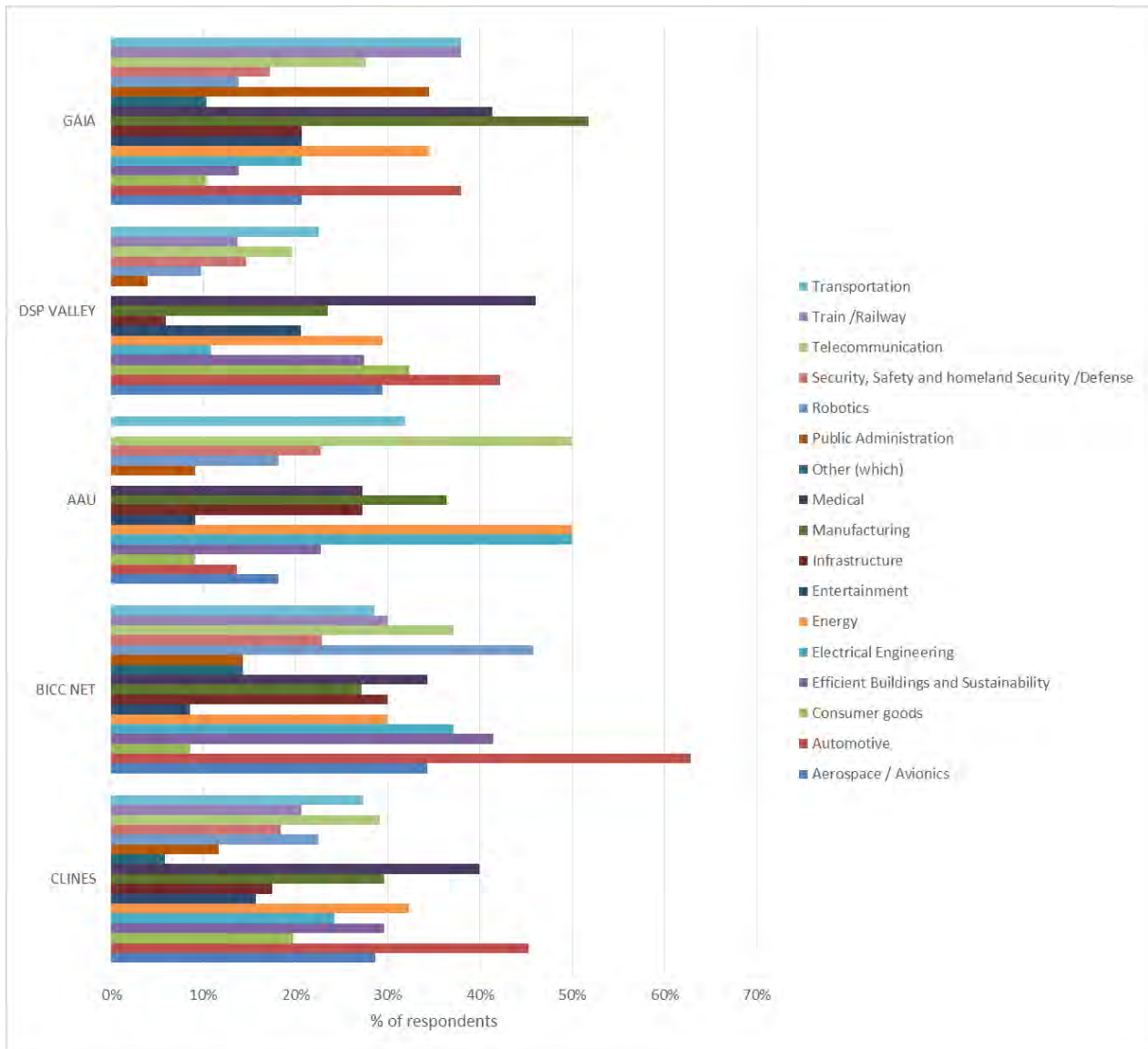


Figure 7 - Business domains

3.1.2.1 Total CLINES Ecosystem

Most of the respondents are geographically focusing on international and national markets. They are mainly active in industrial market sectors. The top 3 business domains where CLINES respondents are focusing on are automotive, medical and energy.

3.1.2.2 Regional Comparison

With regard to regional focus and market sectors regional results and overall CLINES results only differ slightly:

- With regard to regional focus the Flemish respondents focus more on national and regional markets whereas the respondents from other regions are slightly more internally focused.
- With regard to market sectors the industrial systems sector is the most important, although the Spanish respondents report that the service sector is slightly more important.

Concerning the business domains there is a considerable difference between the overall CLINES top 3 of business domains and the top 3 in each region. This can be explained by the fact that the larger number of respondents from DSP Valley and BICC bias the combined result.

DSP Valley - BE	GAIA – ES	AAU - DK	BICC - GE
Medical	Manufacturing	Telecommunication	Automotive
Automotive	Medical	Energy	Robotics
Consumer Goods	Automotive Transportation Railway	Electrical Engineering	Efficient buildings & sustainability

3.1.3 CLINES Expertise & Capabilities

For the whole CLINES ecosystem, respondents report both hardware (mainly sensors/actuators) and software (applications) development capabilities. A good share of the respondents are also involved in integration activities. Specialized Smart Cities capabilities and expertise are widely available amongst cluster members.

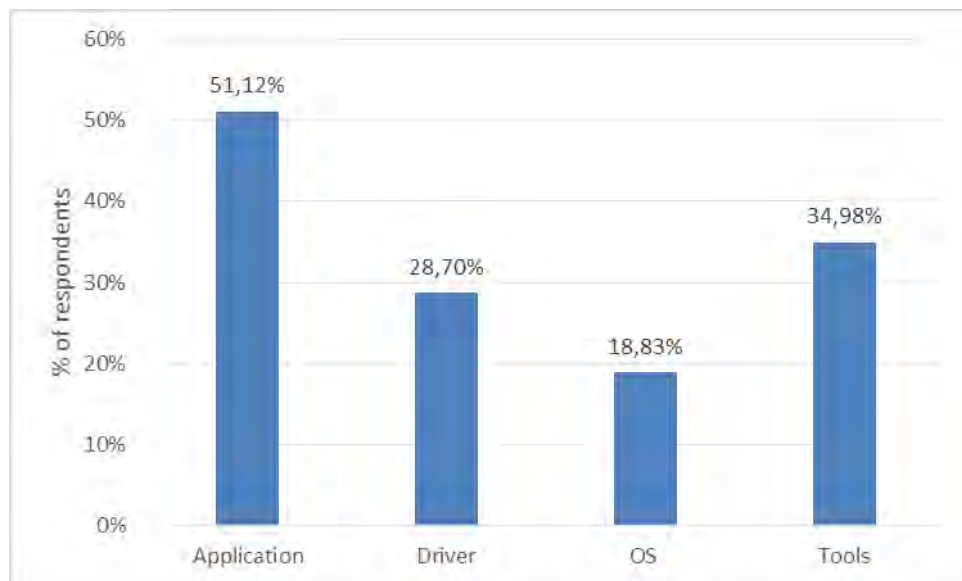


Figure 8 - Software development

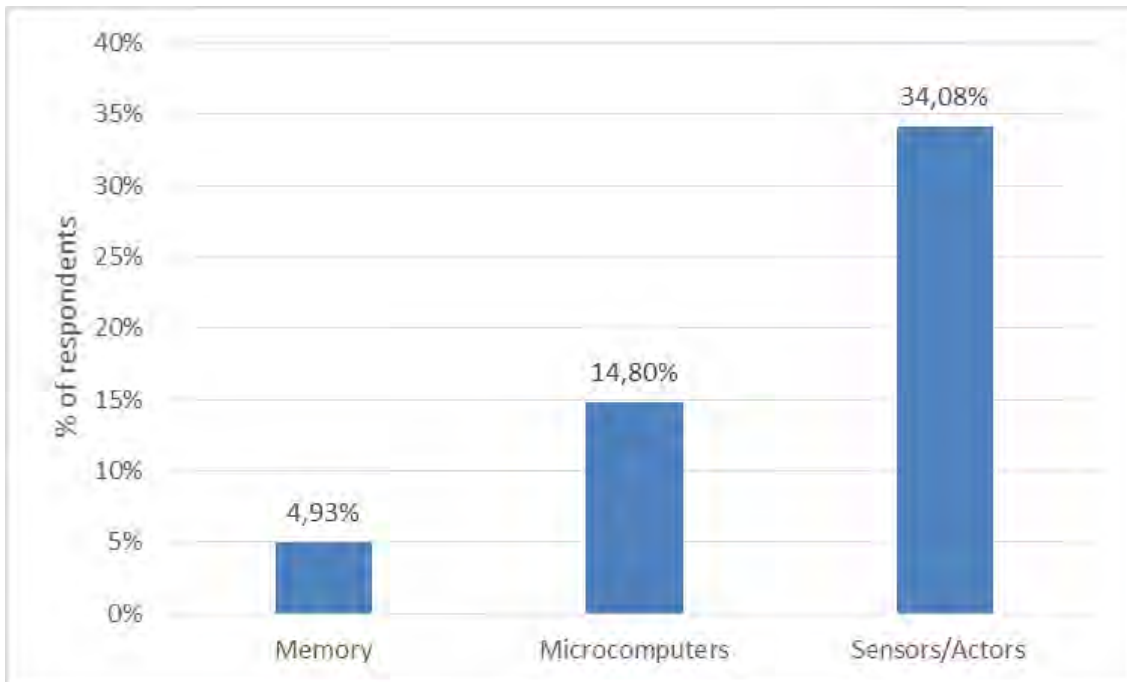


Figure 9 - Hardware focus

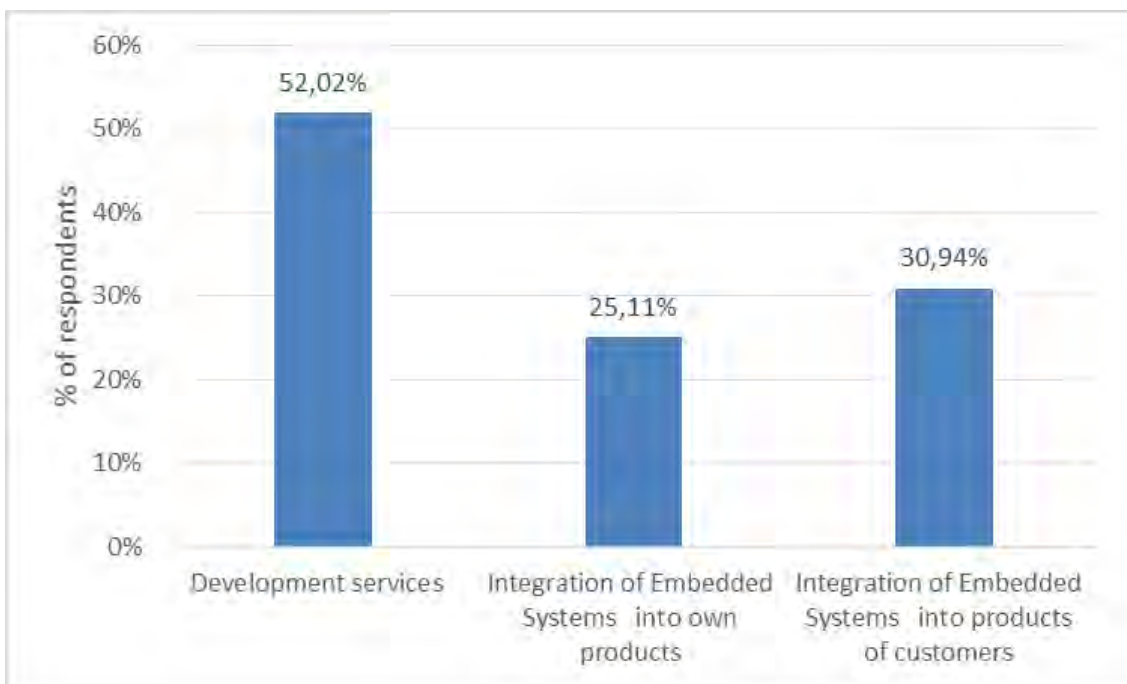


Figure 10 - Development vs. integration

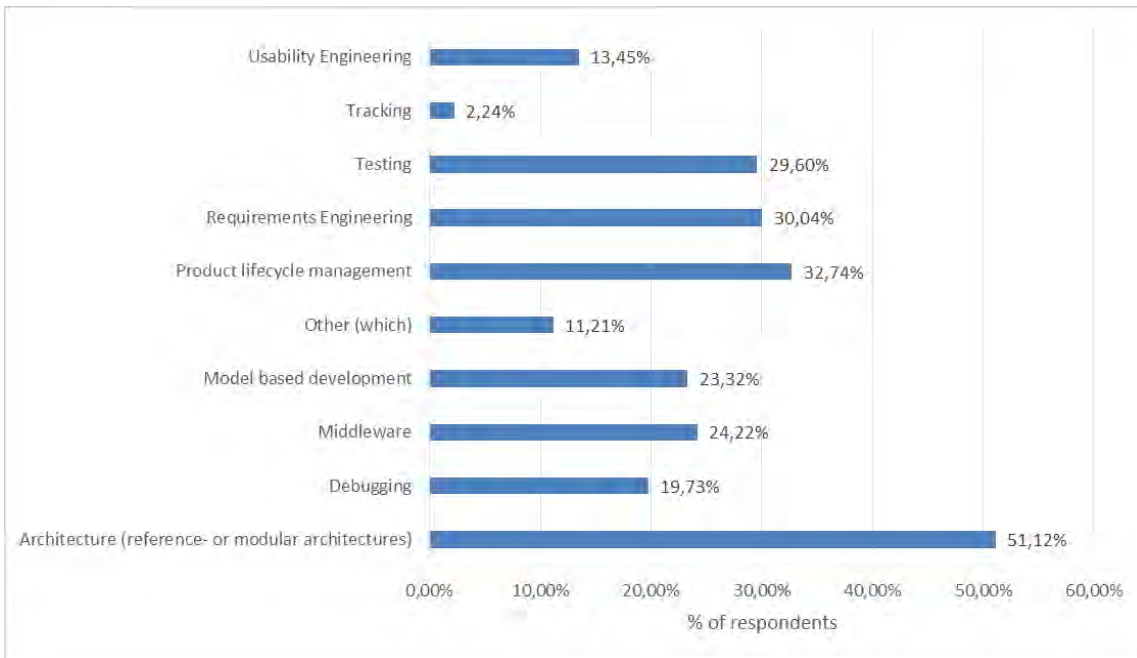


Figure 11 - Capabilities

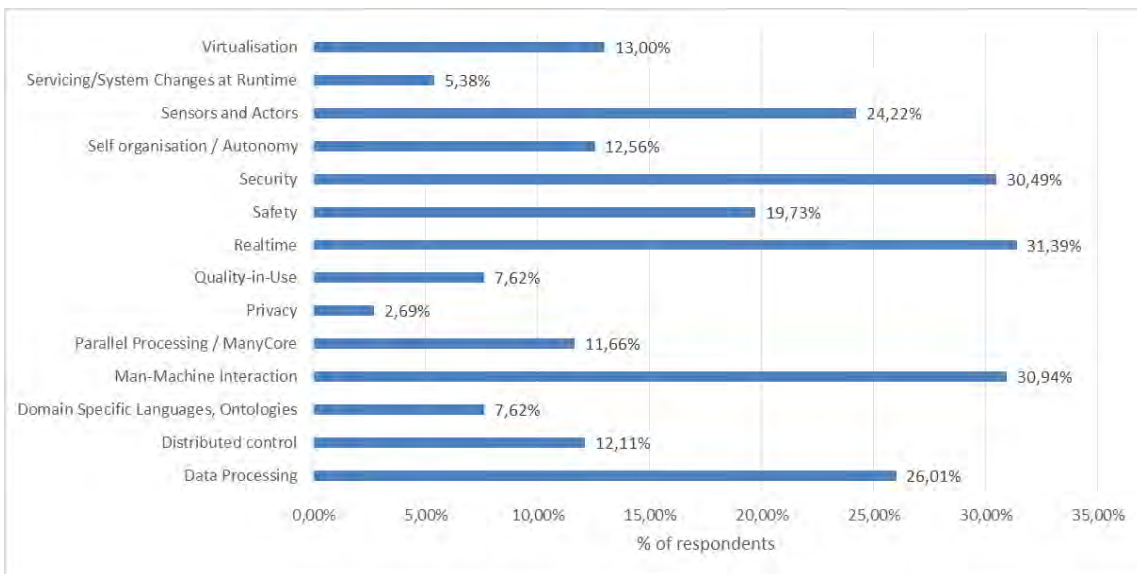


Figure 12 - Specialized expertise

3.2 **BICCNet, Bavaria**

3.2.1 **BICCnet, the core of the cluster**

BICCnet, the Bavarian Information and Communication Technology Cluster, was founded in 2007 by the Bavarian Ministry of Economics (StMWIVT), by which it is supervised and funded. Organisationally, BICCnet is integrated within the Technische Universität München.

The goal is to ensure the growth of the ICT industry in Bavaria, by activating and interlinking the innovation and productivity potential of the Bavarian ICT enterprises, research centres and universities. Research results are to be transformed into marketable applications more quickly. Over the past years, the currently 650 core actors (from industry and research centres) participated in 171 events, and collaborated 19 cooperation platforms and 12 joint R&D projects. New co-operations are being continually established. A focus on marketable innovations and a specialisation of the involved parties is inherent. To a large extent new cluster members are activated, motivated and integrated by already existing members and stakeholders.

3.2.2 **Bavaria at a glance**

Nearly all branches of industry of any significance to the German economy are not merely represented but have a powerful presence in Bavaria. They include electrical engineering, automotive engineering, aerospace, information and communication, finance, and the media industry. A part of the economy is dominated by international giants like BMW or Allianz insurances, who have their headquarters in Munich. Beyond that, the market consist of a healthy and curious network of SMEs who act as suppliers for the industry leaders, or often are niche industry leaders themselves.

Following is a list of the Bavarian key players in each of the industries:

Automotive: BMW, Audi, Knorr Bremse, AVL, MAN, OKS Spezialschmierstoffe, Iwis

Live Sciences/Medical: sepp.med, Siemens Medical, SurgicEye, many concentrated in the “Medical Valley” in the town of Nürnberg;

Aerospace: EADS, German Aerospace Center (DLR), MTU aero engines

Financial Services: Munich Re, Allianz, Hypovereinsbank/UniCredit, Oskar Schunck, wirecard, Münchner Bank

3.2.2.1 **ICT in Bavaria**

In a German context, the Land of Bavaria is quite a heavyweight: 40% of all IT companies are located in Bavaria. One third of all patents in the ICT industry are granted to Bavarian companies. A total of 380 000 people - 44% of the German ICT workforce - are employed in the ICT sector here. Each year, 4000 students graduate with an IT degree.

Because of the ample presence of various industries in Bavaria, the ICT companies have the advantage of being close to their specialised industrial customers. The topics revolve around

Software and Systems Engineering, Embedded Systems, Smart Grid, Modelling, Home Automation, Communication Systems, Multicore and Security – much of it brought together under the headline of Cyber-Physical Systems.

