Vision, Mission and Strategy

EURIPIDES² European Smart Electronic Systems

EUREKA

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1. Executive summary

Jean-Luc Maté - EURIPIDES² Chairman

"Electronics is an "enabling" technology and a "propulsive" sector directly contributing to at least 10% of the World GDP.

Electronics is an "enabling" technology and a "propulsive" sector directly contributing to at least 10% of the World GDP. **The electronics industry today employs about 2.5 million people in Europe.** This very large industry will grow nearly twice as fast, during the coming years, as the total world GDP.

Europe has a strong position in professional "embedded" electronic systems. This position rests on European excellence in a number of industrial leaders, such as high performing technology for aerospace, defence, transport and high technology with best cost due to high volume in automotive, industrial engineering, machinery and energy. This is a two-way synergetic relationship ; **European excellence in embedded systems also consolidates the position of the downstream incorporating industries.**

Today European industry has the opportunity to acquire strong initial positions by targeting the new markets for heterogeneous electronic product integration, smart sensors and power electronics, **enmeshed and implanted systems.** This is where the value added by the positioning of European industry and its know-how are the greatest. Europe must from the start become a major player in these revolutionary new markets.

This virtuous innovation cycle and value chain must be maintained and developed. The EURIPIDES² cluster aims to support cooperative industrial research in Europe in the crucial domain of **smart electronic systems integration**. EURIPIDES² will focus on research and development close to actual applications and marketable products that could be manufactured in Europe with competitive prices. This involves exploiting the complementarities of all the different players in the electronics scene, such as academia, SMEs, large companies, integrating companies and end-users, as partners in cooperative projects.

The heterogeneous character of the EURIPIDES² ecosystem, and of the EURIPIDES² projects partners, echoes the concept of heterogeneous electronic integration and smart electronic system integration. Maintaining and developing the strength of European industry in the field of advanced technology and production, and as a consequence, to boost employment and growth in Europe is also the ultimate objective of EURIPIDES².

The EURIPIDES² ecosystem covers activities that range all the way up the electronic systems integration value chain, from materials, equipment and technologies, through components, modules, up to embedded, mechatronics, enmeshed and implanted systems. **In 2012, these activities involve about 1.7 million employees in Europe, out of the 2.5 million employed in all the European electronics industry.**

By the end of the current decade, in 2020, the players in the EURIPIDES² domain could provide about 700 000 new jobs. Naturally all these new jobs are not only the result of the action of EURIPIDES² and its members. But in an industry where technology and innovation play a key role, supporting research and development, international cooperation and harmonisation, and the position of SMEs is a crucial factor of growth. **In this way EURIPIDES² cooperative R&D projects have a direct impact on employment and economic growth in Europe.**

EURIPIDES² Vision: European Leadership in Smart Electronic Systems Integration design development and manufacturing

This is a global strategy to set up a virtuous cycle of R&D-innovation-manufacturing in Europe, focussed on the fields where European industry is powerful. A strong leading-edge European capability will have the greatest downstream impact on incorporating industries or in every new domain where market positions are still to be established.

EURIPIDES² Mission: Innovation hub for smart sensors, smart power modules and more generally heterogeneous electronic product integration for all leading industry sectors in Europe

EURIPIDES² Strategy:

- Focus on heterogeneous electronic products integration, advanced smart sensors and power electronics
- Increased participation of SMEs building on EURIPIDES2 “savoir faire” and network
- Involve European industrial leaders in supporting the definition of the innovative electronic hardware platforms
- Capitalize on its partnership with DG Connect (European Commission) to further cooperate with the EU Horizon 2020, the R&D&I framework and Key Enabling Technology areas (printed electronics, robotics, photonics, ...)
- Promote multi-sectorial projects through the EUREKA cluster co labelling
- Priority stress on following-up European innovation for manufacturing in Europe

Today the major challenge is to improve the competitiveness of European industry, and as a consequence to maintain and **create new manufacturing and employment opportunities in Europe.**

The prospects of employment evolution in the EURIPIDES² domain in Europe over the coming decade, where 700 000 new jobs can be created in Europe, show the major importance of the action of EURIPIDES², which can help make part of these new job prospects become real, through the power of the European Smart Electronic Systems technology, design and manufacturing.

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[1] See Annexe 1: Methodology

[2] The words enmeshed and implanted systems are defined, hereunder.
The three categories we distinguish in electronic systems are :

- stand-alone electronic systems, such as TVs, mobile phones, PCs... ;
- embedded systems, such as automotive or aerospace electronics for instance, which are systems conventionally incorporated into larger pieces of equipment or platforms belonging to the electrical or mechanical engineering sectors ;
- enmeshed or implanted systems, which are a new and emergent domain, where electronic smart systems and devices are beginning to be used as inclusions in products, materials, or even living bodies, such as in textiles, clothing, building materials, animals, and the human body for health and bio applications.

[3] In particular, through the experience gained in COWIN, a support action (FP7) to strengthen the European competitiveness in miniaturized smart systems. This initiative is dedicated to commercial exploitation of advanced technologies coming from collaborative European research work. In particular, COWIN facilitates interaction between public and private investment in Europe.

2. The Smart Electronic Ecosystem supports EURIPIDES²

Agnès Paillard
Chairwoman
"Smart Electronic systems are of course paramount for our Competitiveness Cluster"

Andrzej Moscicki
President
"We express our support to EURIPIDES²"

Eef Boschman
Director
"The EURIPIDES² cluster will be a perfect platform to participate as SME"

Ismail Hakki Sagir
Assistant General Manager – Production & Technology
"We support the EURIPIDES² initiative"

Enrique Daroqui Raga
Chief Technical Officer
"ATERSA supports EURIPIDES² and completely agrees with its strategy and mission"

Heinz Moitzi
CTO
"EURIPIDES² strengthens the competitiveness of European electronic industry and secures value creation within Europe"

Vaclav Neumajer
Chairman
"EURIPIDES² is a supportive tool for international cooperative industrial research"

Jan Willem Brands
Chief Technology Officer
"I would like to express the support of Barco n.v. for the EURIPIDES² cluster"

Marek Valdmann
Managing Director
"BIC Ostrava fully supports EURIPIDES² as a supportive tool for international research"

Ton van Weelden
Vice President Business Development
"The EURIPIDES² cluster will be a perfect platform to participate as SME"

Tibor Berceli
Professor - Budapest University of Technology and Economics
"We are in favor of EURIPIDES²"

Jean-Marc Nasr
Chairman
"EADS is very proud to be a member of EURIPIDES²"

Laurent Malier
CEO
"The EURIPIDES² projects are responsible for major advancement"

Laurent Bodin
General Manager
"We are very pleased to support EURIPIDES², its vision, mission and strategy"

Carles Cané
Director
"For CNM-CSIC EURIPIDES² is a very helpful tool for the internationalisation of SMEs"

Carl Van Himbeeck
General Manager
"EURIPIDES² is an important driver for the success of our future systems"

Helmut Matschi
Member of the Executive Board Continental AG
"A flexible, lean, industry and market driven EUREKA cluster like EURIPIDES² is a real competitive tool"

Mario El-Koury
CEO
"CSEM completely agree with its strategy and mission"

Francisco Sanchez Pons
Electronics & ITS Director
"CTAG strongly supports the Vision, Mission and Strategy of EURIPIDES²"

Dario Melchior
Managing Director
"We support and we hope for the renewal of EURIPIDES² EUREKA cluster label until 2020"

Thierry Gouvernel
Head of Strategic Business Development
"EURIPIDES² is an efficient enabler, helping greatly in finding R&D partners"

Thomas Harder
General Manager
"The European ECPE Network is supporting the EURIPIDES² vision, mission and strategy"

éolane

Paul Raguin
Chairman
"For EOLANE, EURIPIDES² is a promising R&D initiative"

femto-st SCIENCES & TECHNOLOGIES

Nicolas Chaillet
General Manager
"FEMTO-ST Institute strongly supports EURIPIDES²"

FICOSA International

Enric Vilamajo Fontantet
R&D Director
"FICOSA sees EURIPIDES² as a major catalyst"

FIEEC

Pierre Gattaz
Chairman
"FIEEC considers the EURIPIDES² initiative totally appropriate to add value in its action"

Fraunhofer IZM

Hubert Lakner
Chairman of the Board of Directors
"For Fraunhofer EURIPIDES² has proven to be a valuable tool for fostering innovation"

gemalto security to be free

Jean-Pierre Tual
Director, Industrial Relations and Corporate R&D partnerships
"EURIPIDES² is a unique tool needed by Gemalto for developing open innovation in heterogeneous secure systems"

GPtech

Eduardo Galvan Diez
Managing Director of Green Power Technologies
"We express the strong support of GPtech for the EURIPIDES² cluster"

iv INDUSTRIELLENVEREINIGUNG STEIERMARK

Thomas Krautzer
Head of Strategic Business Development
"It is an essential component for styrian industries to realize the EURIPIDES² strategy"

KIMM

Jung-ho Lee
Head, Department of R&D Strategy
"KIMM supports EURIPIDES² efforts and completely agrees with its strategy and mission"

KONE

Tomio Pihkala
Vice President
"KONE prepares for being an enthusiastic member of EURIPIDES² in the future"

merkum

Miguel Angel Palencia Garcia
Business Development Manager
"Supporting the EURIPIDES² platform is a perfect way to strengthen our competitiveness and innovation capabilities"