Key **ICT** players: Siemens, Kontron, Cirquent, MicroSys Electronics, Intel Mobile Communications, KUKA, Validas, Nemetschek, scout24, Acronis, EPCOS, Fujitsu Technology Solutions, Giesecke & Devrient, Linguatic, Siltronic, Allgeier, SHS Viveon

3.2.2.2 Core Research Institutions

Universities: Technical University Munich, Ludwig Maximilians University Munich, Friedrich-Alexander University Nürnberg, University of Passau, University of Augsburg

Applied Research:

- **Embedded Systems:** Fraunhofer ESK Institute for Communication Systems
- **Security and Safety:** Fraunhofer AISEC Research Institute for Applied and Integrated Security
- **Modelling:** fortiss institute for software intensive systems; EIT research action line “Cyber Physical Systems” at fortiss

3.2.3 Region Upper Bavaria / Munich

In Upper Bavaria, the core region of the BICCnet cluster, there are 5000 registered ICT companies (not counting the 7400 small traders), with an annual sales volume of 40000 Million Euros. A whole 75% of them reside within the district of Munich.

Munich is the only German town that made it into the Top 10 of the “CNN Global 500” cities according to corporation headquarters. A 2014 study of the European Commission on top ICT hubs in Europe even placed Munich number one, before London and Paris.

Embedded Systems

The 740 registered companies that specialise in Embedded System employ a total of 29000 people. A whopping share of 75% are SMEs (up to 250 employees), with the SMEs alone grossing a total annual sales volume of 4200 Million Euros. Geographically, 60% of the Embedded companies reside in Munich.

Most of the companies are well-established in the domain of Embedded Systems, 83% of them are in the business for more than 3 years.

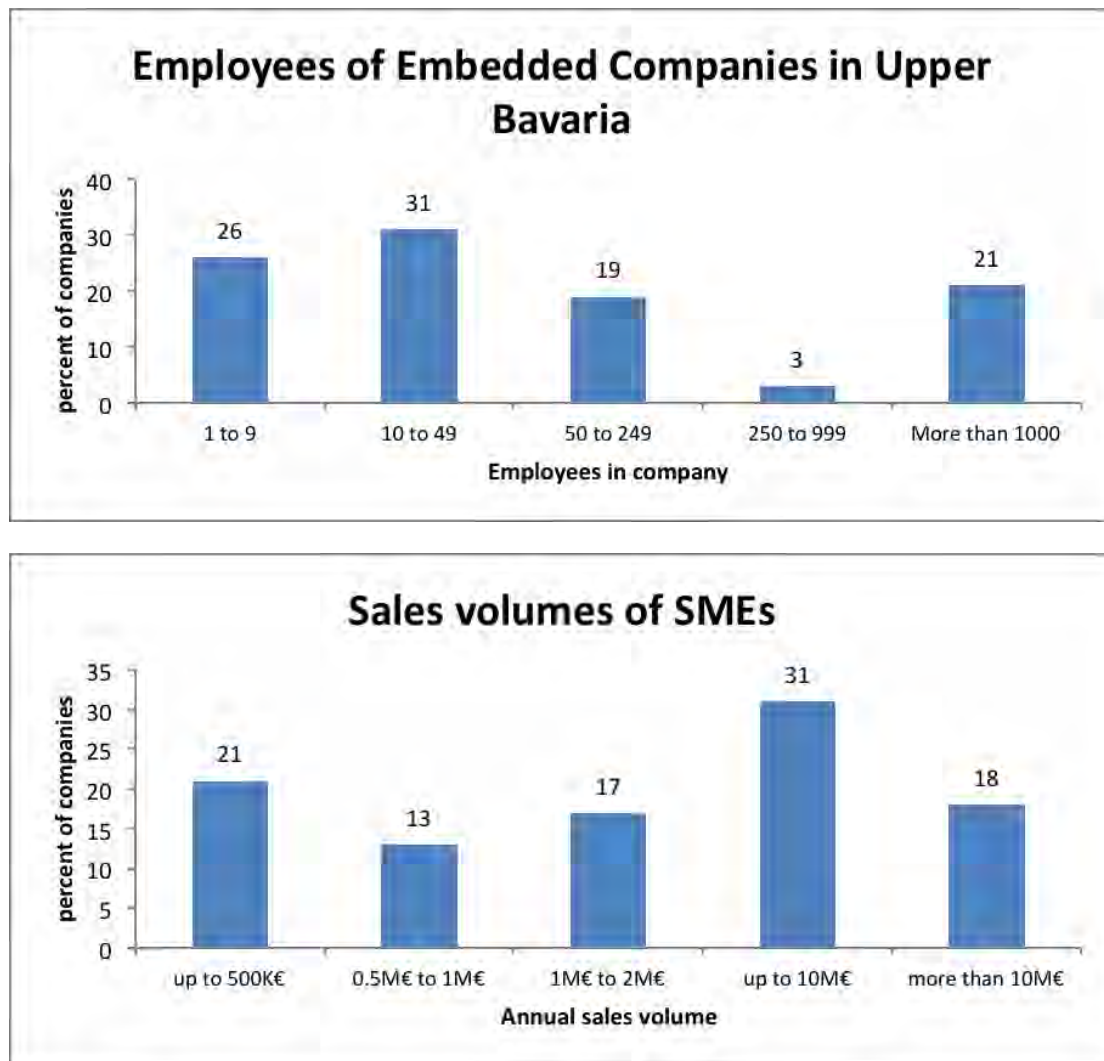


Figure 13 - Employees per company and sales volume of SMEs in Upper Bavaria

3.2.4 Region Swabia / Augsburg

The market volume for embedded systems in Swabia is 650 Million Euros.

The companies specialising in embedded systems do a lot of the required engineering in-house: 69% develop their own embedded software, and 54% even their own hardware. This is mirrored by the finding that 51% use external software development services, but only 10% have cooperation with research institutions. From a cluster perspective, it is encouraging that 25% develop their software in cooperation with partner companies – even though 75% of those cooperations happen on a regional or national scale, which indicates a low-intensity international partner network.

The embedded software is more important than the hardware in the region: 65% of the companies that need embedded systems either for their own products, or in the production process, see the share of embedded software development of their total value creation as high or very high.

The application domains for the embedded systems are very broad, with a stronghold in the automation industry

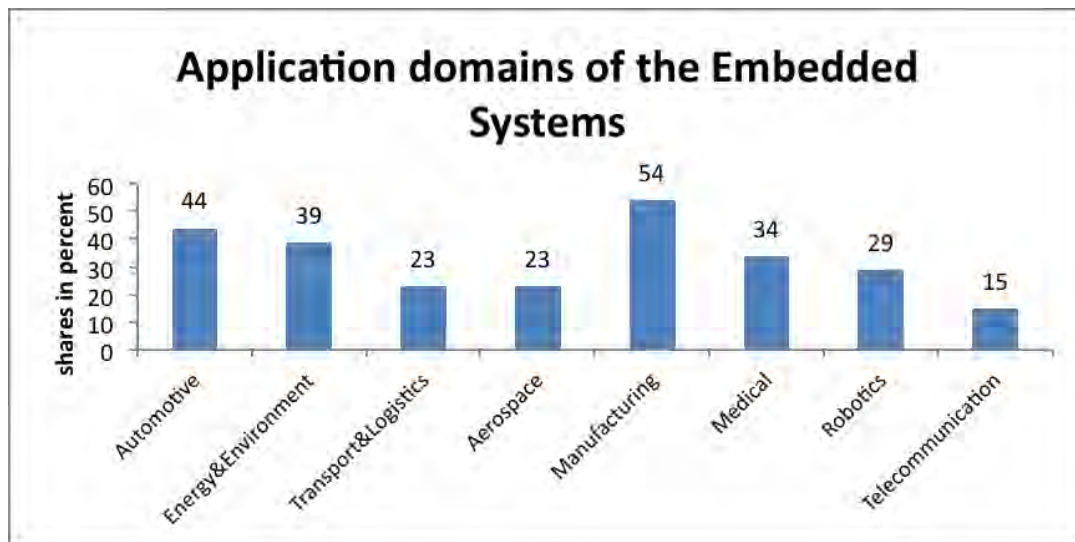


Figure 14 - Application domains in Swabia

3.2.5 Smart City Competencies in Bavaria

The market numbers in the embedded systems domain were already available from previous studies (own, state-published, or compiled by the chambers of commerce). For some regions (Swabia, Upper Bavaria), some detailed statistics gave insight into specialisations. But so far, there was no data that could paint a picture of where Bavaria all together stands on embedded systems for smart cities.

In May 2014, BICCnet contacted 682 persons (from about as many companies and organisations) working in the field of embedded systems, asking to fill out the CLINES-questionnaire. The persons have been selected for their level of involvement in cluster activities. At the closing of the survey (two weeks after the initial mailing, and some gentle reminders), 70 persons had completed the questionnaire. This means we reached the return-rate of 10% we had been hoping for. For the following, do keep in mind that still a majority of the companies chose not to contribute data to this study.

From the respondents, 76% came from companies, and 19% from research institutions (the rest did not self-classify), meaning the answers are rather industry-generated. The participation of the research centres ensures that no burning open issues will get overlooked.

The following is an analysis of their answers, broken down by questionnaire topics.

3.2.5.1 Work fields

Looking at which hardware is produced, microcomputers play a big role with 27% (with 19 company replies here, this is the highest number within the CLINES regions). Memory production has only a small footprint.

Sensors and actuators, which will be needed to give smart cities input and feedback, are of interest to 21% of the companies. The biggest share is developing “general“ hardware, meaning that in a future study we would need to increase the level of detail in the questions here.

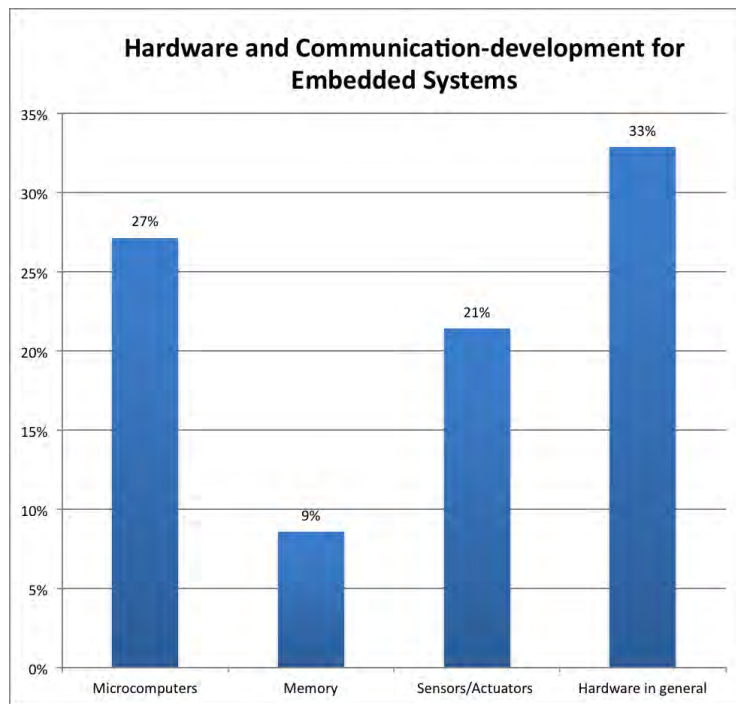


Figure 15 - Work fields: Hardware development

Some companies that can provide infrastructure for smart cities labelled themselves as producers of mechatronic systems.

It becomes clear that companies in Bavaria are not closed to cooperation: While 21% integrate embedded systems into their own products, 54% offer general development services, and 41% specifically help in the integration of embedded systems into products of other companies. The provision of engineering services is visibly a vibrant supporting industry.

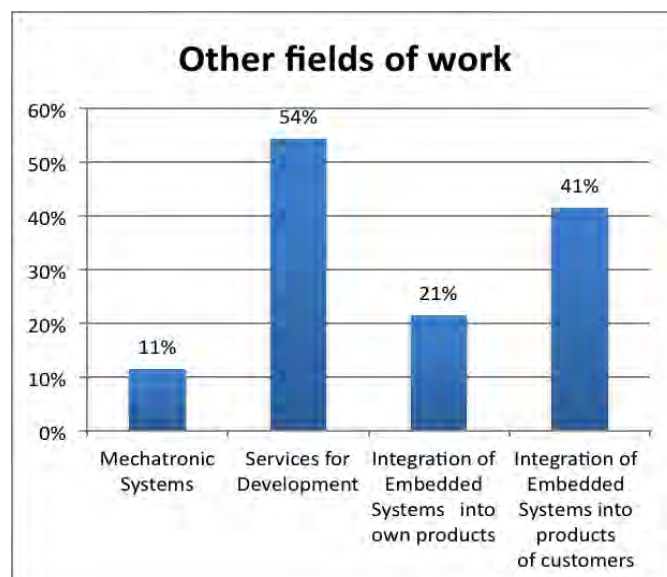


Figure 16 - Other work fields

In software development for embedded systems, it is clear that operating systems and device drivers for those are only of small interest. Along with the focus on integrating products, the development

focus is on applications, and on development tools to improve the development of those applications.

Of the big 43% that do software “in general“, it will be interesting to learn if this includes an upwards-integration of the embedded systems into higher abstractions layers (“sensor to the cloud“).

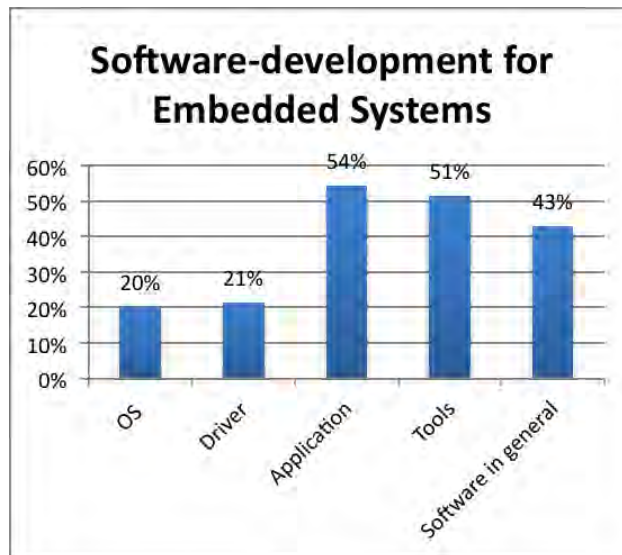


Figure 17 - Types of software development

3.2.5.2 Value Chain Position

Only 5 companies identified as being uniquely about hardware or about software, the rest adds value in both domains.

Hardware is the only domain where companies (8) are dealing directly with end customers! As a separate category from end user products, 9 companies do work as device manufacturers – as those spanning of course the hardware and software aspects.

The real focus is system integration: 47% of the companies are combining hardware and software into products. This nicely reflects the “product integration“ numbers from the “work fields“ answers.

3.2.5.3 Domains

That 63% of the responding companies are doing part of their business in the automotive sector is not surprising, since Munich and Ingolstadt are strongholds of the automotive industry (BMW, Audi). But it’s not only the head of this value chain that sits in Bavaria, but also the companies that produce the machines that produce the cars: Automation is the second-strongest domain, and manufacturing also well above 25%.

Concerning smart cities, Bavaria has a broad selection of competencies: A high involvement in smart buildings (41%) goes with specialisations in energy, infrastructure, transportation, and electrical engineering, the latter all in the 30% range. So from the wiring to the energy to the

transportation, the entire chain is covered. A high presence of telecommunication companies (37%) ensures that the services can be connected.

In the embedded area, consumer goods or entertainment are not of interest.

Few companies address public administration. Since the Bavarian government will be a player in establishing smart cities in the region, CLINES will need to bring politics and industry together on this topic.

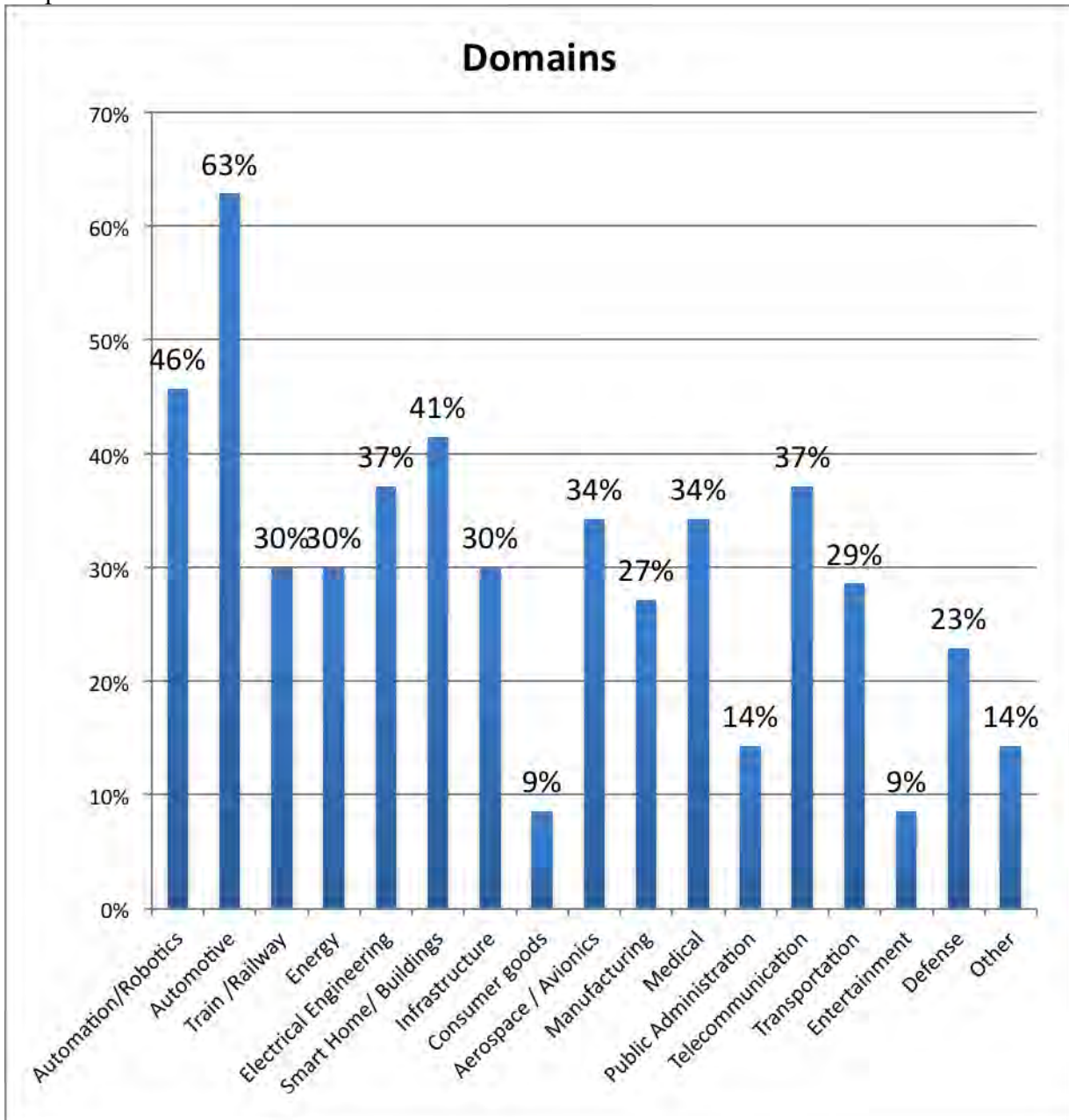


Figure 18 - Business domains with ties to Embedded Systems

3.2.5.4 Special Capabilities

Looking at special capabilities along the hardware/software development cycle, the Bavarian ecosystem is clearly a design-centred one. An astonishing share of 64% of the companies concern themselves with architecture. This finding might explain why the BICCnet working group “Embedded Architectures“ is so successful, and should give the position paper recently published by the working group some political weight.

As a sign of the maturity of the companies, 39% percent have capabilities in model based engineering, a development technique that operates on high abstraction levels, but yields quality improvements in the product – though it would be too much to say that this is the reason that only 21% of the companies have a special focus on debugging. With the fortiss institute as an advocate of model based development being located in Munich, one could conjecture that its collaboration with companies did spread the topic from basic research directly into the industry.

A similar reasoning might hold for the high presence of capabilities in product lifecycle management, and requirements engineering, which go hand in hand in the development cycle.

In the ecosystem, there are some companies that focus entirely on producing middleware – in the group of SMEs that assemble under the marketing name of “Embedded4You“, the middleware is the glue that holds the tool chains of the companies together.

The low focus on usability engineering (9 companies, same as for DSP) is somewhat troubling, since a good user experience becomes an important selling point. But then, consumer goods are the least important product, as pointed out in the domains chapter.

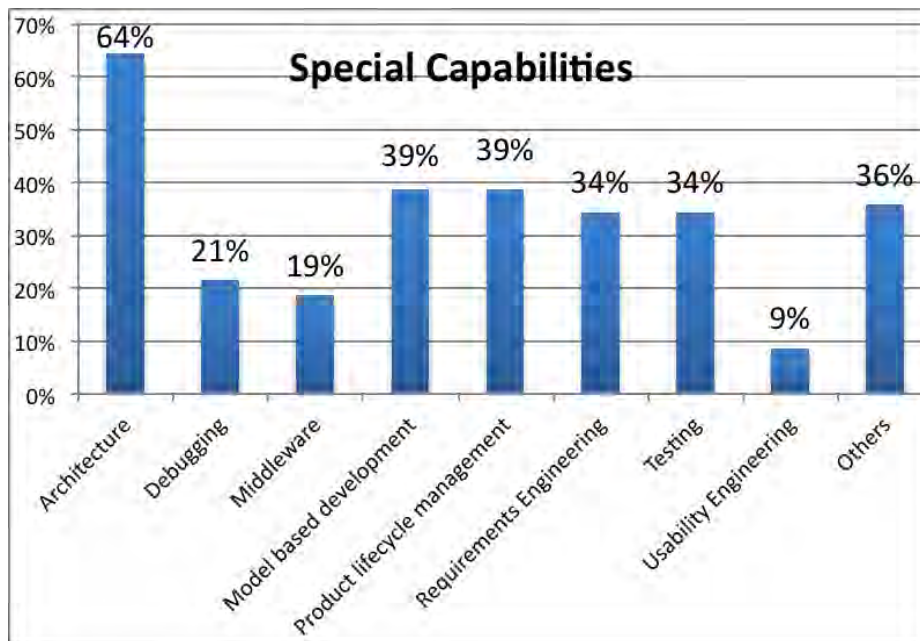


Figure 19 - Special capabilities

3.2.5.5 Specialisation Fields

The companies filling out the questionnaire did really invest some time here: On average, the companies selected the 5 (4.8) specialisation fields most suitable to the company. As a result, we have a very detailed picture of what the companies in Bavaria focus on!

The two most prominent specialisations, real-time and safety, are closely related, and come as no surprise with such a strong presence of automotive industry, which is centred on product safety. Also close by is the ability to build systems of systems (31%), that is building products out of embedded systems that communicate with each other.

But real-time and safety are also traits that are required for smart city infrastructure – which will be a giant system of systems. More building blocks (each above 25%) for the city of the future are sensors and actuators, connectivity (that is, communication links), and data processing. Still accounted for are localisation, low power devices, sensor fusion, and distributed control, each with around 20% of the companies.

The user facing end – as already showing in the special capabilities chapter - is not well covered (computer vision to detect the user situation, and user intention recognition being at 6% and 7%).

One area gets low attention by the embedded companies: Security. For BICCnet, that means that we need to put the members of our security network into contact with our embedded systems community. But already 19% of the companies do mention trust and data security as important capability.

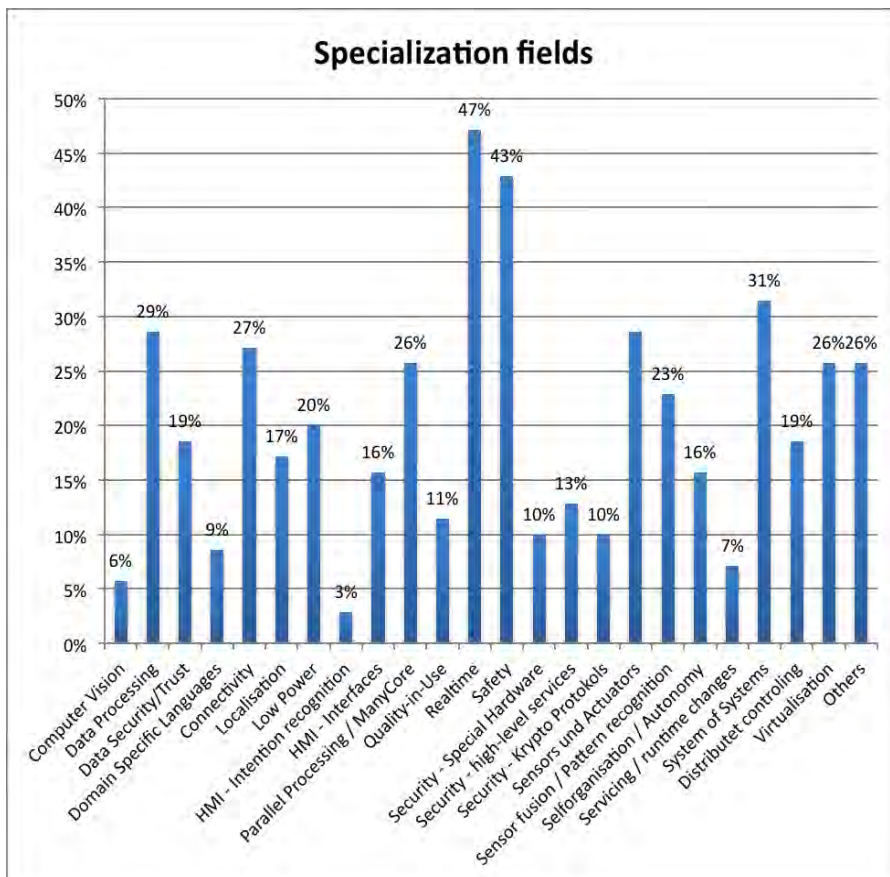


Figure 20 - Specialisation fields

3.2.5.6 Future Business

The question here was where the companies assume a growth potential for them in the next three years.

The predominant answer – smart mobility – automotive industry – is not surprising. The second-most frequent (41%) somewhat is: smart production. That intelligent manufacturing is so much expected to grow is mirrored by the initiative “Industrie 4.0“ of the German government (and was foreshadowed also in the BICCnet co-authored roadmap from 2011, “Cyber-Physical Systems“).

Quite some companies (26) expect business growth for them in the area of energy for smart cities – one half of them in only one of the three areas of accumulation, distribution and generation, the others half in at least two of those fields.

Smart environment, health and living all are expected to be growth areas for more than 20% of the companies, which bodes well for a smart city development.

The low interconnection with public bodies – as manifested in the domains chapter – is again reflected by the low number of 7% for smart governance. The 10-percent-ish numbers for smart people and smart economy most likely does not mean that the companies don’t expect to find smart people, but that the two categories were not explained in the questionnaire and appeared thus too general.

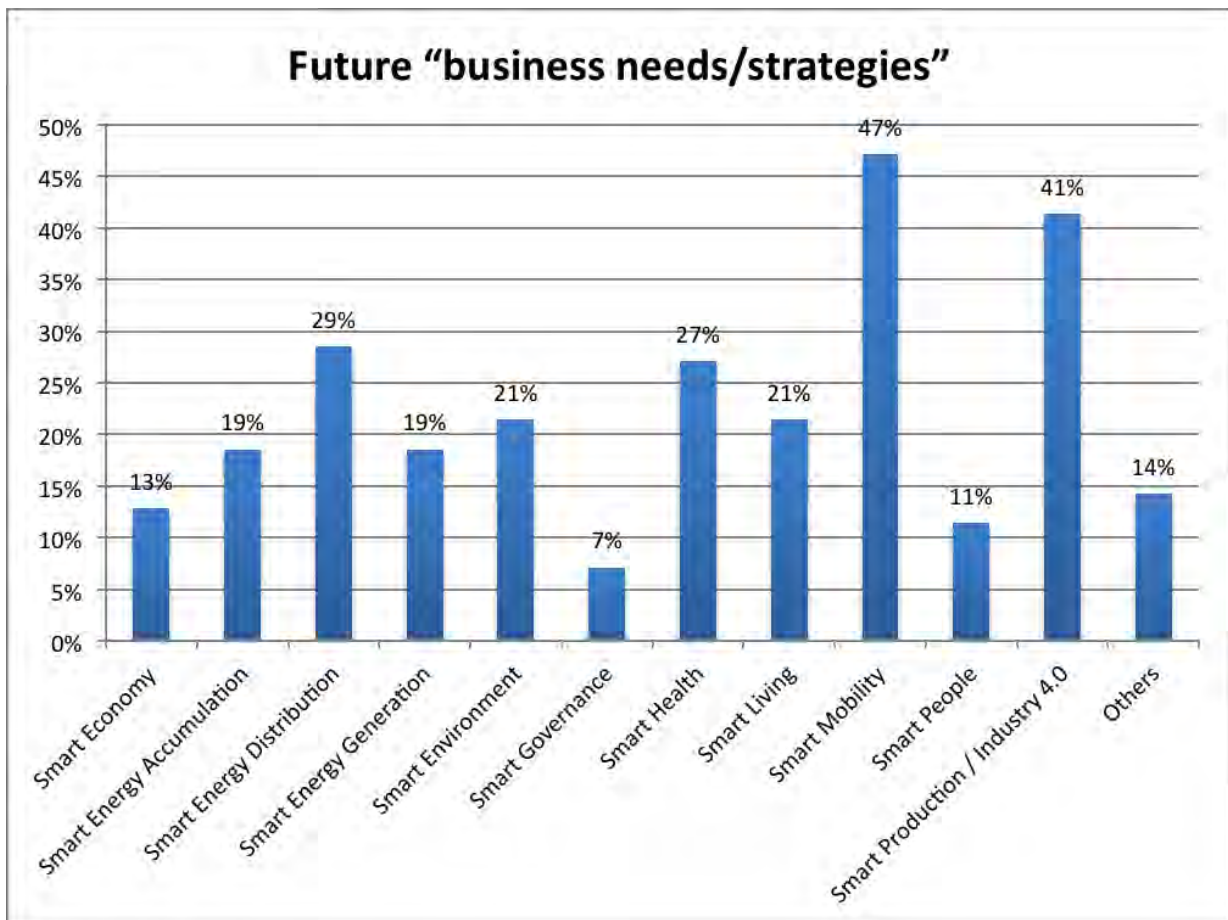


Figure 21 - Future business expectancies

3.2.5.7 Target customers

BICCnet is a B2B network. So, it comes as no surprise that a majority of the companies deal with other companies as their target customers: 77% generate sales in "industry", and 31% in "service". Since 54% of the companies offer "development services", one must assume that a share of those are identified as "services for the industry", thus not showing up in the 31% service customers.

Although BICCnet and DSP are at different positions in the value chains, the percentages for the target customers here are almost identical!

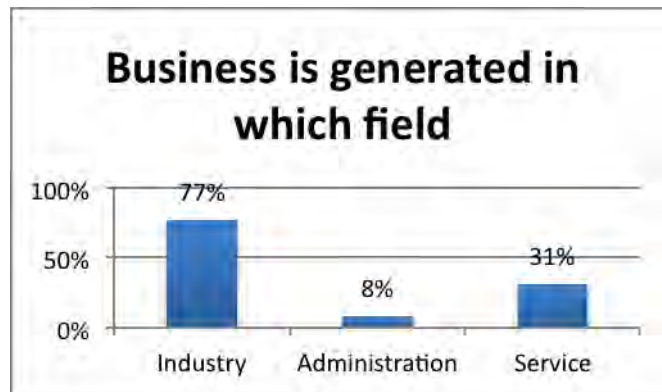


Figure 22 - Current business fields

3.2.5.8 Market regions

We asked for the main sales regions, and found that Germany (67%) is the predominant market. It's encouraging that 46% of the companies have important sales in the whole European market, and 30% even outside Europe.

A quarter of the responding companies is still confined to regional or local markets – it would have to be determined if this is because of the lack of outside partners or sales opportunities, or because the local market is sufficient (as is often the case for small OEM suppliers).

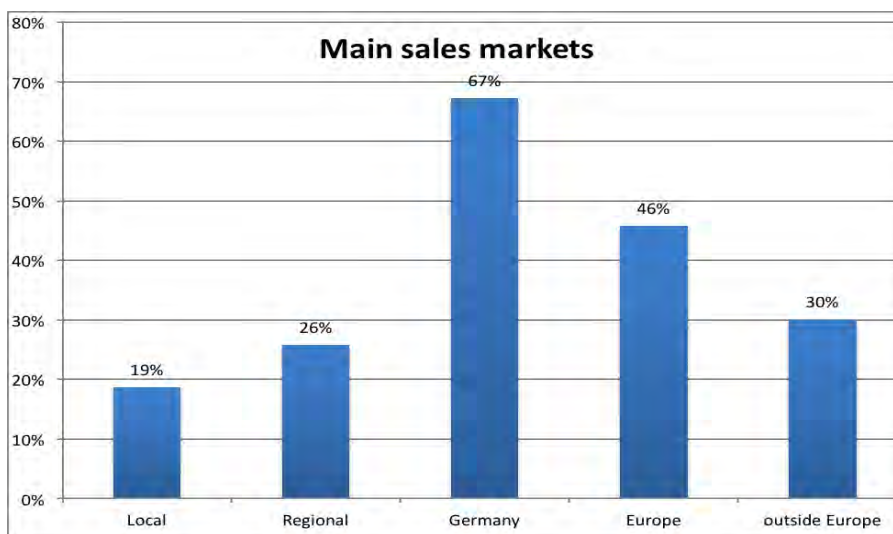


Figure 23 - Market regions

3.2.5.9 Priorities for future business

If we needed proof that BICCnet gathers the CEOs of the companies, and not just the marketing departments, this statistics is: Marketing is deemed the least important (24%) measure to ensure good future business.

What is most crucial for coming business, though, with 61% of the companies agreeing, is cooperation!

That 53% of the companies see a long term strategy crucial to success, is testament to an industry where still hard engineering skills (46%) are important, and not coolest-to-market.

Of course, the CLINES project is explicitly set up to help companies optimise their long term strategy by providing them with insights into the trends (50%) of the next 10 years.

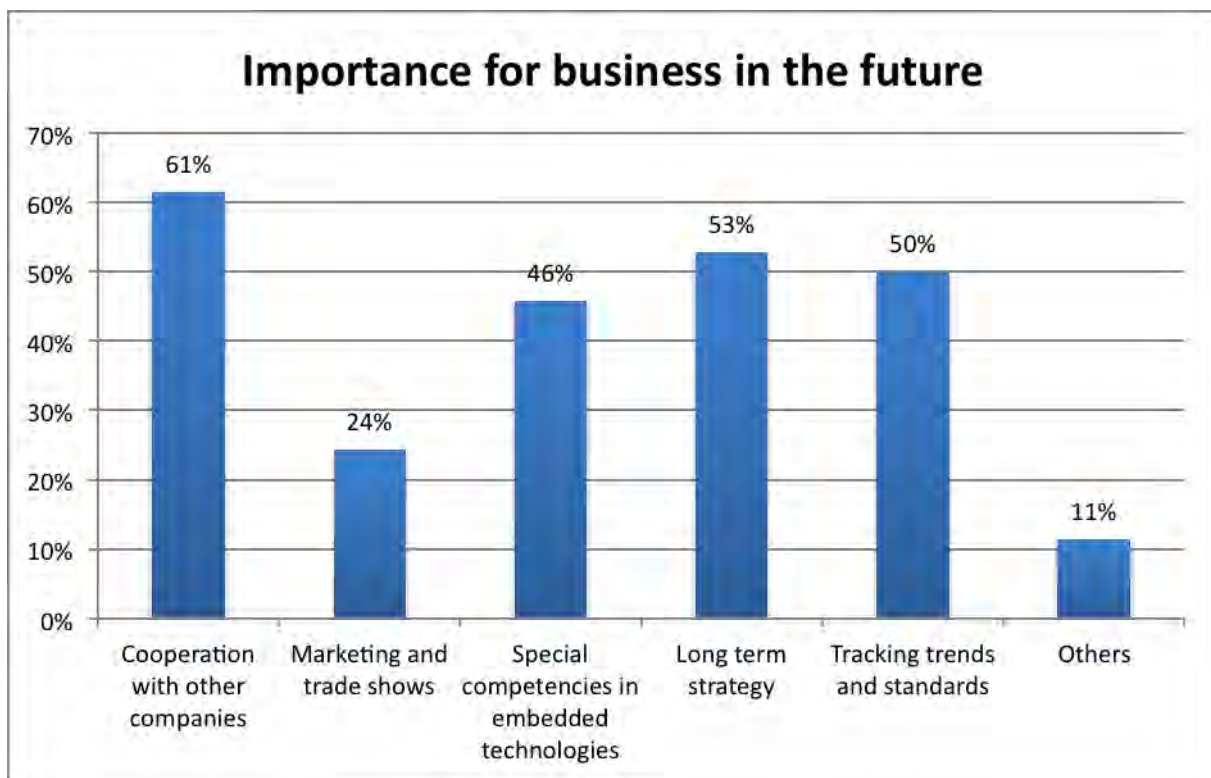


Figure 24 - Success factors

3.2.6 Sources

Sources Bavaria & Upper Bavaria

“IuK- und Medienstandort München 2010“, IHK München and Landeshauptstadt München;
 CNN City Ranking: <http://money.cnn.com/magazines/fortune/global500/2009/cities>

“New Commission study identifies Europe's top ICT hubs”, http://europa.eu/rapid/press-release_IP-14-435_en.htm, April 2014

“Bayern, Wegbereiter der mobilen Gesellschaft“, BICCnet 2011;

“IT ist unsere Welt.“, Invest in Bavaria, 2008;

“Vom Studenten zum Unternehmer: Welche Universität bietet die besten Chancen?“, Ranking 2011, Schmude, Aevermann, Heumann;

“Zukunftspfade Digitales Bayern 2020“, Beauftragter für Informations- und Kommunikationstechnik der Bayerischen Staatsregierung, 2012;

Sources Embedded in Upper Bavaria

“Industriereport 2010: Embedded Systems in Oberbayern“, BICCnet and Landeshauptstadt München

Sources Embedded in Swabia

Overview “Studie Embedded Systems in Schwaben“, IHK Schwaben, 2011, and the detailed analysis of the study's data base.

3.3 DSP Valley, Belgium

3.3.1 Embedded Technologies

As DSP Valley is a cluster of excellence in smart electronic systems and embedded technology solutions in Belgium and the Netherlands, it is clear that the core of its competencies lies in this domain. When the cluster was created back in the 90s of the previous century, the “DSP” stood explicitly for “Digital Signal Processing”, which in itself is a focus area of embedded systems in general. The main activity of the oldest members of DSP Valley is indeed design of low-power components and systems for both analogue and digital (“mixed”) signal processing, including audio, video, connectivity, or localization. Next to this hardware focus on micro- and nano-electronics, we have also seen a growing number of embedded software companies (tool vendors, service providers), so that both the hardware and software dimension of embedded technologies are well represented. The organizations active in embedded technologies in general are at the core of today’s DSP Valley, and we call that core “DSP Valley 1.0”. Indeed, as part of its strategy, DSP Valley has gone through a transformation in the 10s of this century, expanding its technology and business focus in two directions: application domains on top of embedded technologies, and electronics manufacturing at the basis of the embedded technologies. We call this extended ecosystem “DSP Valley 2.0”, and the DSP now stands for “Designing Smart Products”. The following image shows the full DSP Valley 2.0, with 1.0 at its core as the Embedded Technologies in General. Of the current 100+ members, 90% is somehow active in embedded technologies, whether it be hardware or software. In the next section, we will focus on the application domain of Smart Cities, and how it fits into the picture.