MST BW

Peter Josef Jeuk
CEO
"Mikrosystemtechnik supports EURIPIDES² cluster and their effort"

muRata

Shinji Ushiro
President and CEO
"Murata Electronics Oy strongly supports the continuation of this activity"

NovaPack TECHNOLOGIES

Renaud de Langlade
CEO
"I highly recommend a clear and frank support to EURIPIDES²"

NXP

Gerard Beenker
VP - Scientific Director
"NXP Semiconductors always looks for opportunities to co-operate with leading systems companies. EURIPIDES² is one of the platforms to achieve this"

OKMETIC

Markku Tilli
Senior Vice President
"A network like EURIPIDES² is valuable"

OSCILLOQUARTZ

Hans Ruedi Gottier
CEO
"Oscilloquartz strongy recommend the renewal of the EURIPIDES² program"

OSM

Jordi Garriga
Managing Director
"OSM gives the maximum support to EURIPIDES² as a great tool for international R&D"

PHILIPS
sense and simplicity

Casper Garos
Senior Director External Partnerships
"EURIPIDES² closes the missing link in the value chain"

PROVUS

Tunç Dasar
Chief Executive Officer
"We support their efforts and we completely agree with their strategy and mission"

Denis Urmanov
Executive Director
"Russian MEMS Association endorses and supports the new initiative EURIPIDES²"

SAFRAN
Sagem

Nicolas Burgaud
Marketing & Business Development Director
"We support the renewal of EURIPIDES² label"

SEAT

Dietmar Peters
Electric Development Manager
"The EURIPIDES² vision is highly appreciated from our side"

sensonor

Sverre Horntvedt
CEO
«Sensonor appreciates clusters like EURIPIDES² that recognizes the need for innovation»

Philippe Berlie
CEO
"SERMA strongly supports EURIPIDES²"

Gilles Chemin
Business Group Director
"Somfy strongly supports the EURIPIDES² cluster and prepares for being a new member"

Daniel Kroiss
Vice President
"I confirm the support of SORIN CRM with regards to EURIPIDES²"

Carmelo Papa
Executive Vice President
"EURIPIDES² action for innovation is instrumental to European leadership"

Lena Norder
CEO
"Smart Electronic Systems will be of expanding importance for many industries"

Jan Kalous
Chief Executive Officer
"We absolutely agree with EURIPIDES' vision"

Bernard Ledain
Director
"Thales Airborne Systems is looking forward to being an active member of this cluster in the future"

Anna Sztaniszlav
Managing Director
"We support the renewal of EURIPIDES²"

Jaromir Mirovsky
Executive Director
"TTS expresses its support to EURIPIDES²"

Irène Compte
Manager
"EURIPIDES² is a key EUREKA cluster for innovation"

An Nguyen-Dinh
Director of Technology
"We support their efforts and we completely agree with their strategy and mission"

Murat Sarpel
R&D General Manager
"The EURIPIDES² program projects are in the core interest of our organization"

Erkki Leppävuori
Chairman & CEO
"VTT looks forward to being an active member of EURIPIDES²"

Christoph Stoppok
Managing Director
"ZVEI, the German Electrical and Electronical Manufacturers' Association supports EURIPIDES²"

Christian Val
Founder
"We do support the renewal of EURIPIDES²"

3. Introduction

The electronics industry today employs about 2.5 million people in Europe, and about 20 million world-wide.

This very large industry will grow nearly twice as fast, during the coming years, as the total world GDP. In Europe, the electronics industry should on the whole be somewhat slower, largely because Asian countries, and particularly China, have taken a leading position in mass-market electronic products, taking advantage of their large and fast growing markets.

Europe on the other hand has a strong position in more professional "embedded" electronic systems. Historically, "stand-alone" electronic systems, such as TV, radio and audio consumer products were the first to appear on the market, constantly renewed by the ever-growing range of consumer innovations (video recorders and players, PCs, set-top boxes, mobile phones, smartphones, tablets...). Consumer products were followed by professional products, first for defence (radiocommunications and radar), and then for use in business, industry, health or vehicles. These professional electronic products were soon to become **"embedded"** systems, incorporated into platforms such as vehicles (aircraft, ships, trains, cars), machines or industrial processes.

Electronic products have gradually improved productivity in most of the other fields of the economy, and have stimulated innovation. **Electronics is an "enabling" technology and a "propulsive" sector**. Information technology, communications, and control technologies are extensively used in all other sectors, such as manufacturing industries (industrial, process and machine control) and services (administration, trade, transportation, finance, education, health, security…), and have become essential elements of vehicles and other machines.

Today this pervasive presence of electronics as a means for developing human control over the world is taking a major step further with the arrival of smart sensing, smart power and power scavenging, which will again enable the development of new markets. Autonomous communicating smart systems that can be **"enmeshed"** in textiles, clothing, building materials, generate new concepts such as smart clothes, smart walls, smart windows among other innumerable new applications. The materials these smart systems are meshed into themselves become interactive systems, and the word "enmeshed" takes a highly positive meaning. Such autonomous devices can also be **"implanted"** in the human body, or in animals, for health care, identification, or tracking applications. This pervasive change brought by electronic hardware and, increasingly, software, is revolutionising the world economy, and is continually opening vast new fields for growth and improved efficiency and well-being. The major contribution of the electronics industry to human progress will be relayed in the coming decades by the explosion of the new and diffuse markets for autonomous smart systems.

Embedded systems are Europe's strength

(billion euro)	WORLD		EUROPE	
	2012	2020	2012	2020
Stand-alone systems	910	1364	83	74
Embedded systems	472	673	141	174
Enmeshed and implanted systems	14	40	3	10
Total	**1 396**	**2 077**	**227**	**258**

Source DECISION

In Europe embedded, enmeshed and implanted (EEI) systems represented 64% of electronics production in 2012, compared with 35% worldwide, and Europe represented 30% of world production of EEI systems, compared with only 9% of stand-alone systems.

Embedded systems are the strong point of European industry, and must be maintained and developed. With this object in mind, the **EURIPIDES²** EUREKA cluster aims to support cooperative research in Europe in the crucial domain of **smart systems integration**, focussing on research and development close to actual applications and marketable products that can be manufactured in Europe. This support aims first of all to develop the competitiveness of European industry and companies, and to maintain and develop production in Europe of innovative electronic solutions, which in turn will lead to employment and economic growth. This involves exploiting the complementarities of all the different players in the electronics scene, such as academia, large companies, SMEs, integrating companies and end-users, as partners in cooperative projects.

In particular supporting the involvement of SMEs as active partners in the innovation and production process in Europe is a major challenge. SMEs are crucial if the European ambition to remain in the leading edge of world innovation is to succeed. This is a condition for stopping the decline of the share of Europe in world electronics production, which has started also in the embedded systems field.

Europe's strength in embedded systems rests on European excellence in a number of incorporating industries, such as aerospace, defence, transport and automotive, electrical engineering and machinery, and energy. This is a two-way relationship, European excellence in embedded systems also consolidates the position of the downstream incorporating industries.

The European embedded systems industry

	European production 2012 (bn euro)	Share of world production (2012)	Growth 2012-2020 (annual %)
Industrial and transport	64.3	31.0 %	3.4
Aerospace and defence	33.3	29.0 %	2.7
Automotive	33.9	27.2 %	1.7
Medical	9.3	23.2 %	3.7
Enmeshed and implanted	3.4	25.4 %	14.4
Total embedded & enmeshed systems	**144.2**	**29.7 %**	**3.1**
Stand-alone systems	82.7	9.1 %	-1.4
Total electronics industry	**226.9**	**16.2 %**	**1.6**

Source DECISION

Europe is strong in nearly all segments of the **industrial market**. In the railway industry the two European leaders Siemens and Alstom have 24% of the world market, just behind the two Chinese leaders (26%) and before the two North American leaders Bombardier and GE (18%).

In **agricultural machinery** the European CNH-Fiat is among the three world market leaders beside the Americans John Deere and AGCO. In construction equipment and mining machinery the Europeans Volvo Construction Equipment, Liebherr and CNH-Fiat are in leading positions behind the US supplier Caterpillar who dominates the market.

In **power supplies and converters** the European Schneider Electric holds a leading position, and in the strong growth solar applications the German SMA Solar Technology is leader. In the promising field of power distribution and smart grids the Europeans ABB, Schneider Electric and Siemens are world leaders. Osram and Philips hold strong positions in the lighting equipment market and in the new very active solid-state light source market.

Europe is also particularly strong in the **automation field**, with three European manufacturers (Siemens, ABB, Schneider Electric) globally dominating the world market, and four European companies (Mettler Toledo, Elster, Landis+Gyr, Rohde und Schwartz) are among the top ten test and measurement equipment manufacturers.

In the aerospace and defence industry, **security** is the new, emerging and dynamic market. Europe occupies a strong position here, with the presence of major producers and systems integrators many of whom are now moving from the aerospace and defence business into security (e.g. Airbus, Thales, EADS, Smith, Morpho, etc.). However it seems European industry might lose market shares in the new security field, with European production seen as growing at no more than 3.8% on a world market growing at 6.5%.

As the security market evolves to adapt to new security threats and a changing regulatory framework, new European leaders may emerge as well in large application market sectors (environment, energy, transportation) where new security constraints will develop in the future.