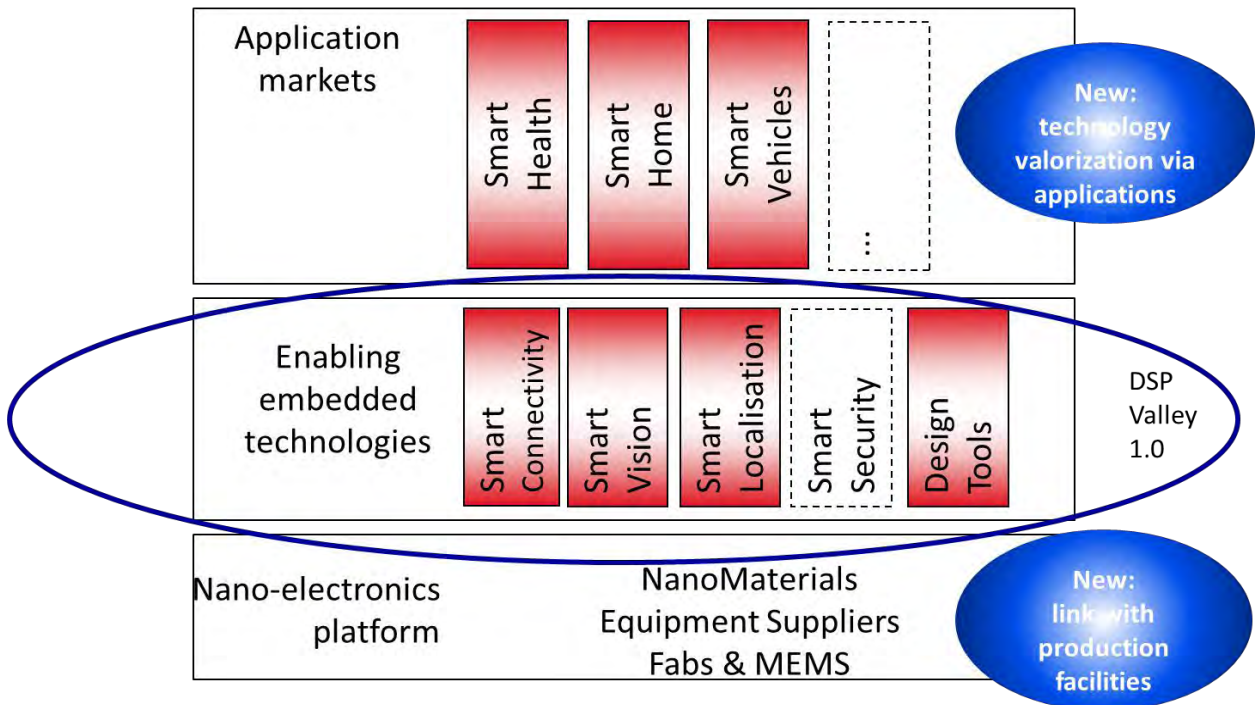


Figure 25 - The DSP Valley Smart Systems ecosystem

3.3.2 Smart Cities

3.3.2.1 General Match of DSP Valley & Smart Cities

If a smart city is “a highly connected environment in which citizens’ issues of mobility, energy consumption, security, health and wellbeing are addressed at the home, building, neighbourhood and city levels”, then CLINES wants to look at how we can help to build this environment by the use of embedded technologies. For DSP Valley as a cluster in embedded technologies, the following matrix shows how our focus domains address the Smart Cities challenges. Note that the competencies “Smart Power” and “Smart Semicon” are not in the competence matrix, but they are competencies that sit between the two bottom layers of the matrix (enabling technologies, and hardware production). Although the matrix simply indicates if the competency addresses a challenge, we also have the number of companies in the cluster that have this competency, and of course the details of what this competency exactly entails.

DSP Valley Competencies <i>versus</i>	Smart Health	Smart Home	Smart Vehicles	Smart Connectivity	Smart Vision	Smart Localisation	Smart Power	Smart Semicon
Smart Cities Challenges								
Mobility	—	—	X	X	X	X	X	X
Health	X	—	—	X	X	—	X	X
Comfort & Wellbeing	—	X	—	X	X	X	X	X
Connectivity	—	—	—	X	—	X	X	X
Safety & Security	—	—	—	—	—	—	—	X

Figure 26 - DSP Valley Competencies addressing Smart Cities Challenges

As can be expected, the underlying technologies can help address all challenges of the Smart City in one way or the other: as soon as smart electronics are involved in any type of device, DSP Valley has members that can provide solutions. As to the application markets that DSP Valley focuses on, they also match directly to the challenges of the Smart City. Of course, this does not mean that DSP Valley can address all challenges. Our focus is always on the embedded devices, and much less on backend ICT systems such as cloud infrastructures, databases, etc. For Smart Health, the focus is on medical devices for monitoring physical parameters, on implants, and on diagnostic devices. For Smart Home, the focus is mainly on energy-efficiency²² in the home (more than on comfort & wellbeing or safety & security). For Smart Mobility, the focus is mainly on the smart electronics in a vehicle (and less on traffic infrastructure or mobility planning).

²² See also the Smart Home roadmap that we Valley developed with its ICT partners in the Interreg TTC Project 2011-2014.

As can be seen from the matrix, Safety & Security is a field that is not explicitly addressed by DSP Valley (although it has some members that do address this domain), so it will be important to see how the other clusters can complete the picture.

3.3.2.2 Detailed Match of DSP Valley & Smart Cities

In order to get a more refined picture of the competences in the DSP Valley ecosystem, the extensive CLINES questionnaire was used to enquire about different sub competences, in particular in the embedded technologies domain. DSP Valley already had material from previous questionnaires and from its member profiles to complete the CLINES questionnaire. In case the information was not available, the members were also contacted by phone for additional inputs. In this section, we briefly comment on the findings per subtopic of the questionnaire. The data was compiled for all of the 102 members early 2014.

3.3.2.2.1 Activities

When looking at the broad categories of "products and services", we seen that on the **hardware** side, about 40% of the members are involved in hardware development. This is related to "sensors/actuators", but we broadened that to all subcomponents (e.g. a communication chip, a power module,..), with the exception of memory components (which were asked about separately). In this case, there are no players producing memory components in the DSP Valley ecosystem. Since most of our members are indeed component designers and builders, we also do not have specific players offering complete microcomputers. As to **software**, we see that the ecosystem is even more strongly into it than "pure" hardware, and even across all subcategories (OS, drivers, applications, tools). This is in line with the fact that the ecosystem has evolved towards the higher layers of the value chains, where software is the dominant differentiator in many embedded systems.

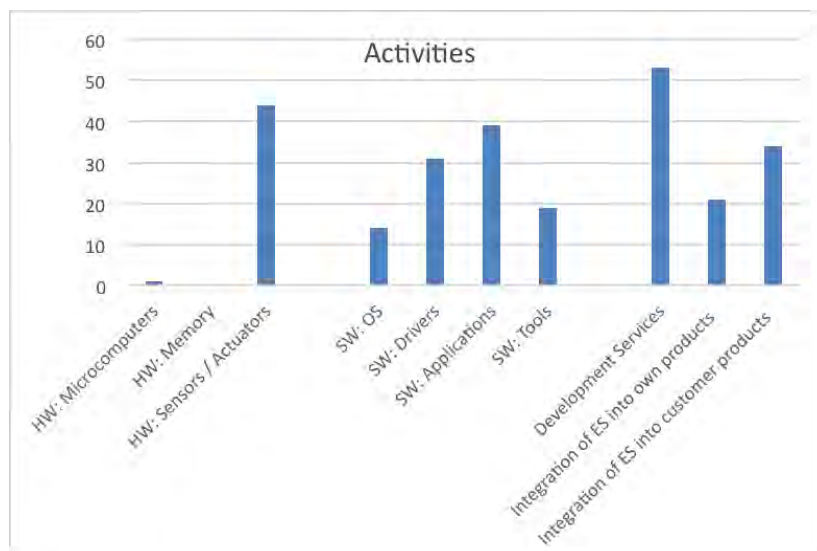


Figure 27 - Activities in Embedded Systems

As to the **services**, more than 50% of the members fall into that category, where they mostly integrate components or develop subsystems for third parties (not own products). This fits with the global picture of Flanders as a service industry rather than a region of end product building companies. We believe that this is not an optimal situation, as there should be a better balance

between service and product companies in the ecosystem. It will then be important to see how the CLINES cluster partners can offer interesting complementarities in this respect.

3.3.2.2.2 Value Chain Position

When looking at the value chain position (from hardware manufacturer to end customer), we see a picture that confirms the data from the previous subsection. The largest subgroups can be found in chip manufacturing, device manufacturing and system integration. The ecosystem is not so strongly represented by end customers (typically end product builders). On the whole, the overall value chain is represented (including distributors and board manufacturers), but the "end customers" are still too much of a minority.

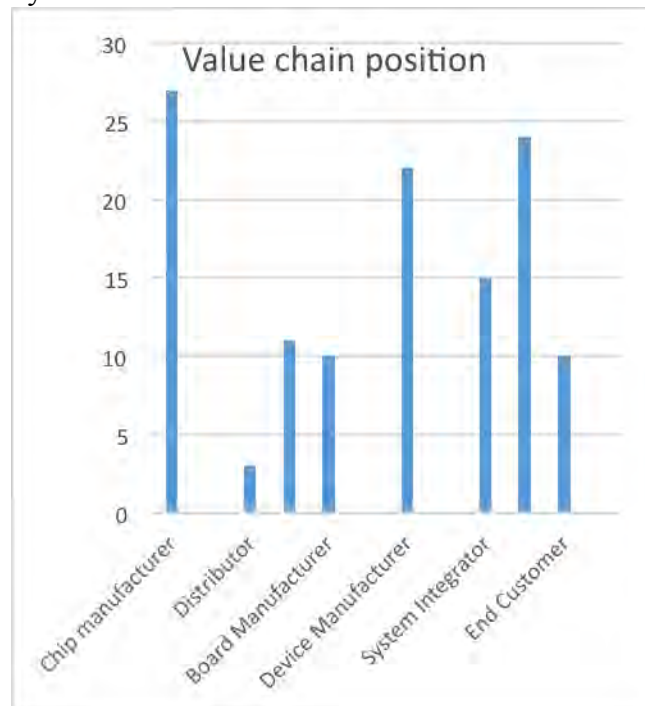


Figure 28 - Value chain position

3.3.2.2.3 Domains

The questionnaire presented a list of about 20 possible activity domains (automotive, medical, telecom, etc.). Analysing all 20 in detail would lead us too far, so we just look at the highlights (most active, less active). The top-3 domains are: medical (again nearly 50% of active members), automotive (also over 40%), and consumer goods – partly linked to entertainment (over 30%). The predominance of the medical domain can be explained by the early presence of players in this field (Philips, Cochlear, Medtronic, etc.), but also by the choice of DSP Valley to focus on the application domain of Medical Technology (now more broadly "Smart Health") as the first of its possible application domains. The application domain of "Smart Home" (combining subdomains from the questionnaire: energy, buildings, infrastructure, entertainment) is also well represented, but less outspoken than Smart Health. In line with a strong presence of players active in automotive (or mobility in a broader sense), the application domain of Smart Vehicles certainly hold great potential for DSP Valley, but this needs to be more explicitly addressed, possibly in co-operation with other clusters active in this domain (like BICCnet).

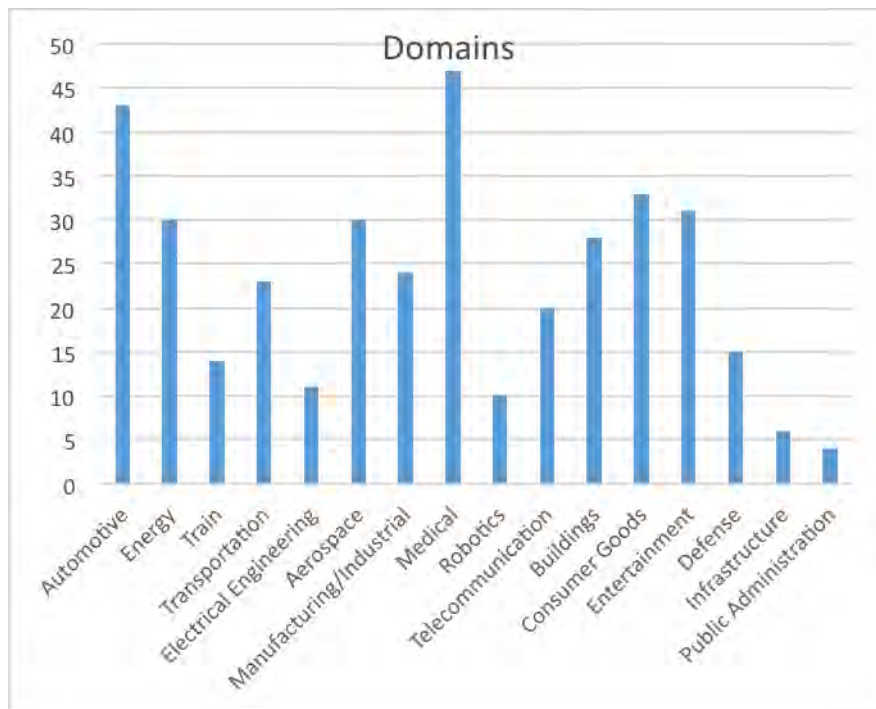


Figure 29 - Business domains

If we look at the least represented domains (less than 10 active members), they are robotics, infrastructure and public administration. As to robotics, given its attractiveness in making embedded technologies visible in "spectacular" ways, this should probably be addressed more strongly in the ecosystem. As to infrastructure, the low involvement is probably related to the fact that the ecosystem largely consists of SMEs, whereas infrastructure products & services are typically addressed by the larger players (like Siemens, ABB, etc.). In this case, if another cluster does have these big players in their portfolio, there would be interesting complementarities. Finally, as our members rarely deal with public administrations (see also Target Customers below), it should not be a surprise that this domain is not well represented.

3.3.2.2.4 Special Capabilities

As to the special capabilities along the hardware/software development cycle, the DSP Valley ecosystem is a typical design community, which is clearly reflected in the dominance of "architecture" as a capability (over 40% of members). The second strongest capability is that of "product lifecycle management" (for whole products, for components, and as a service). A capability that seems to be missing is model-based development, although this may be a matter of terminology that is not known sufficiently; further detailed analysis could shed some light on this gap in the responses. As to the "bread and butter" of hardware/software development, it is also clear that requirements engineering, middleware development, testing and debugging are relatively well represented. It is even worth pointing out that we have a group of companies that have good capabilities in "usability engineering". Indeed, the ecosystem has seen a growing interest (in both directions) between the existing traditional hardware/software design companies on the one hand, and the "industrial design / user experience" companies on the other. With a growing focus on "the user" in the overall context of smart systems, this is a positive and enriching development.

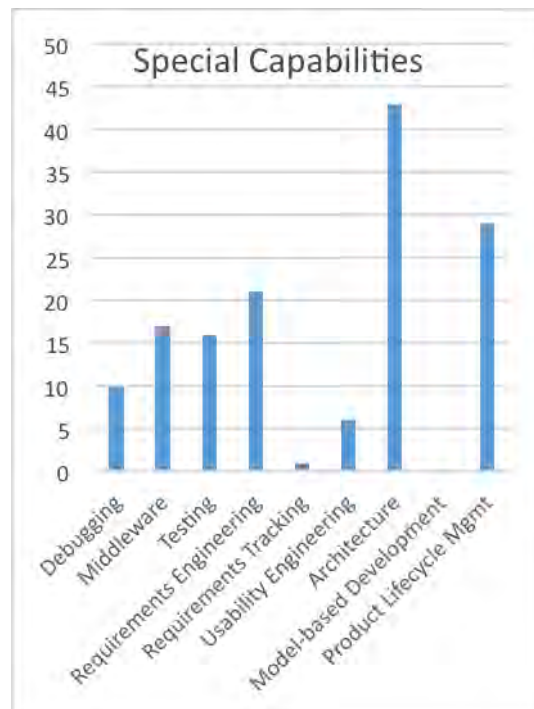


Figure 30 - Special capabilities

3.3.2.2.5 Specialization Fields

As to specialization fields (within hardware and software), the questionnaire contains some 20 possible fields. We will again only highlight the most relevant outcomes. It is no wonder that the "sensors & actuators" specialization (already covered in Activities above) is re-confirmed as the top specialization field. Next to that, real-time processing and man-machine interaction are second and third in the ranking. Categories that are clearly under-represented are safety/security/privacy, as well as data processing, and less concrete (or more research-oriented) specializations like "self-organization/autonomy/changes" or virtualization. On the whole, this also reflects the fact that the DSP Valley ecosystem is not so much "data/server/cloud-oriented" (more "device-oriented"), and that more research-oriented topics are less in focus of the companies. As to the domain of security, we can consider that a gap in the ecosystem, as matters of privacy and security are becoming more and more relevant, certainly in a context of increasing data communication between all entities in M2M systems, the "Internet of Things" and cyber-physical systems.

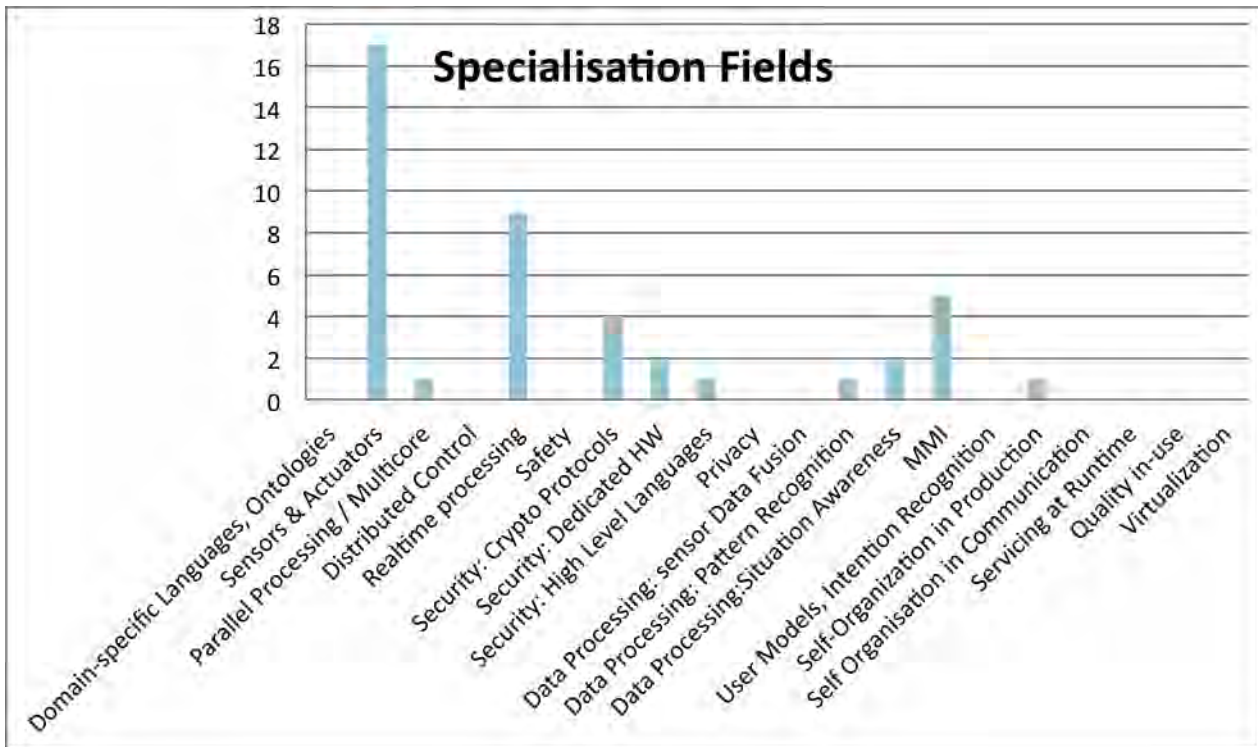


Figure 31 - Specialisation fields

3.3.2.2.6 Smart Cities

Of the 6 Smart Cities dimensions, three are well represented in the DSP Valley ecosystem, with "Smart Mobility" as the dominating one (confirming the findings in the "Domains" section above). The other two are "Smart Living" (strongly related to the DSP Valley application domains Smart Home, and even Smart Health), and "Smart Environment" (referring to e.g. localization, communication, and sensors in the wider environment than the four walls of a home). Smart Economy, Smart Governance and Smart People are not represented, which is understandable as they are less directly related to smart electronic devices. Within the CLINES project, it was also decided that for our Smart Cities application domain, we would focus on exactly the three dimensions represented in DSP Valley, and we will probably see that focus confirmed in the analysis of the other clusters.

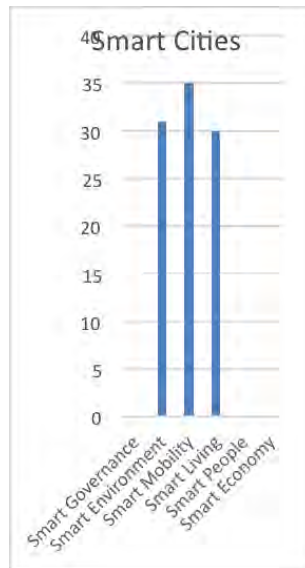


Figure 32 - Business expected in Smart City domains

3.3.2.2.7 Smart Energy

The questionnaire asked about involvement in the Energy domain via three dimensions (Accumulation, Generation, Distribution). As it was clear from the beginning that this topic (and its dimensions) is not in focus within DSP Valley, we knew there would be little response from our members. This expectation was confirmed by the data for the three dimensions. DSP Valley does not look at Smart Grids, but partners up with Smart Grids Flanders, the organization that really focuses on bringing together the players in the energy domain. Still, energy is an important topic within the DSP Valley ecosystem, but from the angle of consumption. That is why we added this as a fourth dimension to the questionnaire ("Smart Consumption"), and we got 28 of our companies confirming activity related to this field. Of course, we would need to refine this into at least two categories: there is the aspect of "low-power" electronics and software, and there is the aspect of energy consumption by users in the Smart Home (and, by extension, the Smart Energy-Efficient City).

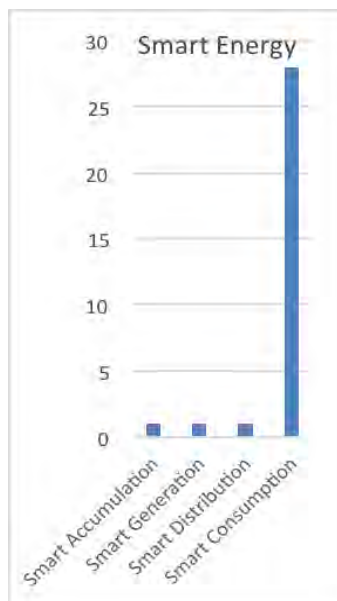


Figure 33 - Business expected in Smart Energy domains

3.3.2.2.8 Target customers

DSP Valley is typically a B2B network. So, it comes as no surprise that a majority of the members have "other businesses" as their target customers: about 70% serves "industry" as a market, and about 35% serves "the service sector" (where in some cases, certain companies cover both submarkets). The consumer market is addressed by few of our members (about 10%), which confirms what was already discussed before. First, the ecosystem has a history of being composed of component suppliers in the value chain. Second, the landscape of companies in Flanders is largely a service-oriented business, with fewer players that actually develop and produce end products here (if end products are represented, it is often as a sales office for a foreign player). As already mentioned, this is a weak point, where possibly other clusters might have a different composition with more players at the top of the value chain. As a final remark related to customers, it is also clear that the public sector is not a typical market segment for the DSP Valley members (see also the Domains discussion above).

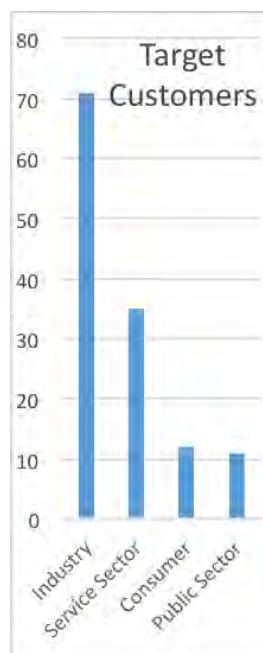


Figure 34 - Current target customers

3.3.2.2.9 Target markets (regionally)

As to the geographical market coverage by the DSP Valley members, the figures show clearly that the main focus is on the local/regional/national market, but with also a fairly strong international orientation. Around 75% of the members are active locally, with some 60% also active internationally. Still, it is clear that companies could do even better internationally (also if they want to grow from small to medium to big), so the internationalisation task for a project like CLINES remains very important, and hopefully the joint forces of the international clusters can help increase the international activity of the combined ecosystems.

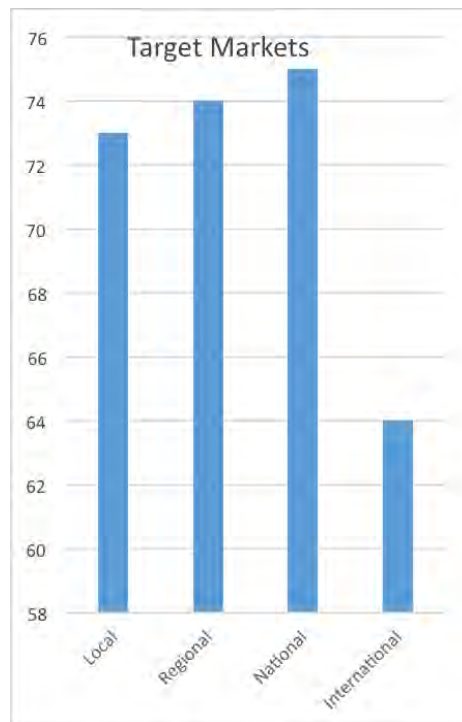


Figure 35 - Market geography

3.4 **BrainsBusiness/CISS, Denmark**

3.4.1 **Embedded Systems Technologies in General**

The cluster competences of the Region Nord (Region of North Jutland) are historically related to the world class competences on mobile communications that have been developed from the mid 1980's. Since then, several global companies have had large development departments and a number of spin-off companies have emerged. In 2008, BrainsBusiness was formed as a joint effort between ICT companies in North Denmark, Region Nord, the city of Aalborg and Aalborg University – funded by the partners and the European Regional Fund. BrainsBusiness is now considered one of the most successful cluster organisations in Denmark with 130 cluster members, primarily SMEs.

Since the mid 1980's, the competences have further evolved into the following technology areas:
Telecom

- Telecom
- Wireless
- Embedded Software Systems
- Data-Intensive Systems
- Human-Computer Interaction

Although the last two areas are not directly included in the traditional definition of embedded systems, they are key technologies in the more general area of Cyber Physical systems which is a key notion within Smart Cities and Smart Societies.

Likewise, BrainsBusiness has pinpointed 10 business areas within which a huge potential has already been proven. This does not mean that other fields hold no potential - just that these ten are currently at the forefront. The 10 current focus areas are:

- Telecom
- Intelligent Transport & Logistics
- IT Services
- Smart Energy Grids
- Digital Health Solutions
- Digital Experiences
- Wireless
- Embedded Software Systems
- Data-Intensive Systems
- Human-Computer Interaction

3.4.2 Smart Cities

Interpreting the above business areas and technological competences in the context of Smart Cities, and also taking the questionnaire into account, the current mapping of Region Nord onto the Smart Cities Challenges looks as follows:

Region Nord Competencies <i>versus</i> Smart Cities Challenges	Smart Health	Smart Home	Smart Transport	Smart Connectivity	Smart Localisation	Smart Power	Smart Living
Mobility	X	X	X	X	X	X	X
Health	X	X	—	X	—	—	—
Comfort & Wellbeing	—	X	—	X	X	X	X
Connectivity	—	X	—	X	X	X	X
Safety & Security	—	X	—	—	—	—	—

Figure 36 - BrainsBusiness/CISScCompetencies addressing Smart Cities challenges

As can be seen from the figure, the companies within the Smart Home area address most of the challenges, whereas the companies within Smart Home/Smart Transport are more focused. The

Safety and Security challenge is by and large only addressed by companies within the Smart Home area.

Out of the 130 member companies, 40 have competences within the area of embedded systems, and we present below their relative profile with respect to the questionnaire of which 22 companies have answered.

Looking first at the *areas of work*, more than half of the companies work with microcomputers and sensors/actuators, which certainly is an expected hardware profile of this particular type of companies. In addition, several companies also work with wireless technologies, which certainly are highly relevant for future Smart Cities. Again, as for the software profile, the companies work on both applications, tools and drivers, which is to be expected and also highly relevant for activities within Smart Cities.

Looking at the *customer profile*, around half of the companies have a major activity on doing general consultancy development services, a clear majority develop their own products, and also more than half of the companies do integration of embedded systems into other companies' products.

The *value chain profile* of the companies show that practically no companies do chip manufacturing, product distribution or deal directly with end customers. The main activity is on developing combined hardware/software devices and system integration for other companies.