World demand for aerospace, defence and security electronic systems will be less dynamic (3.5% growth) than electronics globally because of the slow growth of the military segments. Civil markets should grow faster than world electronics on the whole, civil aerospace around 6%, and security at 6.5%.

Automotive electronics production is dominated by the European Robert Bosch, who has overtaken Denso to become the world n°1 supplier of automotive electronic solutions. Its successful strategy is based on full vertical integration from electronic component manufacturing (sensors) down to complete system integration (ESP, engine control, etc.). The Europeans Continental, Faurecia and ZF follow as fifth to seventh world suppliers, and Valeo as eleventh.

Generally speaking this market is fragmented between automotive equipment suppliers who consider electronics as a major source of innovation and added value. Pure specialist suppliers of automotive electronics are exceptions in the competitive landscape.

In Europe as elsewhere all of the main automotive equipment suppliers have entered the electric vehicle business. Valeo has announced it will concentrate 2/3 of its R&D investment on electric and hybrid platforms, and Bosch is investing with Samsung SDI on Li-Ion batteries while maintaining its effort on the optimization of combustion engines.

This strong position of European automotive electronics suppliers rests on the very strong position of the European automotive vehicles world-wide. Six European car makers are among the world top thirteen, with Volkswagen and Renault Nissan respectively second and fourth world suppliers.

Leading world automotive suppliers 2011 (thousands)

COMPANY	RANK	REGION	PRODUCTION
GM	1	USA	9 146
Volkswagen	2	EU	8 157
Toyota	3	Jap	8 050
Renault-Nissan	4	EU	7 457
Hyundai	5	SKor	6 617
Ford	6	USA	4 873
PSA	7	EU	3 582
Honda	8	Jap	2 909
Suzuki	9	Jap	2 726
Fiat	10	EU	2 400
Chrysler	11	USA	2 004
BMW	12	EU	1 738
Daimler	13	EU	1 528

Source OICA

The European **medical electronics** industry, with almost 23% of world production, exceeds the domestic market needs, and shows a positive trade balance.

The medical electronics industry is changing very quickly and has to meet new demands, such as individual miniaturised diagnostic or healthcare solutions, with products like hearing aids, glycaemia testers, blood pressure testers, electronic thermometers, scales, and many innovating devices such as pill cameras, contactless power charging or communicating pacemakers/defibrillators, implanted chemical testers, etc. A lot of these are becoming consumer stand-alone products, and also products **implanted** in the human body.

These new needs for low-cost mass-market products will contribute to reduce expenditures for hospitals and social security systems. The leading medical electronics suppliers are naturally very keen to capitalize on these new markets, but in many cases the new products have been developed by start-ups or recent spin-offs.

The average age and the life expectancy of the European population is growing, and in this context Europe's health and social security systems are a key advantage. Thus Europe is well placed to fund innovation in cost effective smart systems to assist its aging population, and to manufacture these new health products and services in Europe. This will also contribute to minimizing the cost of new health needs per person (Home monitoring).

In medical imaging the European position is strong, the Europeans Siemens and Philips, behind the American General Electric, hold 70% of the world market, followed by Toshiba.

Europe is also very strong in environmental awareness, and in actions such as CE marking, CO2 regulations, energy consumption standards for homes and equipment... Euripides could take advantage of this strong position to promote smart system applications in these fields, in relation with European companies such as Veolia or Suez that are among the world leaders.

The EURIPIDES² ecosystem covers activities that range all the way up the levels of electronic systems integration value chain, from materials, production equipment and tools, and technologies, through components, modules, up to embedded, enmeshed and implanted systems. **In 2012, these activities involve about 1.7 million employees in Europe, out of the 2.5 million employed in all the European electronics industry.** Each job this industry generates brings at least two more jobs in associated service activities such as design, software, information and telecommunication services...

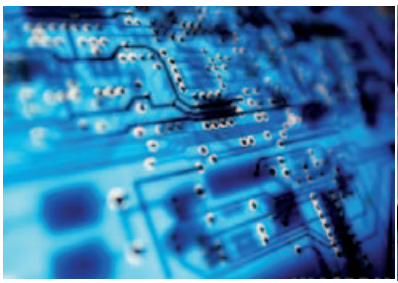
The EURIPIDES² cluster does not cover all the areas of the electronics industries, but is involved in activities at different levels of the electronics value chain, as shown in the following table. At the first and second levels EURIPIDES² does not cover the semiconductor activity, which is taken charge of by the CATRENE cluster. Level 3, in which components are assembled into functional modules and boards, is entirely covered by EURIPIDES², although the borders are sometimes barely visible with the CATRENE domain, and in some cases cooperation between the two clusters has been fruitful. Level 4 is the level of electronic "end-products", where EURIPIDES² mostly focuses on **the professional embedded electronic systems** for which Europe is strong, and on the emerging markets of enmeshed and implanted systems, rather than on the "stand-alone" systems where the European position is weak.

The EURIPIDES² domain inside the electronics industry in 2012 (billion euro)

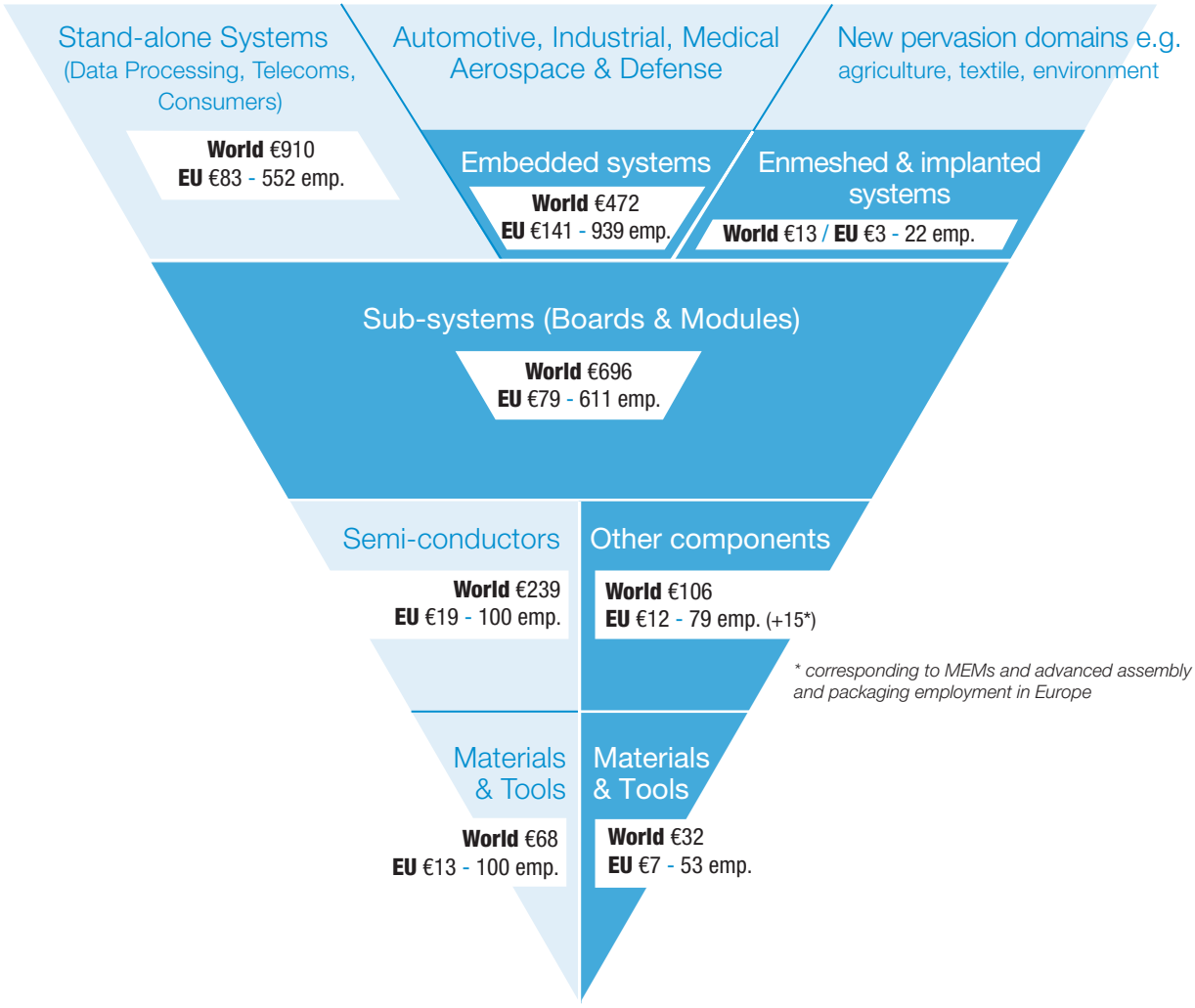
	WORLD		EUROPE	
	All electronics	EURIPIDES² Electronics	All electronics	EURIPIDES² Electronics
LEVEL 1 I Materials, equipment, tools	99.9	31.7	20.1	6.9
LEVEL 2 I Components	344.4	149.3	30.9	14.7
LEVEL 3 I Boards, modules	695.5	695.5	78.5	78.5
LEVEL 4 I Electronic "end-products"	1 395.8	485.2	226.9	144.2

Source DECISION

The figures above measure successive stages in the value chain, and for this reason should not be added together, as each successive stage includes the preceding stages. Thus the sales figure for embedded systems (e.g. automotive electronics) already includes sales of lower levels, i.e. modules, boards, components, materials...