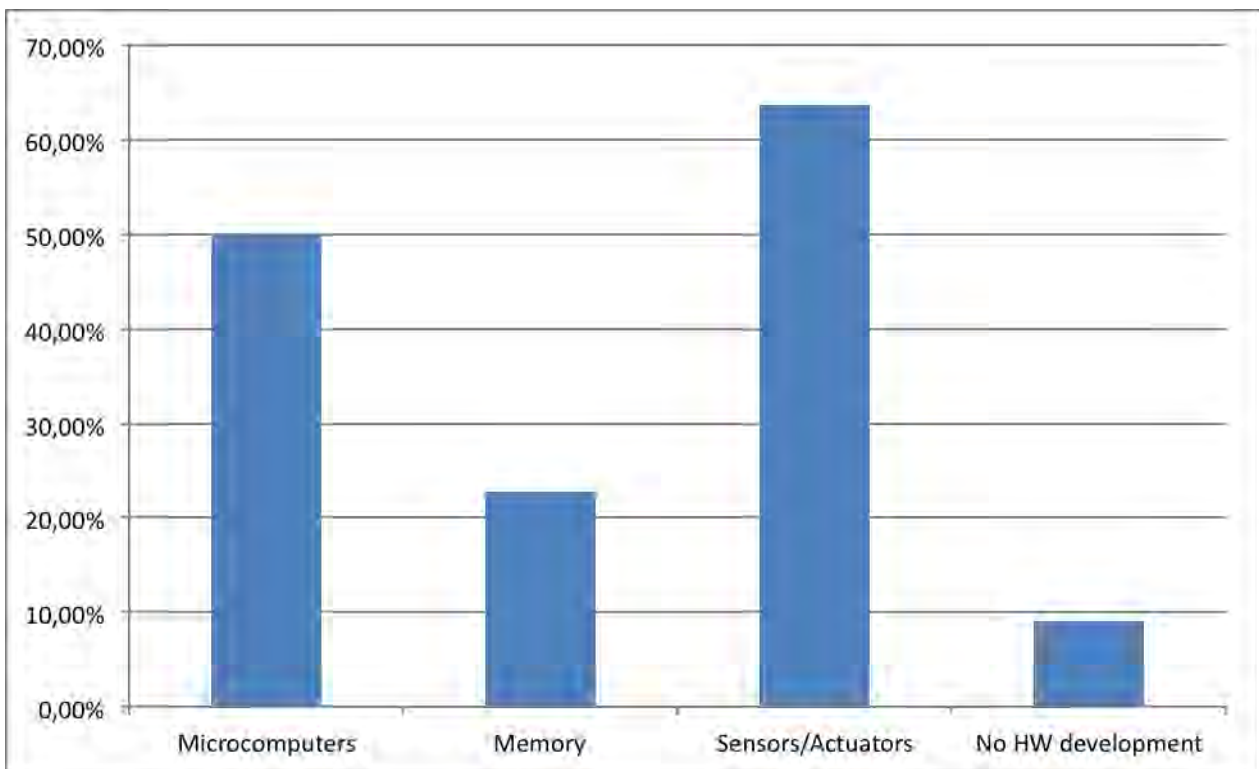


Figure 37 - Areas of work / types of hardware development

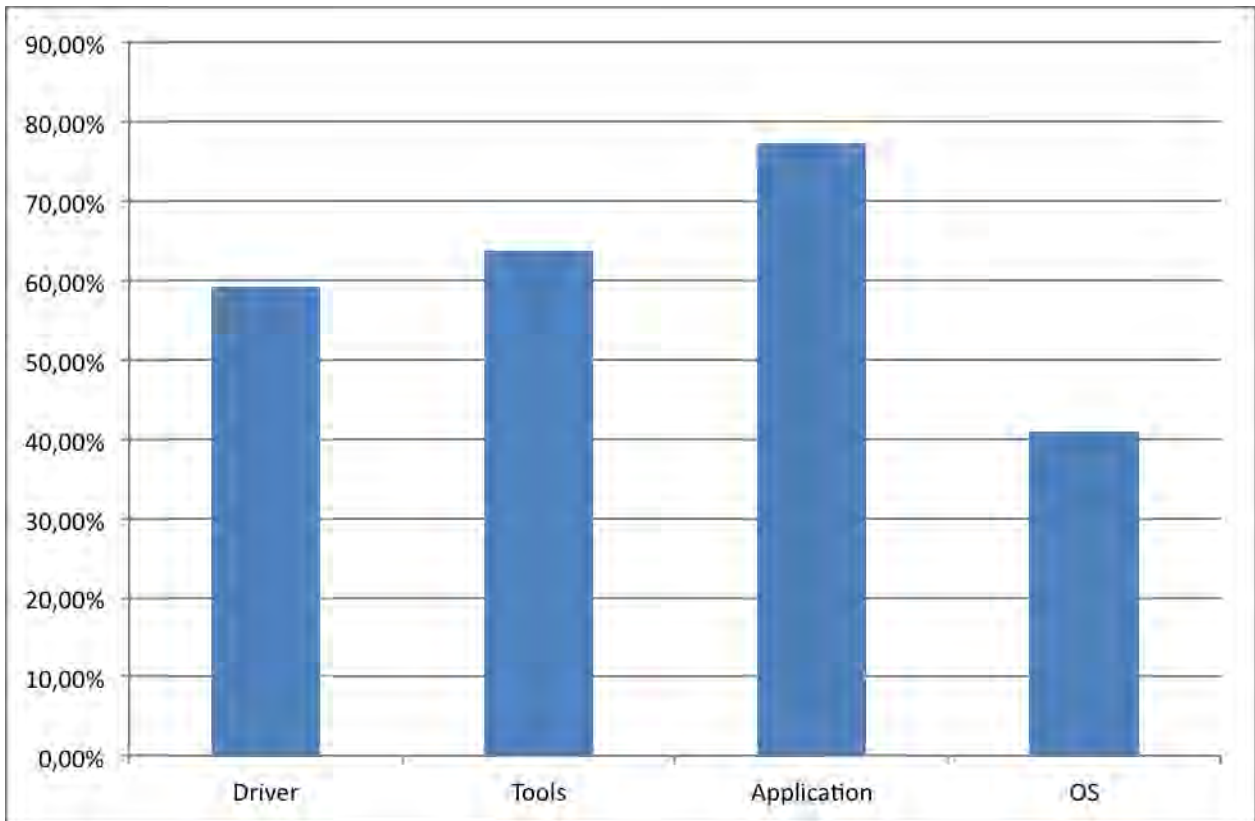


Figure 38 - Types of software development

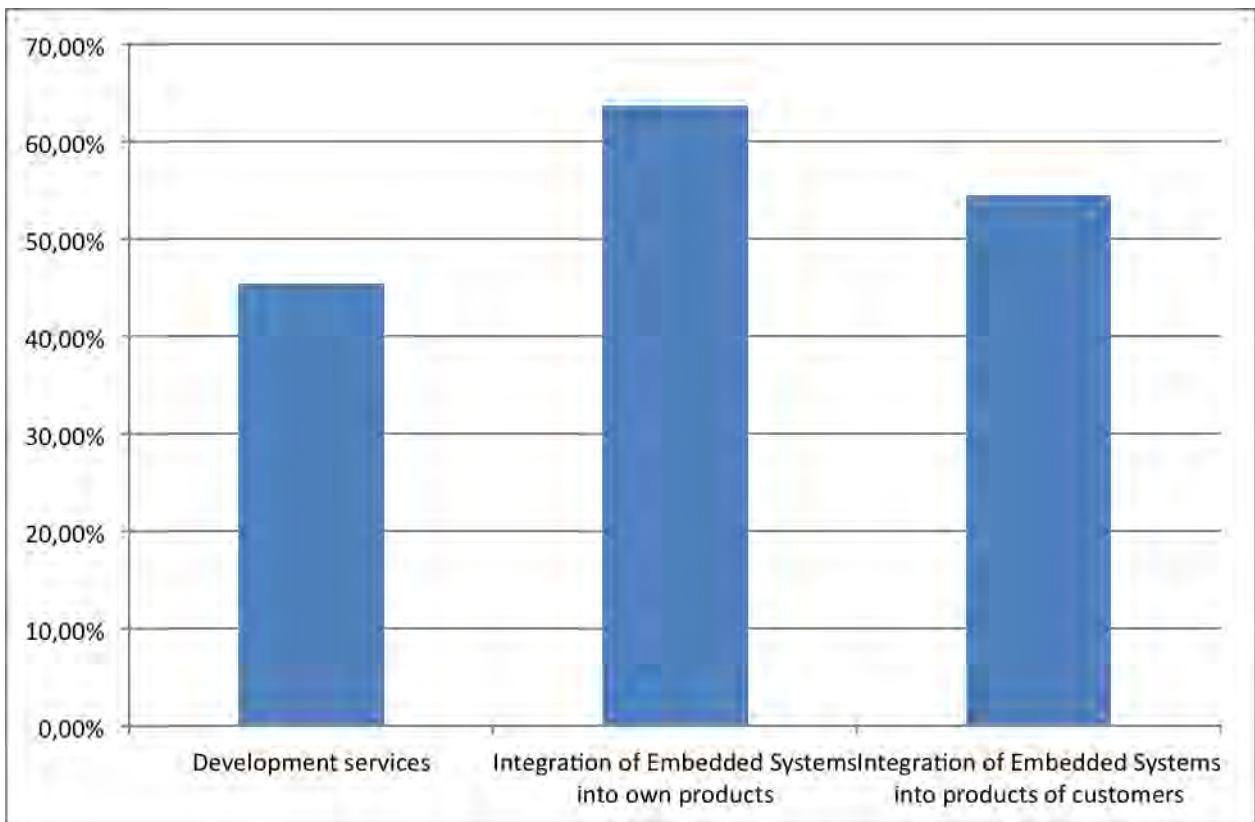


Figure 39 - Customer profile

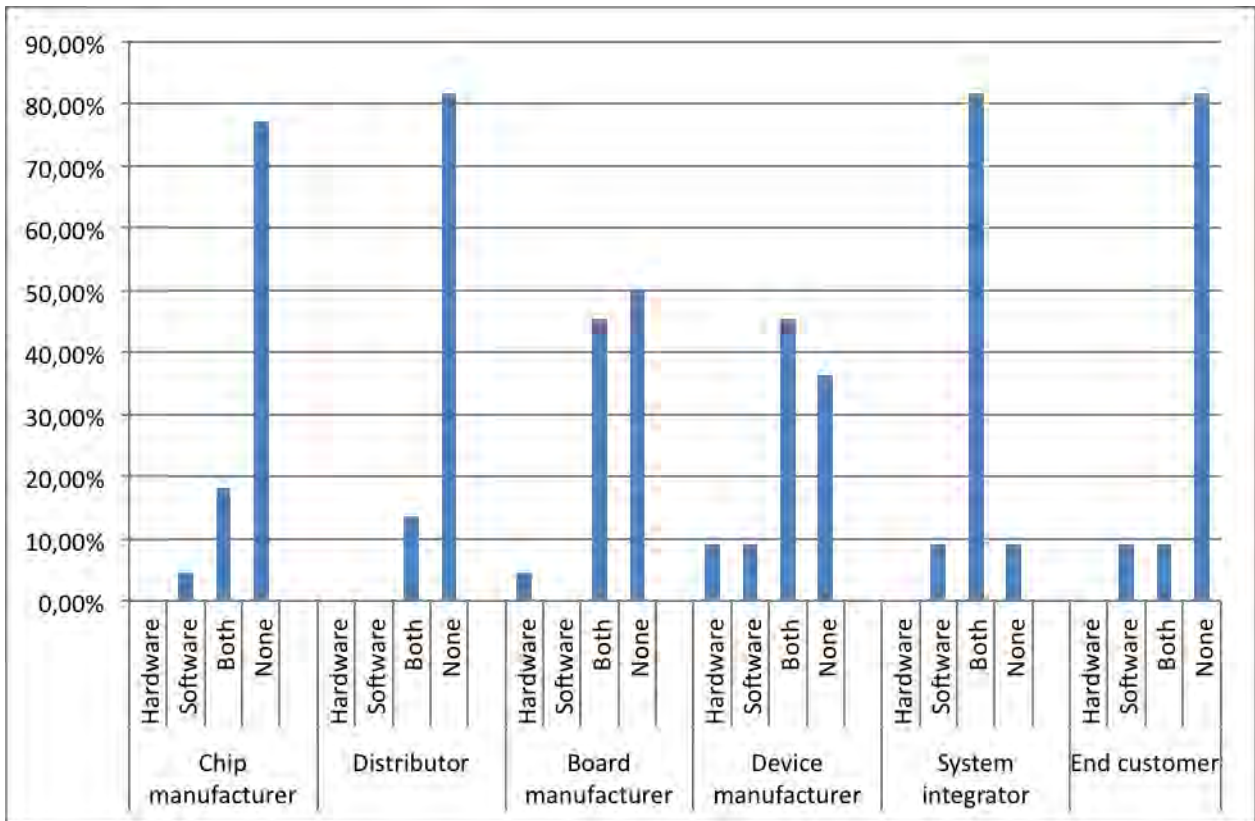


Figure 40 - Value chain profile

As for the *application domain*, more than 50% of the companies are active within energy, hardware and telecommunications. This corresponds well to the fact that home automation is a major competence and it certainly points out a high potential for activities within Smart Cities.

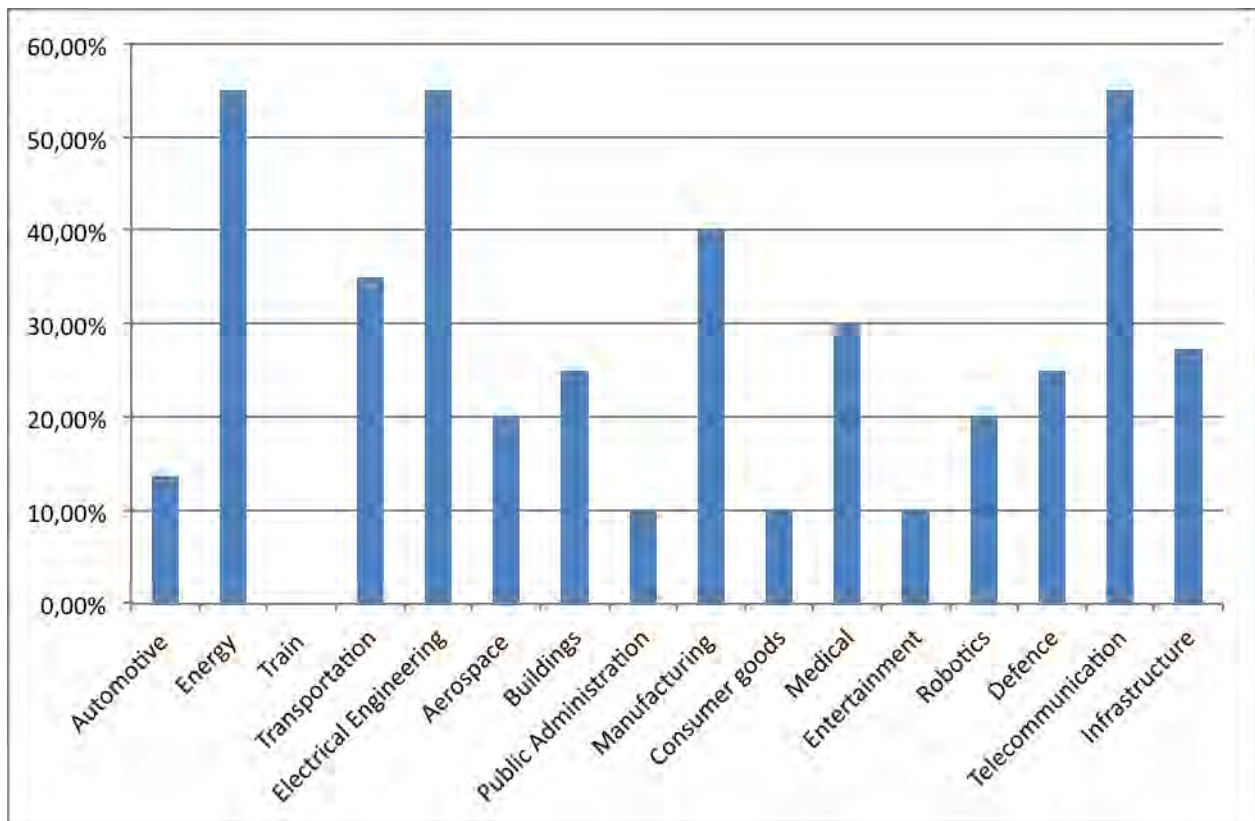


Figure 41 - Application domains

Furthermore, more than 25% of the companies are active within transportation, manufacturing, infrastructure and health care. This reflects well that the region has invested a lot of efforts in traffic monitoring projects and also in the further development of the BioMedCommunity cluster. Also, it points to a potential within the Smart Cities area.

As for the *specialized competences*, more than half of the companies are well equipped with the general development competences – except for product life cycle management. This is a very promising result, because it underpins that the companies within the embedded systems area seem to be at a quite high maturity level. Also, they seem well equipped to manage the high degree of complexity which characterizes future Smart City ICT systems. The main explanation behind this is (to the best of our knowledge) that most of the companies are quite young and henceforth most of the staff has graduated within the last 15 years, where the topics have been part of the ICT engineering curriculum. The lack of competences within life cycle management reflects the fact that only very few companies encompass the full value chain of product development at a noteworthy scale.

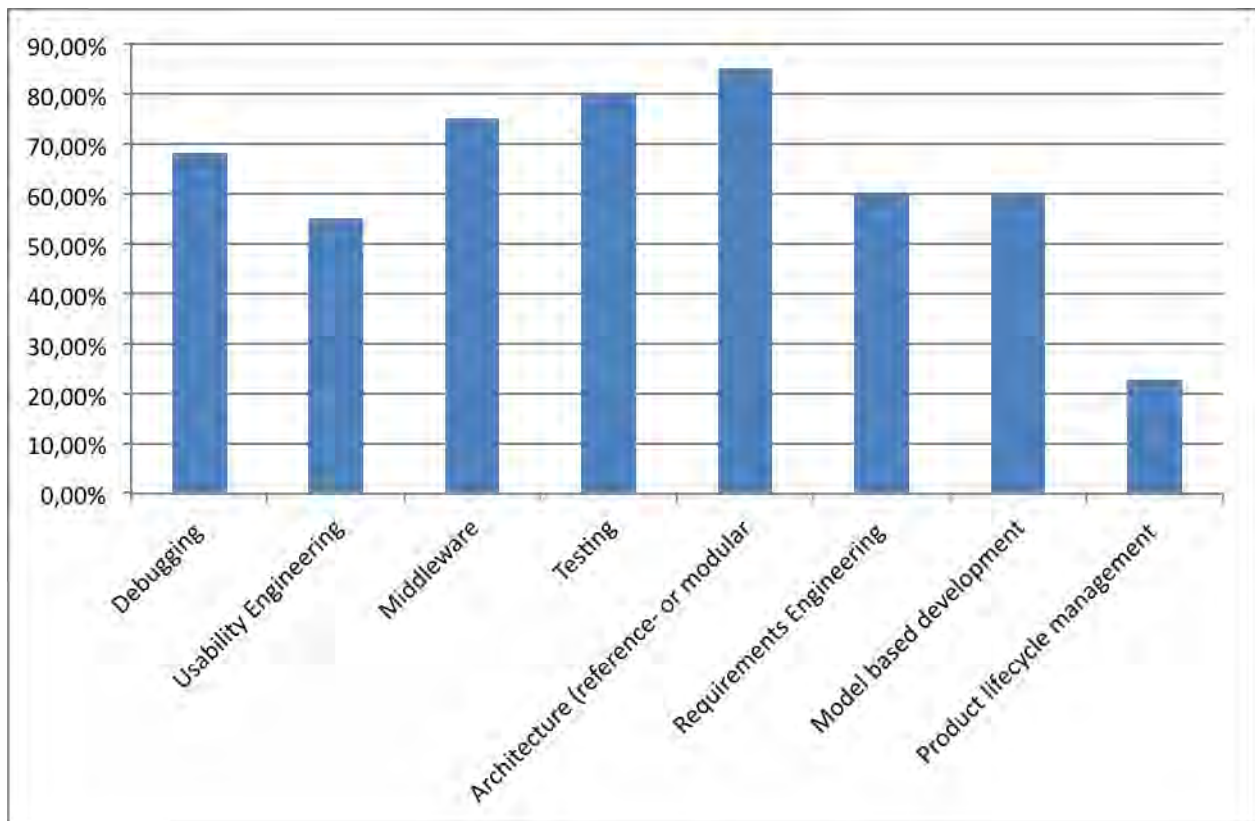


Figure 42 - Specialized competence fields

Looking at the *operation specialization fields* of the companies, more than half of the companies operate within environment control of real time embedded systems – and also with a substantial amount within safety critical systems. As the basic ICT infrastructure of future Smart Cities are complex systems which monitor and control distributed objects like e.g. appliances and energy producing/consuming devices, these competences are highly relevant. The competences correspond well with the fact that a substantial amount of the ICT engineers graduating from Aalborg University have competences within embedded systems and control engineering. Competences within the area of privacy are not well spread among the companies. This is somehow in line with the lack of contents of this topic in the software engineering curriculum.

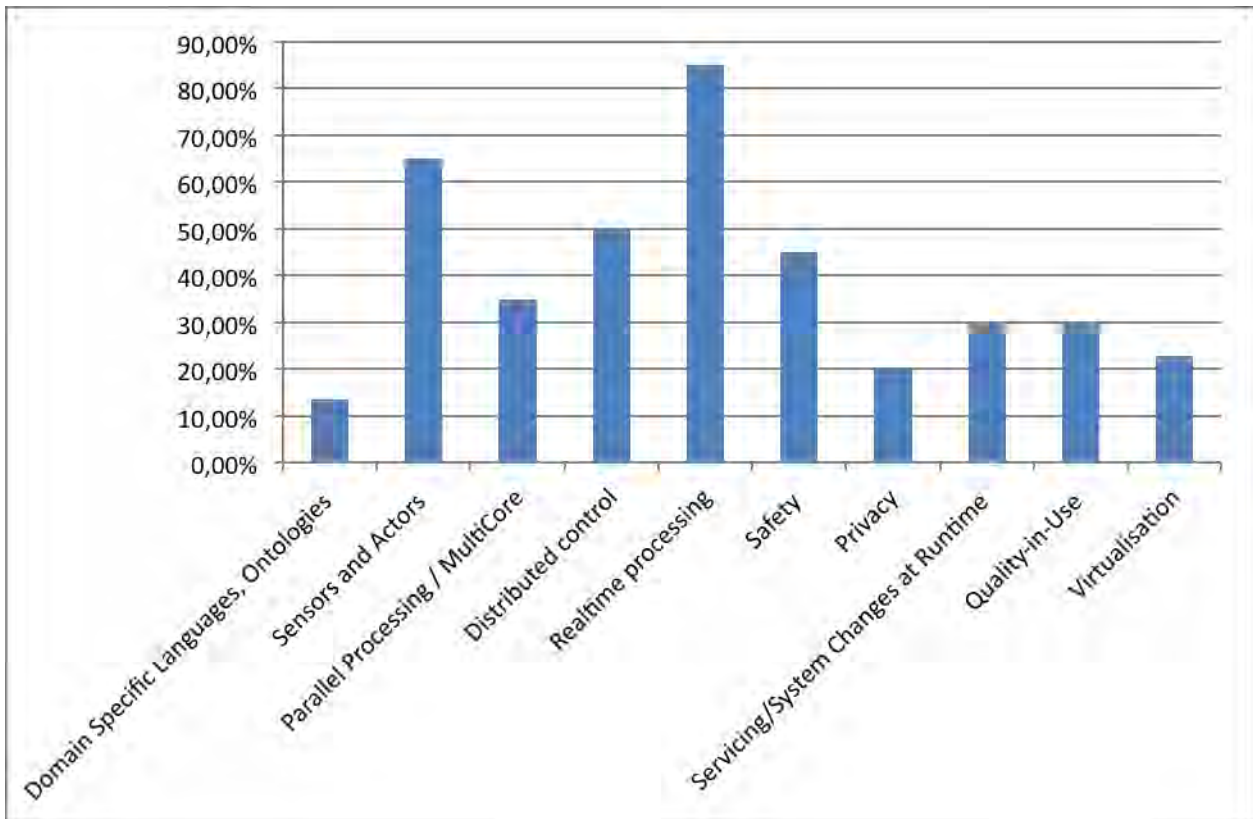


Figure 43 - Operation fields of specialization

Looking finally at the fields within Smart Cities and energy where the companies want to focus in the future, smart mobility, living and environment are the dominating areas, which corresponds well to Smart Cities with a focus transportation, home automation and energy. Somewhat surprising, the expected customers are almost exclusively within the industrial domain, and (as expected) the foreseen market is almost exclusively outside Denmark. However, this requires a further analysis to be consolidated.

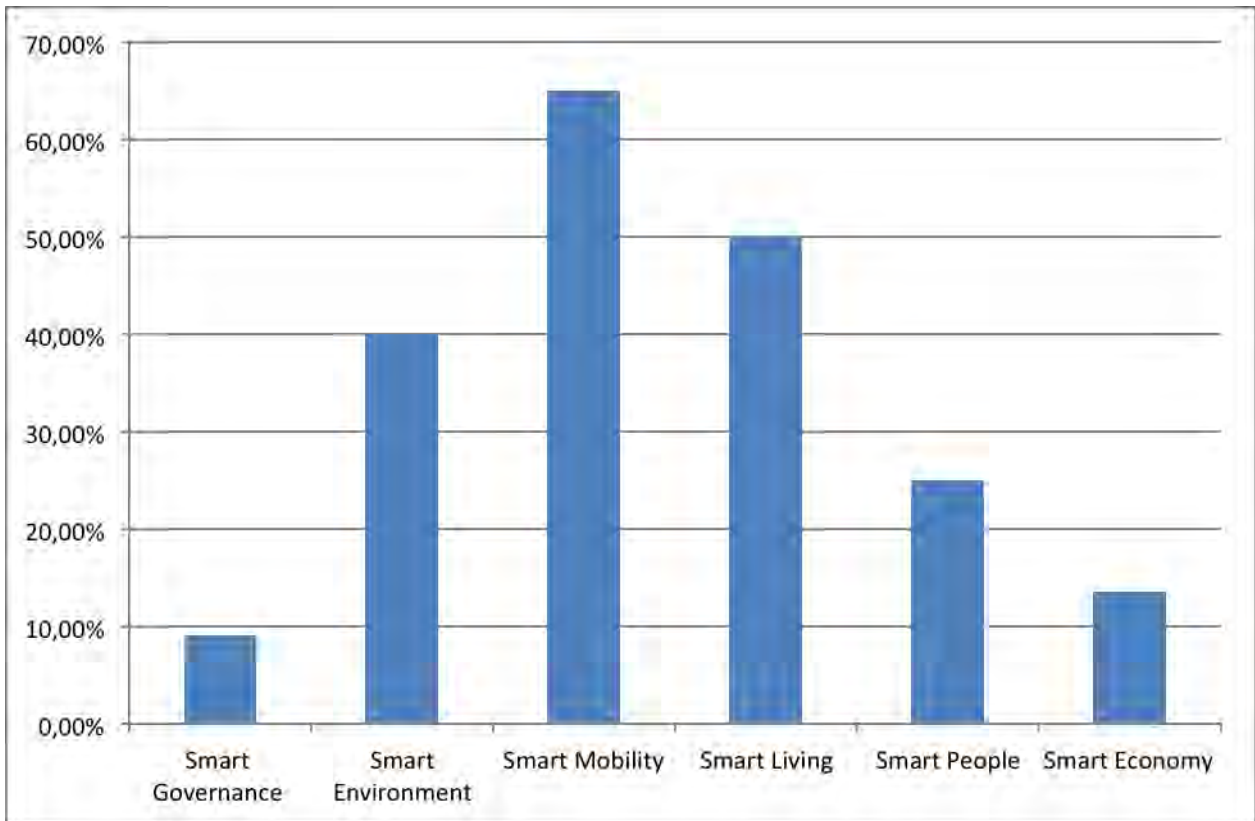


Figure 44 - Future Smart City focus areas

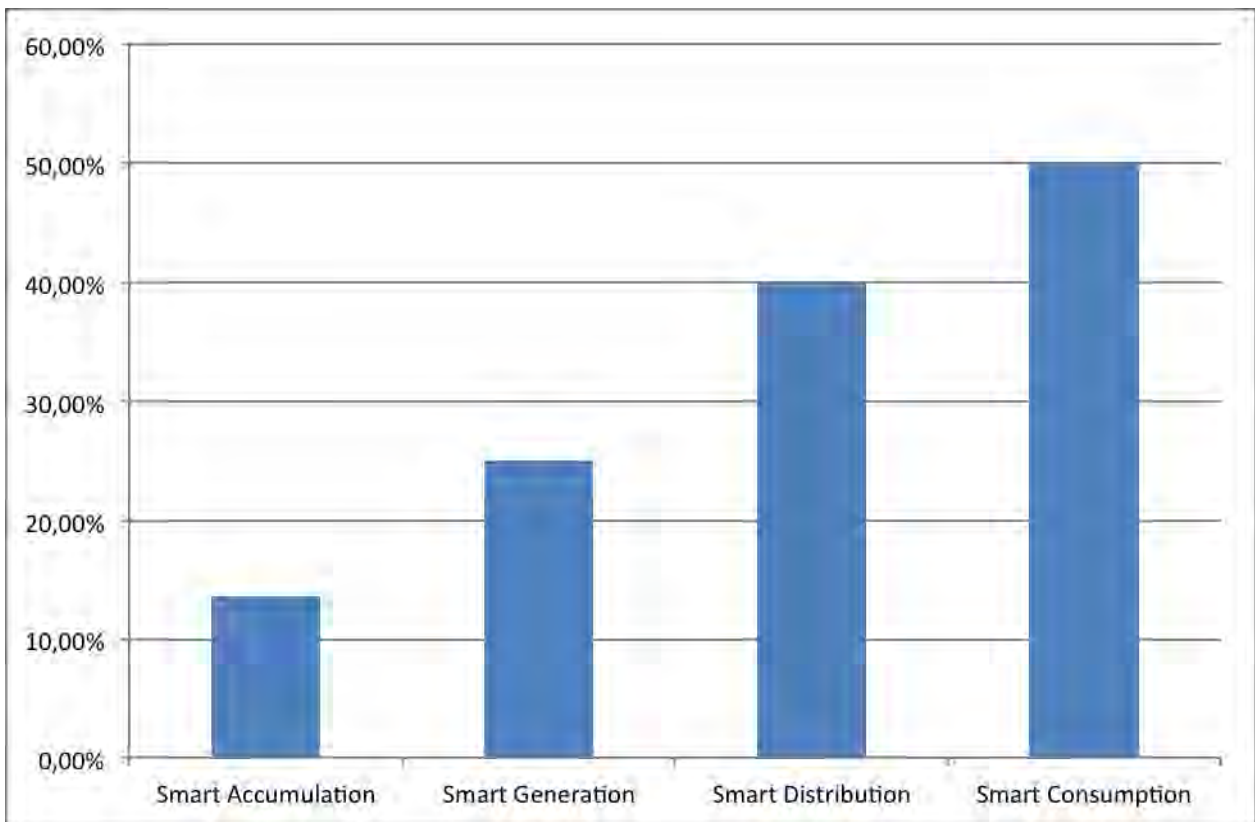


Figure 45 - Future focus areas within Smart Energy

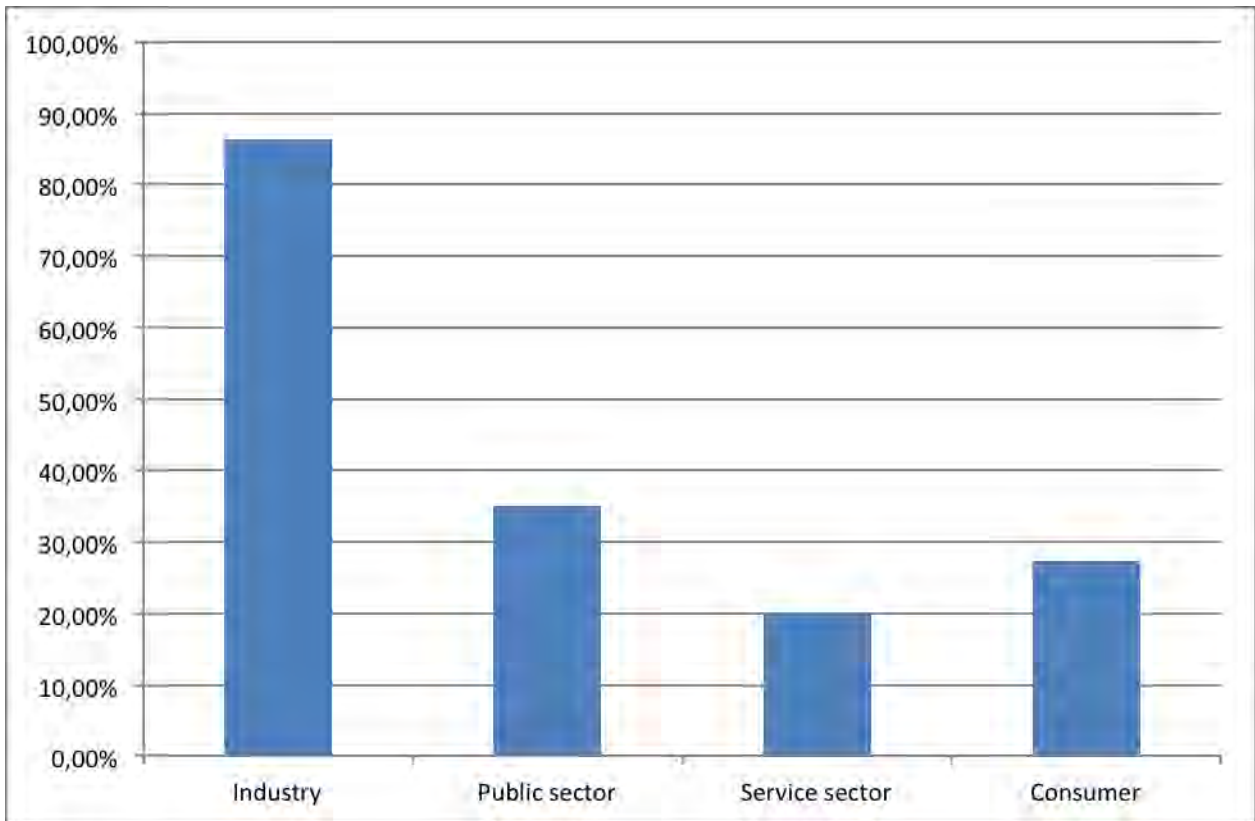


Figure 46: Future market focus

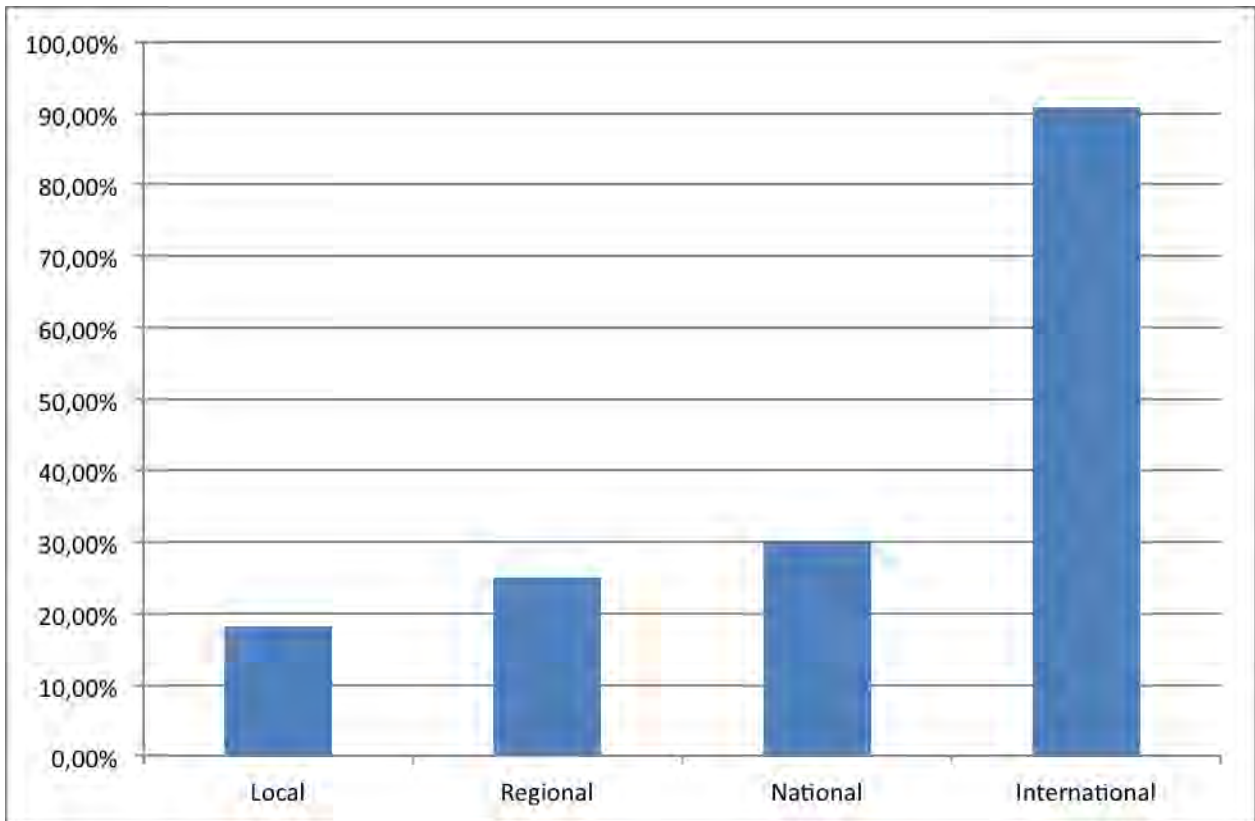


Figure 46 - Future market areas

3.5 GAIA, Basque Country, Spain

GAIA, as a Cluster of ICT, defined as smart when it displays a positive performance in these six areas, and when it has been built based on a "smart" combination of elements (communication, infrastructure, economic development) and on purposeful and independent citizen activities (participation, education) that make sound management of natural resources through participatory governance.

The statistics here are based on a questionnaire, which 29 of GAIA's partners filled out in early 2014.

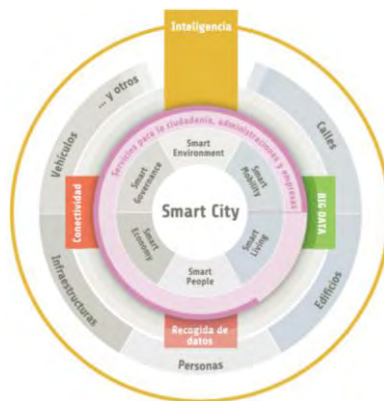


Figure 47 - The Basque Smart City concept

3.5.1 Smart Cities

Analysing the strategies of companies in the Smart Cities area, the companies of the ICT sector of the Basque Country put their future focus on: Smart Mobility, Smart Environment and Smart People

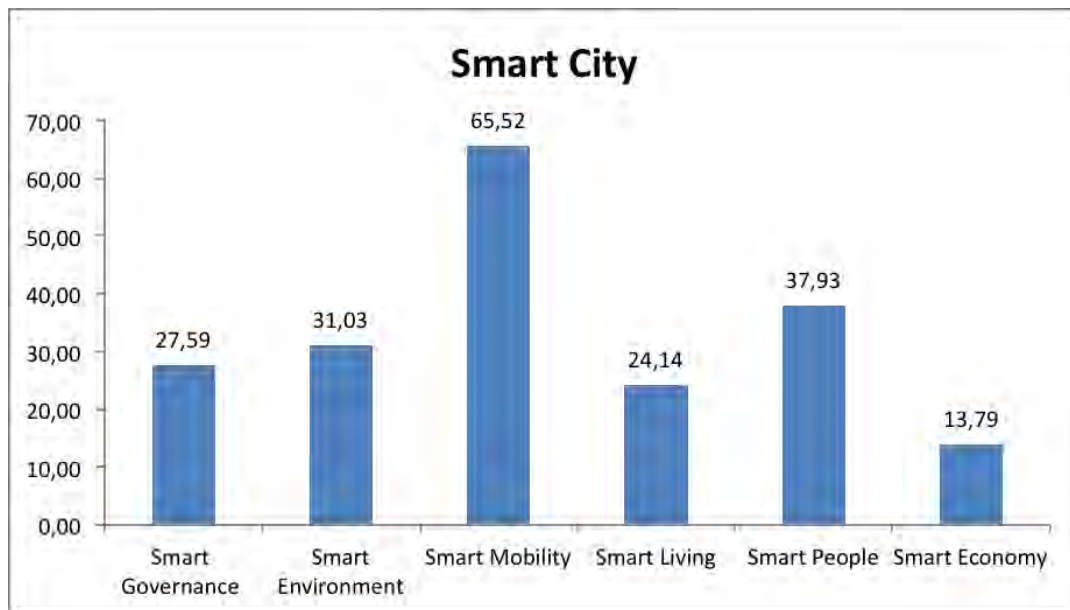


Figure 48 - Future importance of Smart City domains for business

Interpreting the above business areas and technological competences in the context of Smart Cities, and also taking the questionnaire into account, the current mapping of Region Basque onto the Smart Cities Challenges looks as follows:

Smart Cities Challenges	Region Competences		
	Smart Environment	Smart Mobility	Smart People
Learning and reasoning Systems			X
Human centred design cognitive systems			X
Sensor technology	X	X	X
Computing Devices		X	
Cognition, communication, and control	X	X	X
Embedded system security		X	
Verification and Validation (V&V) technologies	X	X	X
Integrated resource management and control (Cloud Computing)	X	X	

Figure 49 - Regional competencies to solve Smart City challenges

3.5.1.1 Smart Mobility

The aspects that companies work within this area are A related to the transportation of people and goods and the use of ICT for local, national and international accessibility. Mainly is mobility of

people, vehicles. For that they use Sensor technology, Computing Devices, Embedded system security.

3.5.1.2 Smart People

The differentiating element between a digital city and a smart city is Smart people.

People are smart in terms of their skill and educational levels, as well as the quality of social interaction in terms of integration and public life and their ability to open to the "outside" world. This way the companies develop Learning and reasoning Systems and also Human centred design cognitive.

3.5.1.3 Smart Environment

Smart environment refers to the use of new technologies to protect and preserve a city's environment. It is related with the Sensor technology and Verification and Validation (V&V) technologies.

3.5.2 Smart Energy

The questionnaire asked about involvement in the Energy domain via three dimensions (Accumulation, Generation, Distribution). This topic (and its dimensions) is in focus within GAIA, we knew that our companies and our Government are interested in it. This expectation was confirmed by the data for the three dimensions. GAIA and the Basque Region look at Smart Grids, and also our partners, the organization that really focuses on bringing together the players in the energy domain. Energy is an important topic within the GAIA ecosystem. We got some 41% of our companies confirming activity related to smart distribution and 20% to the smart generation. Of course, we would need to refine this into by extension, the Smart Energy-Efficient City.

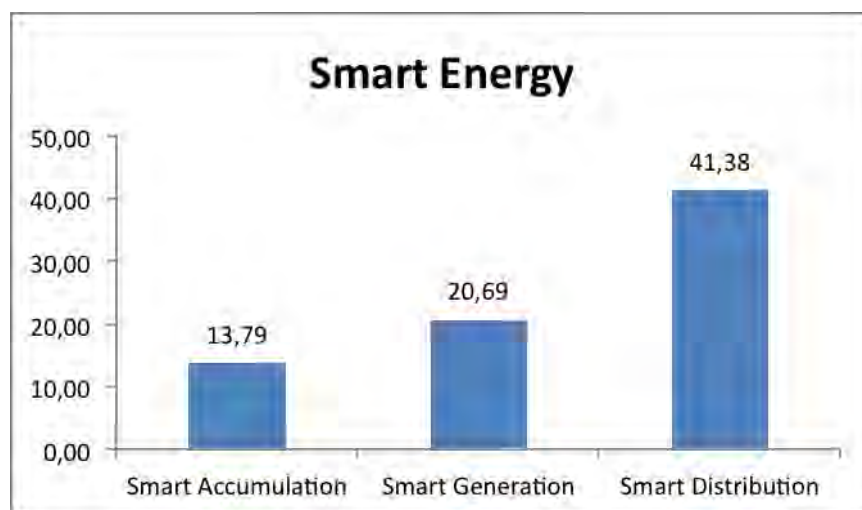


Figure 50 - Future expected business in Smart Energy domains

3.5.3 Embedded Systems Technologies in General

The cluster competences of Basque Country Region are historically related to the world class competences on electronics and software develop that have been developed from the mid 1980’s. In 1980, GAIA was formed as a joint effort between ICT companies in Basque Country and Software companies,– collaborated with any others partners, such as Universities, Research Centres, other Clusters and Administration. GAIA is now considered one of the most successful cluster organisations in Basque Country-Spain with 270 cluster members, primarily SMEs.

Since the mid 1980’s, the work fields have further evolved. Of the respondents, 28% professed to be active in hardware development, and a whole 65% in software development. In software development, they mainly act as systems integrator.

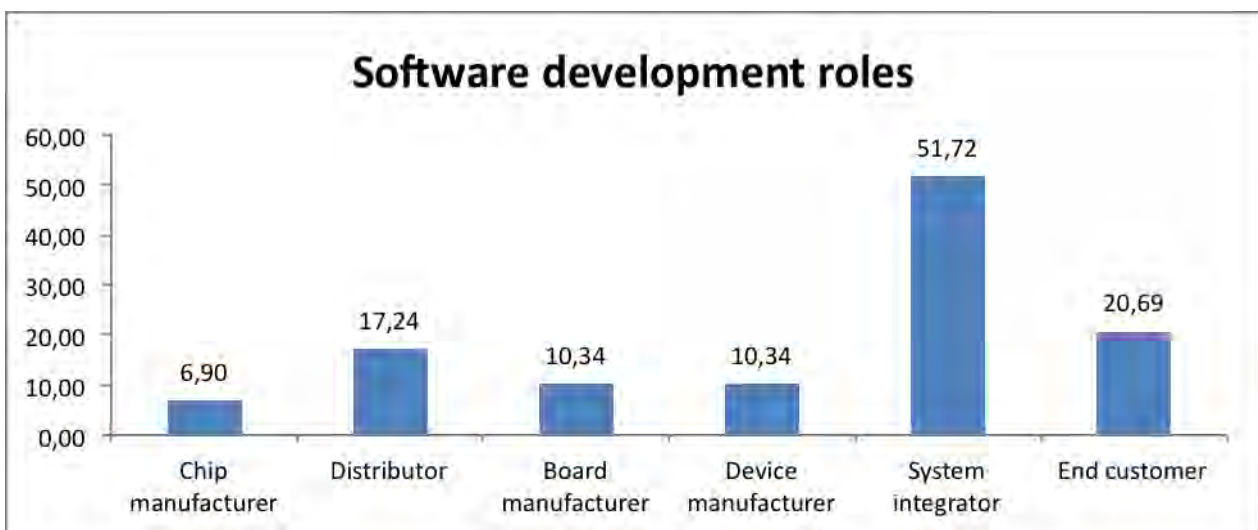


Figure 51 - Current value chain position in Embedded Systems

Likewise, GAIA has pinpointed 10 business areas within which a huge potential has already been proven. This does not mean that other fields hold no potential - just that these ten are currently at the forefront. The 10 current focus areas are:

- Interoperability
- Intelligent Transport & Logistics
- IT Services
- Smart Energy Grids
- Digital Health Solutions
- Wireless
- Embedded Software Systems
- Data-Intensive Systems
- Human-Computer Interaction
- Middleware

3.5.4 Domains

Over the past six years, cities around the world have been working to meet the commitment entered into at the Bilbao Summit to develop the Information Society in their territories and they have taken a step further with a view to promoting innovation and knowledge management processes, two key factors to achieve the competitiveness of cities.