Inverted pyramid showing (in dark blue) the EURIPIDES² domain, World and European production in billion euro, European employment in thousands (out of software application)



** corresponding to MEMs and advanced assembly and packaging employment in Europe*

Source DECISION (see Annexe 1, Methodology)

Stand-alone electronic systems are, among others, PCs, smartphones, tablets, TVs... Embedded systems are electronic systems integrated into a larger system or platform that is not electronic, as for example a car, or an aeroplane... **Enmeshed and implanted** systems are newer developments, where small autonomous electronic systems can be included for example in textiles ("smart clothes"), or building materials, or objects involved in the "internet of things", or implanted in the human body for health care functions. Except for medical applications, this is still a small market, but it will doubtless be booming by 2020.

Today the opportunity for European industry to acquire strong positions in new markets is to aim for enmeshed and implanted systems.

The domain covered by the EURIPIDES² cluster covers materials and tools (other than for the semiconductor industry), components (other than semiconductors), i.e. passive components, optoelectronics, integration and packaging technologies, interconnection, boards and modules design and assembly, and embedded, enmeshed and implanted systems. Tools and production technology are particularly important, in view of the focus on production in Europe, and on the competitiveness of European industry.

Smart systems and heterogeneous integration are a major part of the EURIPIDES² cluster domain. This is where the value added by the positioning of European industry and its know-how are greatest. This is a field where different technologies and capabilities are integrated into functional systems, associating different companies, large companies and SMEs, in cooperative projects. Thus the concept of heterogeneous integration is echoed in the heterogeneous character of the EURIPIDES² R&D project partners. The positive contribution of partner complementarity has nearly always been a success factor for EURIPIDES² projects. This amounts to integrating European strengths at all levels of the value chain, and this undoubtedly contributes to maintaining and developing the strength of Europe in the field of advanced technology and production, and as a consequence, to bring employment and growth in Europe.

Employment in Europe (in thousands)

	Electronics Industry		EURIPIDES² Domain	
	2012	2020	2012	2020
Materials, equipment and tools	153.7	281.9	53.4	75.8
Components	179.2	198.8	93.8	114.6
Boards & modules	611.6	975.0	611.6	975.0
Systems	1 512.5	1 723.4	961.0	1 229.8
Total	**2 457.0**	**3 179.1**	**1 719.8**	**2 395.2**

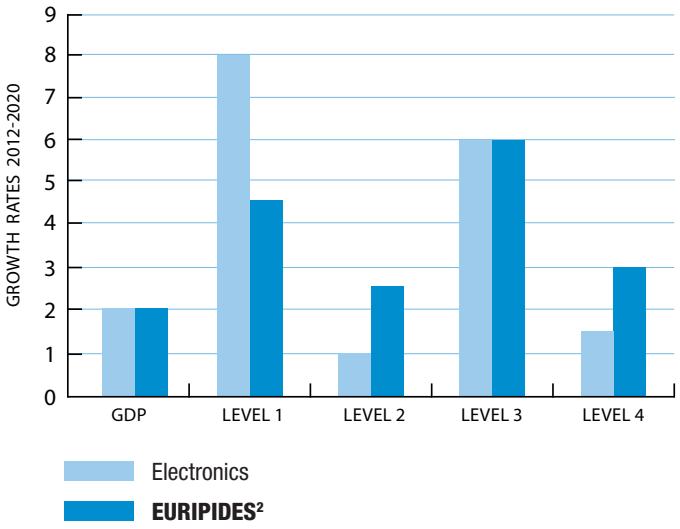
Source DECISION

Employment figures show little double counting, as the sales on employees' ratios we used for our estimates exclude this. However some double counting may remain between levels 3 (sub-systems, boards, modules) and 4 (end-product systems), as we were not able to determine the share of outsourced final assembly by system manufacturers. Thus the final figure may be over-estimated, but this should not exceed 15% of the total employment figure.

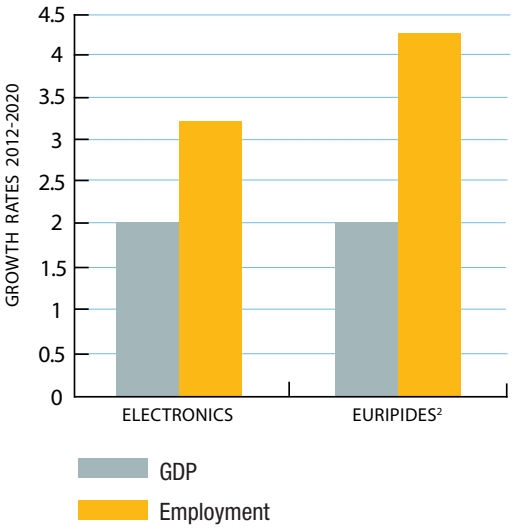
In the table above, the difference between "electronics industry" and "EURIPIDES² domain" is the semiconductor activity and the stand-alone systems activity, which are included in the "electronics industry" but not in the EURIPIDES² domain.

Production in Europe

Note: this chart refers to definition of levels see paragraph 3.1

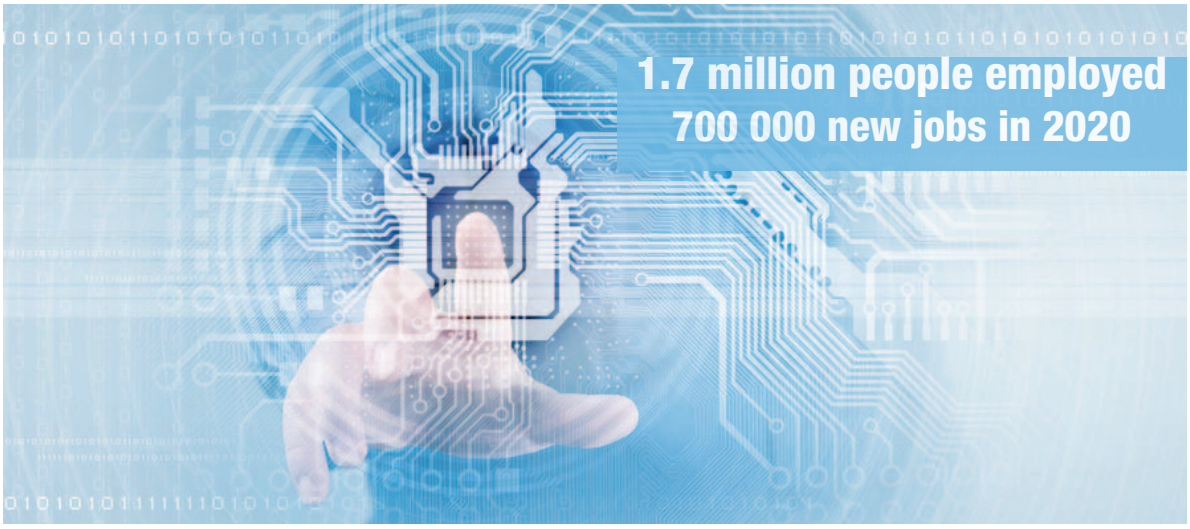


Employment in Europe



The whole domain covered by EURIPIDES² employs about 1.7 million people, and by the end of the current decade, in 2020, the players in the EURIPIDES² domain could provide about 700 000 new jobs. This is a very large figure, and does not include indirect gains in the higher levels, for example in the automotive industry, the aerospace industry, the defence industry or the electrical, mechanical engineering, machine and railway equipment industries, whose competitiveness will be difficult to sustain without innovation by their European electronics suppliers. The independence of the incorporating industries is a strategic issue for Europe. The employment figures given here were estimated by DECISION (see Annexe 1).

Naturally all these new jobs are not only the result of the action of EURIPIDES and its members. But in an industry where technology and innovation play a key role, supporting research and development, international cooperation and harmonisation, and the position of SMEs is a crucial factor of growth. In this way the EURIPIDES cooperative R&D projects have a direct impact on employment and economic growth in Europe.



This direct impact is difficult to measure. However, studies of collaborative EUREKA projects clearly indicate that on the whole yearly sales growth is around 24% higher for EUREKA participating firms, and yearly employment growth is around 21% higher, compared to firms that had not participated in a EUREKA project.
During the first two years after the project, participant's turnover grows twice as fast as non-participants, and after 4-5 years, participants outperform similar non-participants by about one third in terms of turnover growth. In addition, growth in exports for EUREKA participants is more than twice that of similar non-participants.

These figures show the undoubtedly positive impact of the EUREKA R&D projects on growth and employment. The direct impact of EURIPIDES² projects already probably amounts to at least 10 000 jobs created or maintained. This is only for about 50 projects, a lot of which have not yet been completed, and whose impact has not yet become measurable. And the impact must be evaluated globally, as a synergetic result of all the EUREKA and EU FP programmes covering electronics and semiconductors, and also those covering the incorporating industries. It is the whole of this complex of R&D programmes and other support policies that will, if efficiently implemented, achieve the renewed growth of the European electronics industry.

Corroborating this, from a more concrete point of view, the example of a European SME involved in several EURIPIDES² projects, whose sales and employment have grown hand-in-hand with innovation, can be found in Chapter 5.2. In this particular case, both sales and employment have doubled over the last twelve years.