The rapid development of new technologies and of innovation processes has resulted in a new city model, the famous "Smart City". A type of city that uses new technologies to make them more liveable, functional, competitive and modern through the use of new technologies, the promotion of innovation and knowledge management, bringing together 6 key fields of performance: the economy, mobility, the environment, citizenship, quality of life and, finally, management.

In the Basque Country, the areas of performance, as the questionnaire presented a list of about 20 possible activity domains (automotive, medical, telecom, etc.). Analysing all 20 in detail would lead us too far, so we just look at the highlights (most active, less active). The top-3 domains are: manufacturing, medical, and transportation – partly linked to train / railway and automotive. The predominance of the manufacturing domain can be explained by the machine tool industry tradition that is in the Basque Country, also it is very important the medical domain, the fundamental reason is by the choice of Basque Government to focus on the application domain of Medical Technology (now more broadly "Smart Health") as the first of its possible application domains. The application domain of "transportation" (combining subdomains from the questionnaire, for example infrastructure or energy) is also well represented. In line with a strong presence of players active in automotive (or mobility in a broader sense), the application domain of Smart Vehicles certainly hold great potential for Basque Country region.

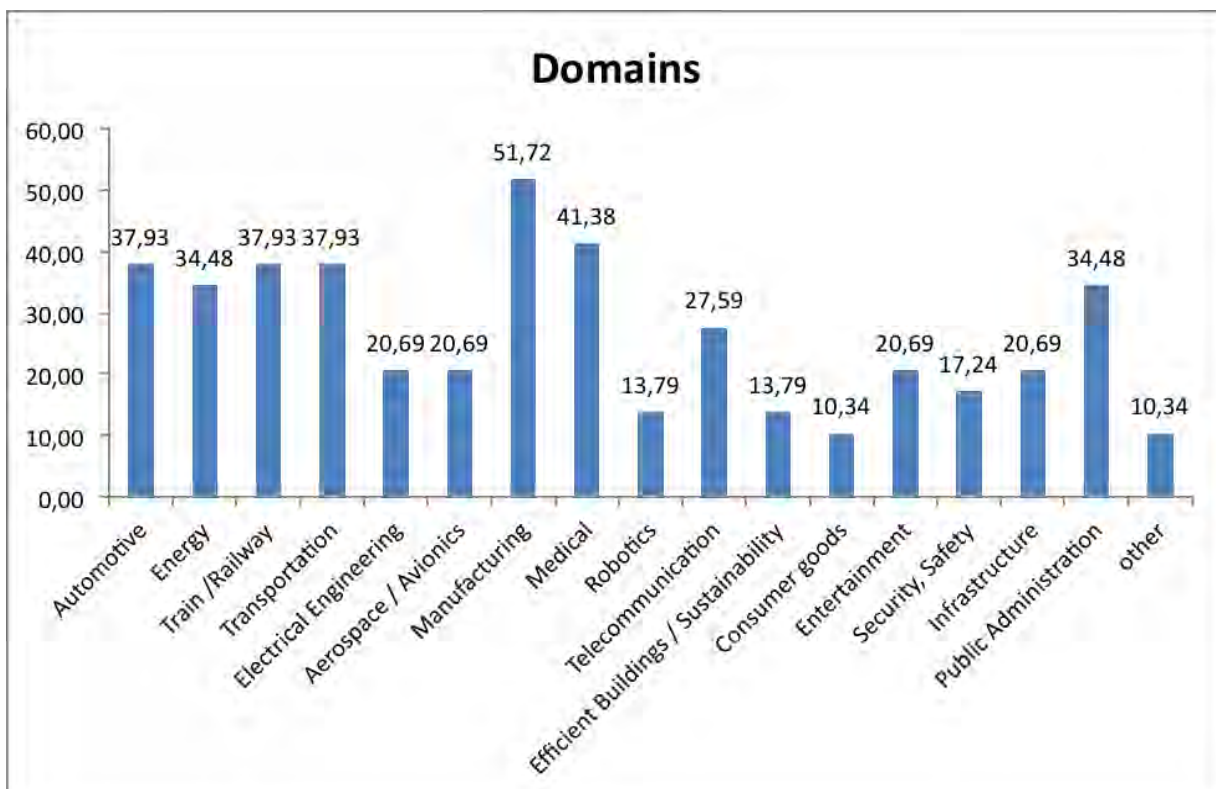


Figure 52 - Current business domains

If we look at the least represented domains (less than 8 active members), they are robotics, as to robotics, given its attractiveness in making embedded technologies visible in "spectacular" ways, this should probably be addressed more strongly in the ecosystem. As to consumer goods, the low involvement is probably related to the fact that the ecosystem largely consists of big companies, whereas infrastructure products and services are typically developed by the larger players (like Indra). In this case, if another cluster does have these big players in their portfolio, there would be interesting complementarities.

3.5.5 Special Capabilities

As to the special capabilities along the hardware/software development cycle, the GAIA ecosystem is a typical design community, which is clearly reflected in the dominance of "model based development" as a capability. The second strongest capability is that of "product lifecycle management" (for whole products, for components, and as a service). It should not be a surprise that these capabilities are well represented because the Basque Country SMEs are well known of working with management processes and advanced management systems.

It is also clear that requirements engineering, testing and middleware development are relatively well represented. It is even worth pointing out that we have a group of companies that have good capabilities in "usability engineering". Indeed, the ecosystem has seen a growing interest (in both directions) between the existing traditional hardware/software design companies on the one hand, and the "industrial design / user experience" companies on the other. In that way GAIA develops a Ergolab (www.llegolab.com) -Living Lab, is a living lab for the improvement of information systems through co-creation and co-design with users.

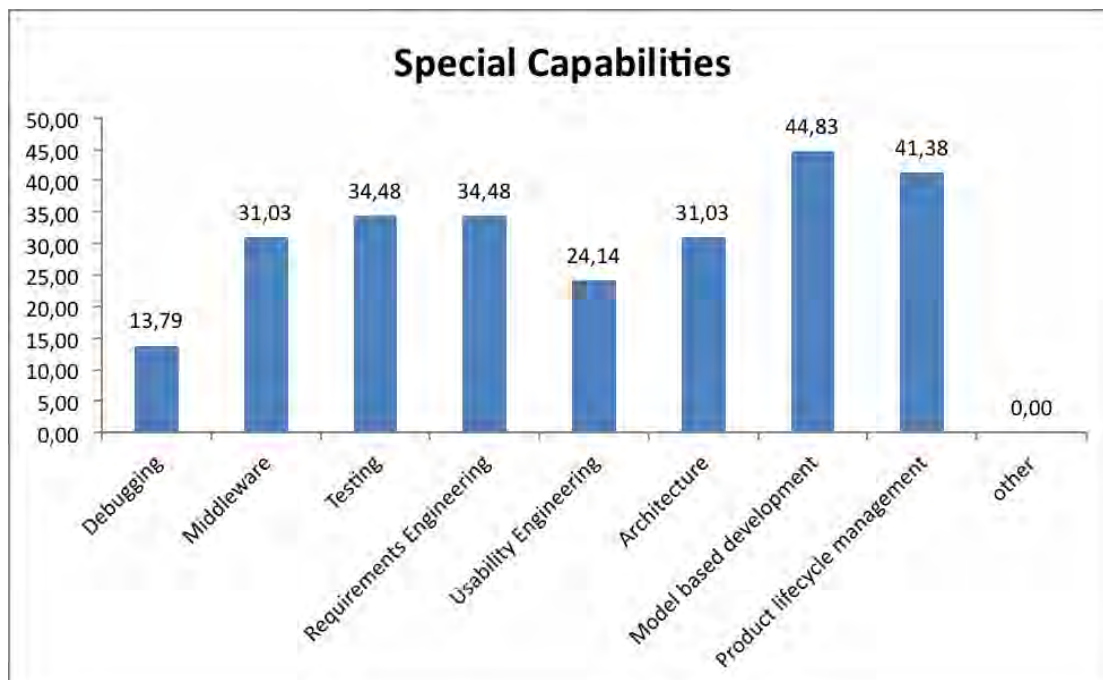


Figure 53 - Special capabilities for Embedded Systems development

3.5.6 Specialization Fields

As to specialization fields (within hardware and software), the questionnaire contains some 20 possible fields. We will again only highlight the most relevant outcomes. Man-machine, self-organization and data processing are in the ranking. Categories that are clearly under-represented are servicing system, as well as sensors and actuators, and less concrete (or more research-oriented) specializations like "distributed in control". On the whole, this also reflects the fact that the GAIA ecosystem is much "data/server/cloud-oriented". As to the domain of distributed in control, we can consider that a gap in the ecosystem. In this case, if another cluster does have these big players in their portfolio, there would be interesting complementarities.

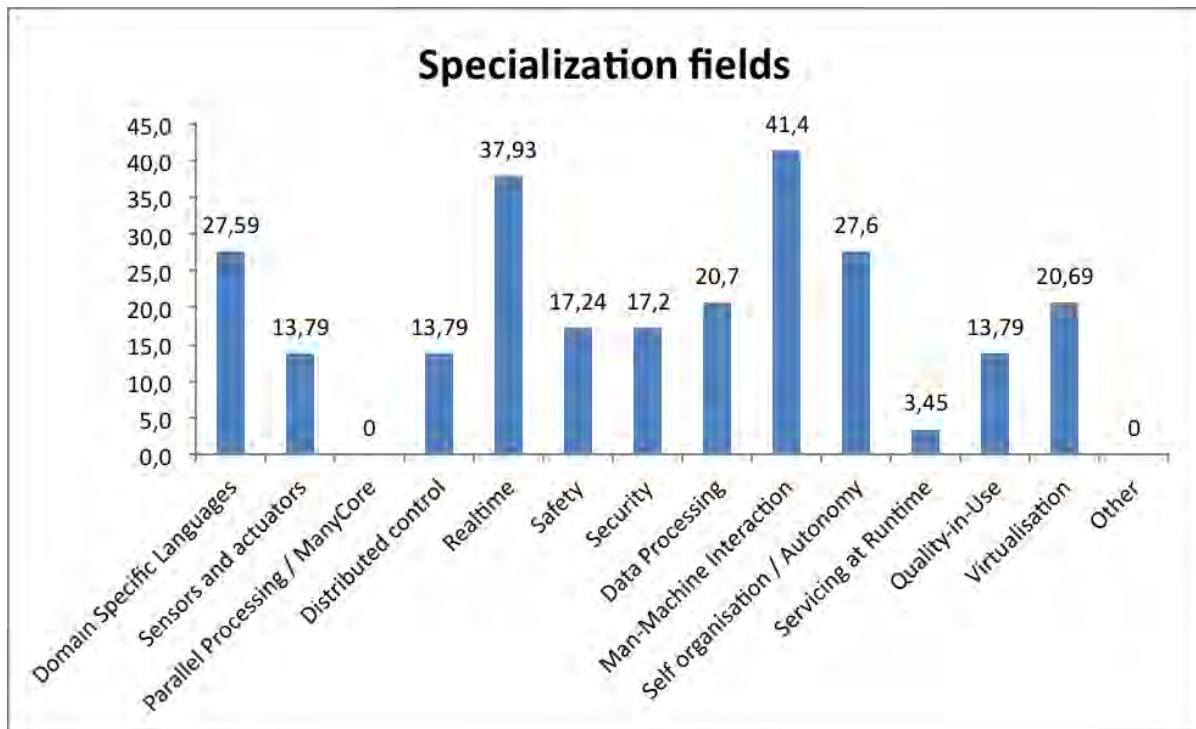


Figure 54 - Specialisation fields

3.5.7 Target customers

GAIA is typically a services sector and Industrial systems network: about 48% serve the "services sector" as a market, and about 44% serve the "the industrial sector" (where in some cases, certain companies cover both submarkets). The landscape of companies in Basque Country is largely a service-oriented business, with many players that actually develop and produce end products. As we think, this is a strong point. As a final remark related to customers, it is also clear that the public sector is also a typical market segment for the GAIA members (about 24%).

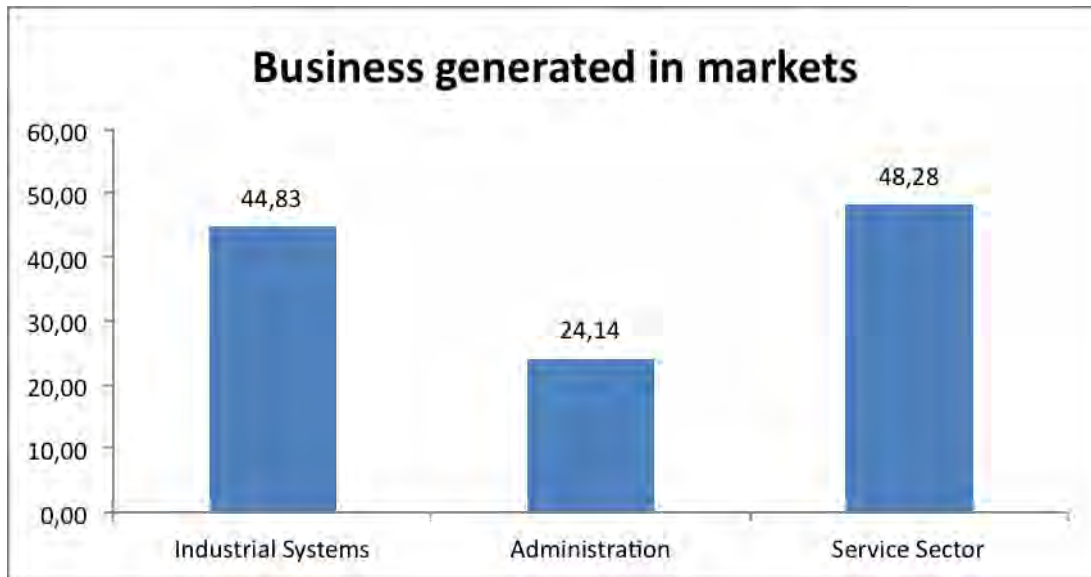


Figure 55 - Current markets

3.5.8 Market geography

As to the geographical market coverage by GAIA members, the figures show clearly that the fairly strong on the international orientation, around 70% of the members, it is clear that companies could do even better internationally (also if they want to grow from small to medium to big), so the internationalisation task for a project like CLINES remains very important, and hopefully the joint forces of the international clusters can help increase the international activity of the combined ecosystems.

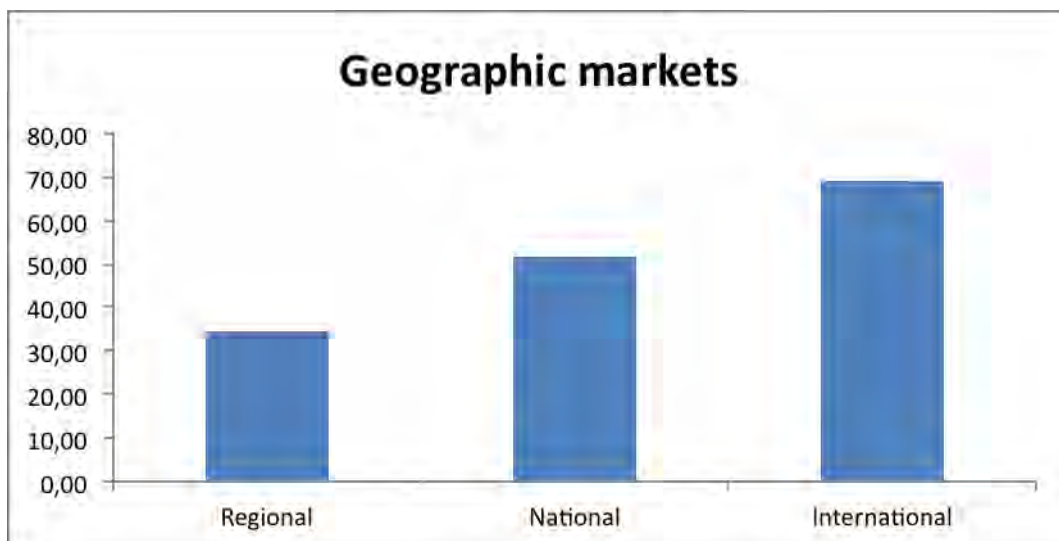


Figure 56 - Current geographic market coverage

4 List of Figures

<i>Figure 1 - The reach of the CLINES project</i>	4
<i>Figure 2 - The partner network of Silicon Europe</i>	12
<i>Figure 3 - Questionnaire respondents in each of the CLINES partner regions</i>	32
<i>Figure 4 - Smart City priorities per region</i>	33
<i>Figure 5 - Geographic focus</i>	34
<i>Figure 6 - Business sector</i>	34
<i>Figure 7 - Business domains</i>	35
<i>Figure 8 - Software development</i>	36
<i>Figure 9 - Hardware focus</i>	37
<i>Figure 10 - Development vs. integration</i>	37
<i>Figure 11 - Capabilities</i>	38
<i>Figure 12 - Specialized expertise</i>	38
<i>Figure 13 - Employees per company and sales volume of SMEs in Upper Bavaria</i>	41
<i>Figure 14 - Application domains in Swabia</i>	42
<i>Figure 15 - Work fields: Hardware development</i>	43
<i>Figure 16 - Other work fields</i>	43
<i>Figure 17 - Types of software development</i>	44
<i>Figure 18 - Business domains with ties to Embedded Systems</i>	45
<i>Figure 19 - Special capabilities</i>	46
<i>Figure 20 - Specialisation fields</i>	47
<i>Figure 21 - Future business expectancies</i>	48
<i>Figure 22 - Current business fields</i>	49
<i>Figure 23 - Market regions</i>	49
<i>Figure 24 - Success factors</i>	50
<i>Figure 25 - The DSP Valley Smart Systems ecosystem</i>	52
<i>Figure 26 - DSP Valley Competencies addressing Smart Cities Challenges</i>	53
<i>Figure 27 - Activities in Embedded Systems</i>	54
<i>Figure 28 - Value chain position</i>	55
<i>Figure 29 - Business domains</i>	56
<i>Figure 30 - Special capabilities</i>	57
<i>Figure 31 - Specialisation fields</i>	58
<i>Figure 32 - Business expected in Smart City domains</i>	59
<i>Figure 33 - Business expected in Smart Energy domains</i>	59
<i>Figure 34 - Current target customers</i>	60
<i>Figure 35 - Market geography</i>	61
<i>Figure 36 - BrainsBusiness/CISScCompetencies addressing Smart Cities challenges</i>	62
<i>Figure 37 - Areas of work / types of hardware development</i>	63
<i>Figure 38 - Types of software development</i>	64
<i>Figure 39 - Customer profile</i>	64
<i>Figure 40 - Value chain profile</i>	65
<i>Figure 41 - Application domains</i>	66
<i>Figure 42 - Specialized competence fields</i>	67
<i>Figure 43 - Operation fields of specialization</i>	68
<i>Figure 44 - Future Smart City focus areas</i>	69
<i>Figure 45 - Future focus areas within Smart Energy</i>	69
<i>Figure 46 - Future market areas</i>	70

<i>Figure 47 - The Basque Smart City concept</i>	71
<i>Figure 48 - Future importance of Smart City domains for business</i>	72
<i>Figure 49 - Regional competencies to solve Smart City challenges</i>	72
<i>Figure 50 - Future expected business in Smart Energy domains</i>	73
<i>Figure 51 - Current value chain position in Embedded Systems</i>	74
<i>Figure 52 - Current business domains</i>	75
<i>Figure 53 - Special capabilities for Embedded Systems development</i>	76
<i>Figure 54 - Specialisation fields</i>	77
<i>Figure 55 - Current markets</i>	78
<i>Figure 56 - Current geographic market coverage</i>	78