All this naturally assumes EURIPIDES² will continue to have the positive impact it has had in the past on the competitiveness of European industry, and as a consequence on the localisation of production in Europe. It is vital that this support should not only be maintained, but developed. If support to European cooperative research, and particularly the industry-related research and development, should diminish, not only would new jobs created be much less, but employment in Europe in the domain might regress to the benefit of other regions in the world.

A major challenge of this day is to **maintain and improve the competitiveness of European industry,** and as a consequence to maintain and **create new opportunities for manufacturing and employment in Europe.**

The prospects of employment evolution in the EURIPIDES² domain in Europe over the coming decade, hopefully bringing 700 000 new jobs in Europe, show the major importance of the action of EURIPIDES², which can contribute to making these new job prospects become real, through the progress of smart systems integration in Europe.

4. What is EURIPIDES² ?

4.1 I Smart systems integration in Europe today

Segmentation of functionalities, technologies and products in the EURIPIDES² domain

The EURIPIDES² cluster covers a complex and evolving **value chain**, involving products, technologies and processes at all the successive levels of integration inside the electronics industry.

LEVEL 1

1.1 I **Equipment and tool suppliers**
1.2 I **Materials**
1.3 I **Substrates and packages**

LEVEL 2

2.1 I **Active components** (MEMS + advanced assembly activities)
2.2 I **Passive components** (Capacitors, Magnetic, Resistors, Quartz and filters…)
2.3 I **Interconnection components** (Printed Circuit Boards, Connectors)

LEVEL 3

3.1 I **Electronic board assembly**
3.2 I **Electronic module assembly** (RF, Power, Sensors, Batteries, Displays…)

LEVEL 4

4.1 I **Stand-alone electronic products/systems** (e.g. smartphones, PCs...)
4.2 I **Embedded products/systems** (e.g. engine control unit...)
4.3 I **"Enmeshed" or "implanted" products/systems** (e.g. intelligent clothes, building materials, medical implants, ...)

EURIPIDES² covers part of levels 1 and 2, the other part concerning semiconductors is covered by CATRENE. EURIPIDES² covers all of level 3. In level 4 EURIPIDES² focuses on embedded systems, Europe's strong point, and on the emerging markets of enmeshed and implanted systems. Stand-alone systems production is declining in Europe, and, except for specific cases, that is not where R&D support will bring the best results for European industry.

Down-stream from level 4 but outside the historical EURIPIDES² focus, is level 5, with the mechanical or electrical systems incorporating the level 4 electronic embedded systems, such as cars, aircraft, ships, trains, or industrial machines... These can in turn be considered as part of a level 6 of wider social meta-systems (such as traffic, city, factory, company or whole value-chain, hospital...). Although these down-stream levels are not part of the EURIPIDES² domain, players in these levels are concerned by EURIPIDES² projects, and may be partners in them. Indeed downstream players can bring important contributions to the development of innovation, by ensuring that they answer the needs of the end-users.

This is in particular the case of car manufacturers, aerospace, defence and security players, mechanical and electrical engineering companies. And also, at a further downstream level, players from the food industry, from the building industry, or from operators in the energy, telecommunications, or health sectors could be fruitfully associated with the innovation process.

Table: Parallel segmentations of the EURIPIDES² domain

Smart system functionalities	Process and component technologies	EURIPIDES² industrial value chain
Sensing, Metering, Measuring **Actuating**, incl. smart power electronics and LED, laser, light **Data** storage and processing, artificial intelligence **Communication** and data transmission (incl. wired and wireless communication), communicating objects Man-machine **interface**, e.g. displays, key pads, machine to machine, … **Energy** storage, management and harvesting (smart grids, smart building, ...)	**Materials** and Process technologies **Component** technologies including MEMS, optoelectronics, printed, flexible electronics and bioelectronics **Packaging** technologies, housing **System integration** technologies **Reliability**	LEVEL 1 I Processes, equipment and tools, materials, substrates, packages LEVEL 2 I Interconnection and passive components as well as MEMs and advanced packaging activities (excluding other semiconductor devices) LEVEL 3 I Subsystem assembly, boards and modules including SiP, MCM and other 3D assemblies... LEVEL 4 I Electronic products, systems, stand-alone (e.g. smartphones, PCs...), embedded (e.g. engine control unit...), "enmeshed" or "implanted" (e.g. intelligent clothes, building materials, medical implants, ...)

The products in the different levels of the value chain that compose the EURIPIDES² domain answer different functionalities seen from the user point of view, and result from different technologies and processes. These are juxtaposed on the table above, but there is no horizontal correspondence.

Quantitative evaluation: sales and employment in the EURIPIDES² domain

The EURIPIDES² domain concerns activities that employ about 1.7 million people in Europe today, out of the 2.5 million employed by the whole of the European electronics industry.
There are no statistics evaluating precisely the domain covered by EURIPIDES², but the following figures give orders of magnitude, and enable a vision of the relative importance or EURIPIDES² in the electronics industry.

Total production, EURIPIDES² domain, World, billion Euros

LEVEL	DOMAIN	2010	2012	2015	2020
1	**Materials & Equipment**	**29.0**	**31.7**	**36.7**	**47.4**
1.1	Materials	14.5	15.9	18.4	23.7
1.2	Tools	9.7	10.6	12.2	15.8
1.3	Substrates, packages	4.8	5.3	6.1	7.9
2	**Components**	**137.9**	**149.3**	**172.9**	**224.5**
2.1	Active	41.1	43.5	50.5	66.4
2.2	Passive	31.6	33.0	35.9	41.7
2.3	Interconnection	65.2	72.7	86.5	116.4
3	**Subsystems**	**653.0**	**695.5**	**846.6**	**1 089.7**
3.1	Boards	506.7	527.9	649.2	795.8
3.2	Modules	146.3	167.6	197.4	293.9
4	**Systems**	**438.0**	**485.3**	**557.1**	**713.3**
4.1	Stand-alone (not in the domain)	0	0	0	0
4.2	Embedded	427.1	471.9	538.7	673.1
4.3	Enmeshed	10.9	13.4	18.4	40.2

Source DECISION

Employment in Europe, in the whole of the electronics industry (thousands)

LEVEL	DOMAIN	2010	2012	2015	2020
1	**Materials & Equipment**	**145.0**	**153.7**	**194.2**	**281.9**
2	**Components**	**195.8**	**179.2**	**186.1**	**198.8**
2.1	Active	120.8	100.5	100.5	99.1
2.2	Passive, interconnection	75.1	78.7	85.7	99.7
3	**Subsystems**	**573.7**	**611.6**	**748.4**	**975.0**
3.1	Boards	422.3	439.9	541.1	663.2
3.2	Modules	151.4	171.7	207.3	311.8
4	**Systems**	**1 481.3**	**1 512.5**	**1 576.6**	**1 723.4**
	Total	**2 395.8**	**2 457.0**	**2 705.3**	**3 179.1**

Source DECISION

Total production, EURIPIDES² domain, Europe, billion Euros

LEVEL	DOMAIN	2010	2012	2015	2020
1	**Materials & Equipment**	**6.5**	**6.9**	**7.9**	**9.9**
1.1	Materials	2.8	3.1	3.5	4.1
1.2	Tools	2.7	2.7	3.2	4.0
1.3	Substrates, packages	1.0	1.1	1.2	1.4
2	**Components**	**14.7**	**14.7**	**15.7**	**17.8**
2.1	Active	3.4	2.8	2.9	2.8
2.2	Passive	3.2	3.2	3.2	3.3
2.3	Interconnection	8.1	8.7	9.9	11.6
3	**Subsystems**	**73.4**	**78.5**	**96.0**	**126.4**
3.1	Boards	50.7	52.8	64.9	79.6
3.2	Modules	22.7	25.7	31.1	46.8
4	**Systems**	**134.0**	**144. 2**	**155.9**	**184.4**
4.1	Stand-alone (not in the domain)				
4.2	Embedded	131.3	140.8	151.3	174.4
4.3	Enmeshed	2.7	3.4	4.6	10.0

Source DECISION

Employment in Europe, in the EURIPIDES² domain only (numbers)

LEVEL	DOMAIN	2010	2012	2015	2020
1	**Materials & Equipment**	**50.1**	**53.4**	**60.9**	**75.8**
2	**Components**	**93.2**	**93.8**	**100.7**	**114.6**
2.1	Active	18.1	15.1	15.1	14.9
2.2	Passive, interconnection	75.1	78.7	85.6	99.7
3	**Subsystems**	**573.7**	**611.6**	**748.4**	**975.0**
3.1	Boards	422.3	439.9	541.1	663.2
3.2	Modules	151.4	171.7	207.3	311.8
4	**Systems**	**893.6**	**961.0**	**1 039.0**	**1 229.8**
	Total	**1 610.6**	**1 719.8**	**1 949.0**	**2 395.2**

Source DECISION

The EURIPIDES² ecosystem: the players

The European electronics industry is increasingly focused on professional and automotive embedded systems in a highly synergetic value chain. Both large international or regional groups and SMEs are positioned all across the Euripides domain and all through the value chain, from level 1 to level 4,

In this multiform European ecosystem, the EURIPIDES² cluster, in the EUREKA framework, acts as an innovation hub, gathering all the different players, academia, SMEs and large companies, materials, tools and component specialists, integrators and assemblers, and incorporators, to work together on advanced heterogeneous integration technologies and smart systems development.

Today the EURIPIDES² organisation is hosting:

500 partners

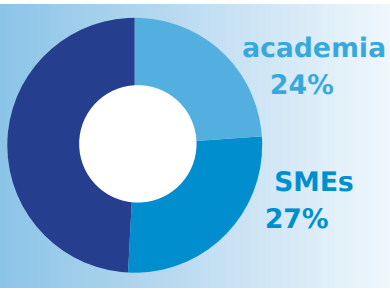
17 funding countries

Austria, Belgium, Czech Rep., Finland, France, Germany, Hungary, Ireland, The Netherlands, Norway, Poland, Slovenia,Spain, Sweden, Switzerland, South Korea and Canada

56 labelled projects

85 project proposals

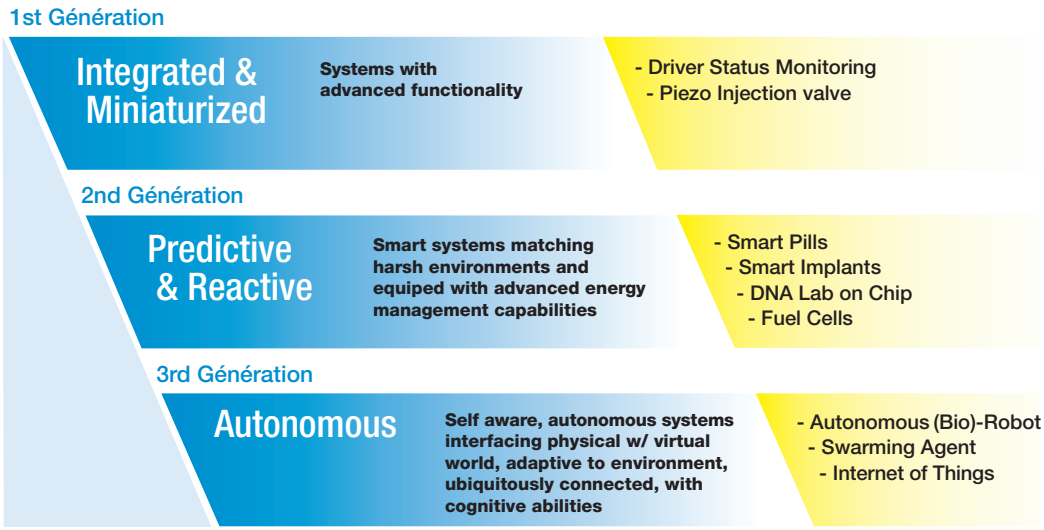
400M€ funding on R&D over the past years with the following workshare distribution :



4.2 | Trends for the future

The role and nature of products, tasks and players are changing. Smart systems are in the process of evolving from miniaturised integrated devices to autonomous systems. This is enabled by new complex assembly and packaging technologies and processes. And in turn this change is enabling the renewal and extension of present markets, particularly in embedded systems, and the opening of vast new market areas, more specifically enabled by autonomous smart systems, in enmeshed and implanted ubiquitous applications.

Successive generations in smart systems



Source STMicroelectronics

The past trend was dominated by miniaturisation. The main new markets and applications during this period were in wire and wireless telecommunications and multi-media convergence, requiring ever greater miniaturization and integration (SoC and SiP, CSP/WLCSP). This has enabled a strong growth of the electronics industry, with constant renewal and innovation of products, with ever-greater functionalities and user-friendliness. In this stage innovation was mostly technology driven.

In the future the trend will be, in a first stage, towards predictive and reactive systems, and, over the coming decade, towards autonomous and often connected systems, which will enable the development of new markets for emmeshed and implanted systems. These may also sometimes be integrated into a single grid system, a network or matrix of sensors and actuators.

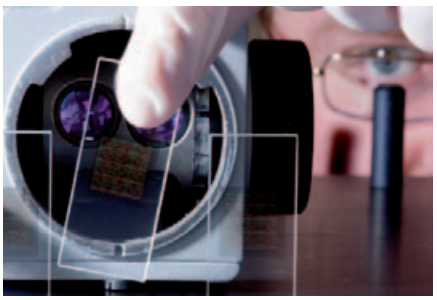
In the stage of the future development, the availability of adaptable autonomous devices will open the way for market-pulled innovation, and applications in sectors not yet using electronics much outside manufacturing and process control, such as the food, textile, or building materials industries. Innovation in smart systems will help to sustain the world-leading European incorporating industries, but it can also revitalise industries like textile with a new technological content. Europe must seize the opportunity of this paradigm change.

Some new markets generated

Market demand	Technology and smart system requirements
New energies and sustainable development	Power (components, batteries, fuel cells...) and Power Management for new energies, smart grid, transportation (auto, trains, planes), metering (electricity, water…), green electronics, eco-design…
Positioning, micro-actuating, robotics	MEMS everywhere and in SiP or 3D packaging
Intelligent clothes, medical assistance, safety and security	Flexible, stretchable, wearable, implantable electronics
Food industry	Traditional and conservative industry, sensitive to quality, safety, durability Sensitivity leads to bias towards the safety domain and the biosensor-lab-on-chip type of devices Micro-nano technology based systems fast quality determination quality differentiation Move quality control to the earlier stages of production

Power and autonomy are crucial in new applications

In all visions of Smart Sensors, for Internet of Things, Smart cities, Sustainable development, Smart Clothes, Medical devices, etc… there is a need of **power scavenging** for developing self sustainable systems and subsystems but there is also the complementary aspect of developing **new sensing ultra-low power devices.** This challenge will require new sensing materials and sensing methodologies that will need to be as reliable as all other ultra-low power electronics.



New complex assembly and packaging processes all through the chain

Past and future innovation in smart systems will depend on continuing advances in component, integration and assembly technologies. This will require “More Moore” from semiconductors, but also “More than Moore” bringing new possibilities from heterogeneous integration.

Pursuing past innovation trends, incremental innovation in advanced packaging and interconnection will bring new developments in:

- System in package
- Wafer level processes (Wafer level packaging, thin film packaging, thinning…)
- 3D and 2.5 integration (TSV process including etching, insulating and filling...)
- New processes for interconnection (lead free, copper pillars, high density interconnection…)
- Embedded Wafer Level Ball Grid array (polymer, placement, molding, curing...)

Beside these improvements, there should also be technological breakthroughs in a number of areas, which will enable new markets to emerge:

- More and more new materials, for complementing Si substrates (SiC, GaN, Saphire, Glass, Plastic, paper…) or for interconnection purposes (Carbon nanotubes, new solders…)
- Organic photovoltaics, organic semiconductors, flexible displays, lighting devices (including both OLED and electroluminescent products), flexible batteries, printed conductors & passive components, encapsulation (barrier layers, low WVTR), patterning processes (printing, ink jet)
- 3D electronics, enabling the embedding of components in any dimension of any object
- Bioelectronics, molecular electronics, functionalized surfaces, computing, self assembly, Integrated Smart Systems (including smart objects, sensors and smart textiles)

In order to achieve these breakthroughs, the key challenges will be **to master heterogeneous integration**, not only as a range of technologies, but also as a process of industrialisation, and as a process of wider cooperation within the ecosystem.

From a technological and industrial perspective:

- Materials: electrical performance (conductivity, carrier mobility), processability, stability
- Processes: higher resolution and registration
- Encapsulation (flexible and transparent barriers)
- Modelization and simulation of heterogeneous structures
- New standards and regulations to be defined

From a global ecosystem perspective:

- Heterogeneous systems will require companies and organizations to adapt to more complex business and innovation ecosystems where cooperation will be mandatory in order to concentrate all the skills required to meet industrial and technical challenges
- It will also generate new areas of competition between system, module and component suppliers as well as electronic manufacturing services suppliers

Trends in embedded, enmeshed and implanted system markets

EURIPIDES² mainly focuses on embedded systems, where Europe is strong, rather than stand-alone systems, where production has for some time been developing in other regions of the world, and particularly in Asia. And positions should be taken as soon as possible in the new areas of enmeshed and implanted systems.

In Europe embedded, enmeshed and implanted (EEI) systems represented 64% of electronics production in 2012, compared with 35% worldwide, and Europe represented 30% of world production of EEI systems, compared with only 9% of stand-alone systems.

And the prospects for production of stand-alone systems in Europe are not favourable, mainly because production tends to be localised near the large and fast growing markets in Asia.

Embedded systems are Europe's strength

(billion euro)	WORLD		EUROPE	
	2012	2020	2012	2020
Stand-alone systems	910.4	1 363.9	82.7	74.0
Embedded systems	471.9	673.1	140.8	174.5
Enmeshed and implanted syst.	13.6	40.2	3.4	10.0
Total	**1 395.9**	**2 077.2**	**226.9**	**258.5**

Source DECISION

Automotive markets

There should be a decline in the world share of European production of automotive electronic systems over the coming years. This due to the trend of embedded systems production to follow the localisation of vehicle production. Vehicle production is strongly increasing in Asia because of the fast growing local markets. The way to counteract this is through innovation, which will enable Europe to manufacture the most innovative systems, before letting them migrate to Asia after a time, when newer systems will have replaced them in Europe.

Automotive embedded systems market development

(million euro)	2012	2020	Growth rate (%)
World	120 030	163 815	5.3
Europe	32 691	37 470	1.7
European share	27.2 %	22.8 %	

Source DECISION

Innovation in this field is also very much linked with the development of electric vehicles in Europe. It is important that major programmes be launched in this field, if Europe is to retain its technological leadership in the automotive embedded systems field.

Development of the share of electric vehicles in world annual vehicle sales

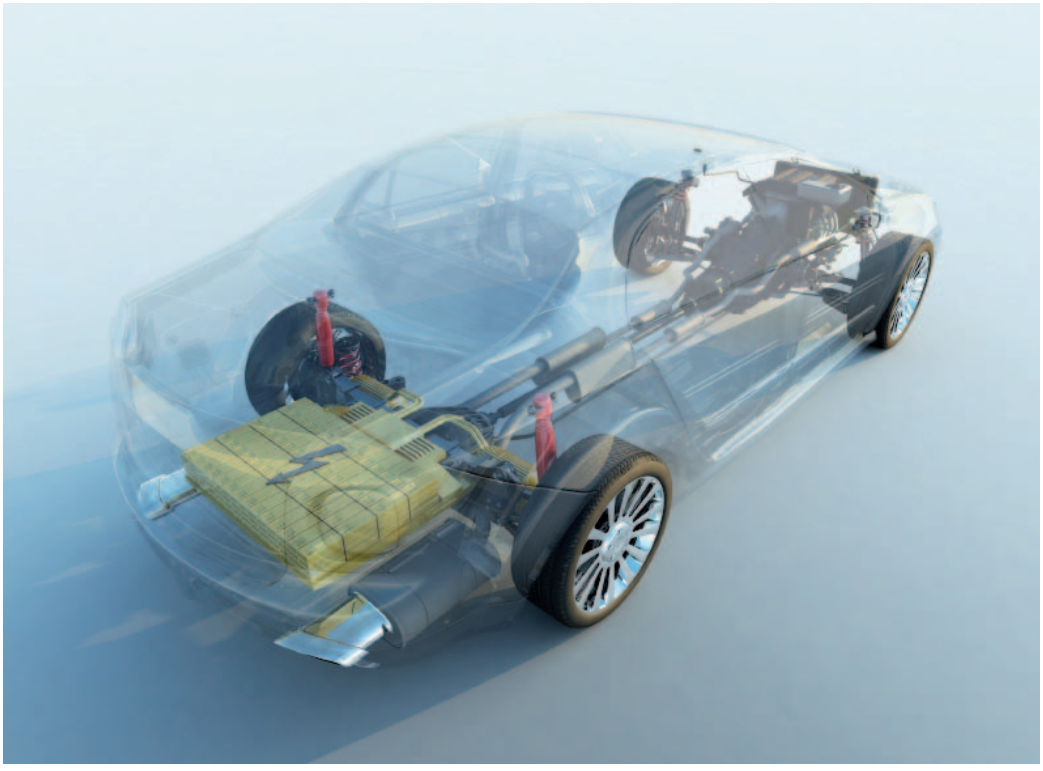
	2011	2021
Internal Combustion (ICE)	95.0 %	72.0 %
Hybrid (HEV)	4.8 %	15.0 %
Electric (EV)	0.2 %	10.0 %
Fuel cell (FCEV)	0 %	3.0 %
Total	**100.0 %**	**100.0 %**

Source DECISION

Beside the increased number of electric vehicles (Hybrid Electric Vehicles, Plug-in Hybrid Electric Vehicles, Battery Electric Vehicles) entering production, **the major trends driving the demand for the increased penetration of electronics in cars will be:**

- Stricter fuel economy and emissions mandates
- Consumer demand for greater vehicle efficiencies driven by rising oil prices
- Legislated requirements for advanced safety systems, such as advanced airbags, stability control systems, and on-board tire pressure monitoring
- Consumer demand for greater safety, comfort, and convenience features
- Adaptation of all technologies to small, smart and affordable connected urban vehicules

The stringent demands for safety and comfort have led historically to a continuous adding-on of new functionalities with an average of 15% weight increase of all car segments as well as a growing electrical power demand at an average of 100W/year over the last 17 years, and this trend will continue in the future. Up to 5 km of wiring, 80-100 sensors, 50-80 processors, 80-100 actuators are common in cars nowadays.



Aerospace and security markets

Over the past decade, the success of the European players Airbus, Eurocopter and Arianespace on civil markets consolidated Europe as the worldwide number one supplier of civil platforms. On the other hand, the growth of US military expenditure driven by the Iraq and Afghanistan wars has reinforced the USA as the leading production region of defence equipment.

Good news for Europe is that over the five coming years, prospects in the civil aerospace market seem much brighter than in the defence market. Less pleasing is the prospect that on the new and dynamic security markets Europe is likely to lose market shares on the world scene over 2012-2020.

The trend in aircraft, as in cars, is to a continuous increase in the functionalities performed by embedded electronic systems, and to the parallel increase in their share in the global cost of the platform. EPoSS has distinguished four directions of development in future aircraft over the current decade and beyond.

The “electric aircraft”

In the “electric aircraft” pneumatic and hydraulic components will be replaced with electrical actuators controlled by networked and flexibly managed devices. Smart sensors and actuators will permit fly-by-wire functions. Within less than ten years, fuel cells APUs (Auxiliary Power Units) are expected to appear, using sensors, process monitoring and control. After that, a new generation of optical components and optical sub-systems will enable new fly-by-light functionalities. For this, research and development on new technologies is required in areas such as sensors, actuators and networks.

The “connected aircraft”

The “connected aircraft” involves the integration of the aircraft into an overall and global communication system, where aeronautical and space communications will be interoperable with terrestrial systems. The connected aircraft will offer new features for passengers through bi-directional broadband links, e.g. the “Flying Office”. Aircraft maintenance will be more efficient and costs will be reduced. Remote monitoring of structures and systems will be possible. Aircraft-to-ground communication will be affordable by high bandwidth low cost data links. With a 10-15 years time horizon ad-hoc networks with flexible routing capability may allow aircraft-to-aircraft communication.

The “intelligent aircraft”

The “intelligence” of the aircraft will develop gradually and will peak with the all-freight, fully automated aircraft. Over one decade a series of intelligent features will be realised of which the first will be cabin control functions achieved by applying new sensing devices. Innovations in maintenance and operation, e.g. condition dependent maintenance based on sensing functions and data fusion, will follow. Advanced ground operations will be possible by guidance, and a reduction of turn-around time will be achieved. Full situational awareness of the aeroplane will be realised, which includes gathering and processing all relevant information on the aircraft’s environment. The fully automated all-freight aircraft could technologically be realised towards the year 2017. Secure data links and position determination are key requirements for this.

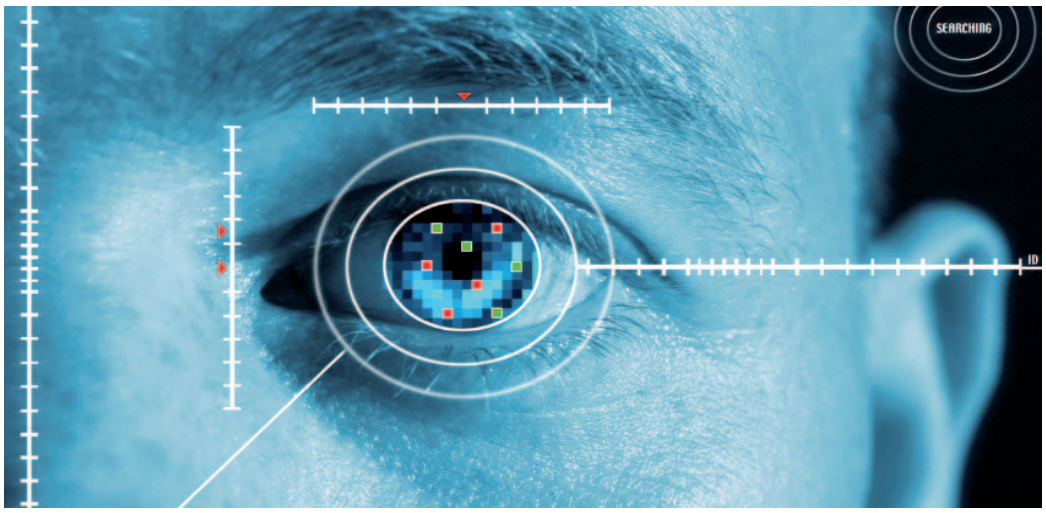
Aerospace and defence embedded systems market development

(million euro)	2012	2020	Growth rate (%)
World	118 533	155 603	3.5
Europe	34 402	42 641	2.7
European share	29.0 %	27.4 %	

Source DECISION

The efficient aircraft

The “efficient aircraft” describes the future of the aircraft in terms of cost and performance improvements. Significant breakthroughs will be obtained in the near future in the monitoring of passengers and in the guidance and tracking of luggage and goods, all based on wireless technologies. By the beginning of the next decade, significant progress in aircraft all-weather capability are expected by applying synthetic vision systems based on radar/lidar and by remote warning and stabilisation systems. New actuators and feed-forward control will allow effective power control and hence power optimisation. Significant progress is expected in adaptive aerodynamics, resulting ultimately in morphing aircraft structures, particularly morphing wings. Flow control by integrated micro sensors and actuators will contribute to these developments. The development of active-material-based embedded actuators in the aerodynamic lifting composite structure will enable effective load control devices for a series of new air vehicles. The lidar based forward looking turbulence auto-control and wake vortex warning systems to be developed for the “intelligent aircraft” will make flights less turbulent in harsh weather conditions.



Security is also an important market, although under much pressure on the budget front. This to a certain extent relayed by the new security markets. Following the attack of September 11th 2001, “Homeland Security” appeared as a new high potential market in those more developed regions confronted by terrorist threats and requiring new protection measures. After 10 years of continuous investment and market consolidation under the impulse of the US Department of Homeland Security, the security market is only starting today to turn into a reality and a real growth driver for major electronic equipment suppliers worldwide.

This slow market development is a consequence of the heterogeneous nature and complexity of the security market from both a demand and a supply chain perspective.

The global security market is composed of the “traditional” security markets (access control, fire alarms, electronic safes...) and of emerging “new” security markets.

The new emerging security markets come in particular from the wish to increase the level of protection of citizens and countries against external threats such as natural disasters, terrorist attacks or organized crime.

These markets range from the protection of airports, commercial cargoes or water distribution networks to the civil protection area (emergency services, fire-fighters).

All these application areas increasingly rely on the capability of electronic devices (sensing, processing, communication, etc.) to deliver additional functionalities and added value to global security systems. Considering the size of the corresponding investment, emerging security markets rely heavily on public investment (government security) or public/private partnerships (public/private security).

Industrial markets

Europe is strong in nearly all segments of the industrial market, a vast domain that comprises many diverse segments:

- Vehicle systems (for railway, marine, off-road, and other on-board applications)
- Lighting
- Instrumentation, measuring and test equipment, a field heavily dependent on the telecommunications and semiconductor industries (automatic test equipment)
- Control equipment for industry, utilities, buildings and networks (motion control, automation and power management)

European manufacturers hold strong positions in most segments of vehicles. In the railway industry the two European leaders Siemens and Alstom have 24% of the world market, just behind the two Chinese leaders (26%) and before the two North American leaders Bombardier and GE (18%).

Railway Systems Market World Players 2010

COMPANY	Market share (%)
CSR (China)	13%
CNR (China)	13%
Bombardier (CAN)	13%
Siemens (EU)	13%
Alstom (EU)	11%
GE (USA)	5%
All others	32%

Source: DECISION, Manufacturers

In **agricultural machinery** the European CNH-Fiat is among the three world market leaders beside the Americans John Deere and AGCO. In North America and in Europe, the electronic content of agricultural machinery is particularly high and is continuing to grow with the development of "precision farming". This enables the optimisation of the farming process, with significant economical and environmental benefits. However Chinese and Indian manufacturers are fighting hard to conquer new markets in Europe and North America.

In **construction equipment and mining machinery** the Europeans Volvo Construction Equipment, Liebherr and CNH-Fiat are in leading positions behind the US supplier Caterpillar who dominates the market. In forklift trucks the Europeans Kion and Jungheinrich also hold leading positions world-wide.

In the diverse field of **power supplies and converters** the European Schneider Electric holds a leading position, and in the strong growth solar applications the German SMA Solar Technology is leader. In the promising field of power distribution and smart grids the Europeans ABB, Schneider Electric and Siemens are world leaders. Osram and Philips hold strong positions in the lighting equipment market and in the new very active solid-state light source market.

In the **test and measurement equipment** field four European companies (Mettler Toledo, Elster, Landis+Gyr, Rohde und Schwartz) are among the top ten manufacturers, which is however rather an American and Japanese stronghold.

Europe is particularly strong in the **automation** field, with three European manufacturers (Siemens, ABB, Schneider Electric) globally dominating the world market, beside four Americans (Rockwell Automation, Emerson, Honeywell, General Electric), and one Japanese (Mitsubishi Electric). Asia is becoming the first market area for automation electronics, but Europe is still the main region in terms of production, representing 42% of the world total, thanks to the European manufacturing sites of leaders ABB, Siemens, and Schneider Electric. Software and services provided by manufacturers represent a large and growing portion of the automation market, which consists increasingly in distributed smart systems rather than central hardware.

Factory and Utility Automation, Leading World Suppliers

Rank	Motion Control	Manufacturing automation	Process automation
1	Siemens	Siemens	ABB
2	Mitsubishi Electric	Rockwell Automation	Emerson
3	ABB	Mitsubishi Electric	Honeywell
4	Rockwell Automation	Schneider Electric	Siemens

Source DECISION

In Programmable Logic Controllers, which control machines, batch cells, conveyors, assembly lines, Siemens is by far the leading supplier.

Distributed Control Systems are used in many process industries like oil and gas, petrochemical, cement, papermaking, etc. They use decentralized controllers along the system, all connected together and to the different other components of the system. ABB is world leader on this market.

AC Drives control speed and other parameters of AC motors. As a large percentage of electric motors is still without electronic drives, this represents a large potential market, and Siemens and ABB hold leading positions.

Numerical Control consists of coordinated computerized motion-control devices, used to pilot multi-axis machine-tools.

Industrial robot demand (over 100,000 units per year) is drawn by the Japanese market, which accounts for at least half of the total world demand. Europe is the second largest market with one quarter of total sales. There is a total of one million industrial robots in use worldwide, 40% of them are located in Japan. In the manufacturing industry, the density of robots in Japan is three times more than in the USA and almost six times more than in Europe.

Industrial Networks, including field networks, are drawn by the increasing penetration of Ethernet (IP) solutions, enabling the integration of the factory field system into the enterprise network. Wireless connection between devices is the main trend in factory and utility automation systems today.

Building and Home Automation, Leading World Suppliers

Rank	Building Automation	Home Automation
1	Honeywell	Legrand
2	Siemens	Schneider Electric
3	Johnson Controls	Matsushita
4	Schneider Electric	Leviton

Source DECISION

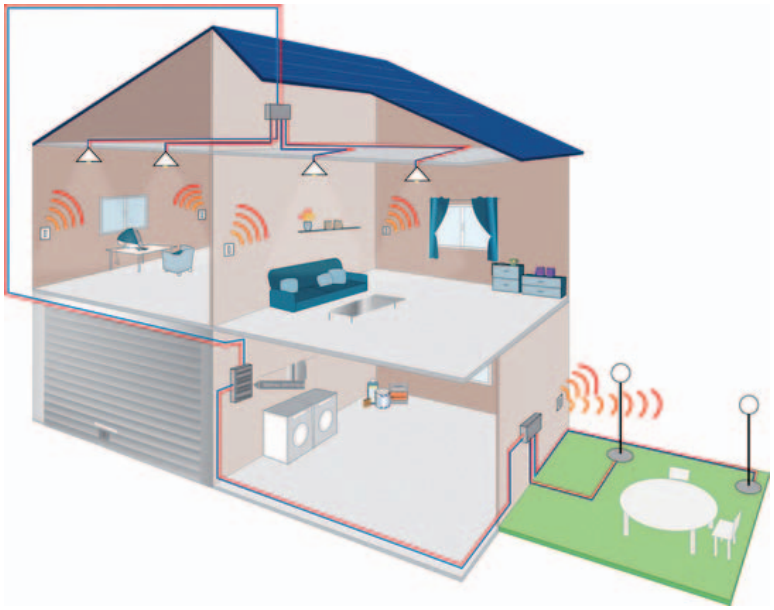
In building and home automation the European supplier Legrand is in a leading position. Building and home automation systems (enabling so-called smart building/homes) are meant to provide occupants with comfort, energy efficiency, and security. Energy efficiency has now become the first parameter for decision makers. Building and home automation is, like factory automation, based on bus networks connecting sensors and actuators to controllers and man-machine interfaces. This enables monitoring heating, ventilating and air conditioning (HVAC) systems, lighting systems, fire and alarm control systems, access control systems, and other security systems. Heating and air conditioning systems are also incorporating more electronics for energy saving, silent operation, easy control and maintenance.

Cloud computing also benefits facility and building managers as their automation software can now be used “as a service” (SAAS). Among the hardware devices, video cameras are used not only for security tasks but also, being connected to HVAC and lighting systems, to detect if a room is occupied or not, and even to count the number of occupants, for real-time adjustment of lighting and heating.

Industrial embedded systems market development

(million euro)	2012	2020	Growth rate (%)
World	201 562	310 746	5.6
Europe	62 448	81 788	3.4
European share	31.0 %	26.3 %	

Source DECISION



Medical markets

The medical electronics industry is expanding and changing very quickly. It has to meet new demands, such as individual miniaturised diagnostic or healthcare solutions, with products like hearing aids, glycaemia testers, blood pressure testers, electronic thermometers, scales, and many innovating devices such as pill cameras, contactless power charging or communicating pacemakers/defibrillators, embedded chemical testers, etc. These new needs for low-cost mass-market products will contribute to reduce expenditures for hospitals and the attendant social security systems. The leading medical electronics suppliers are naturally very keen to capitalize on these new markets, but in many cases the new products have been developed by start-ups or recent spin-offs.

New technologies will shortly arrive on the market in the following segments:

- Computer assisted surgery and robot aided surgery to improve precision and to reduce post-operative consequences
- Telemedicine for distant diagnosis, and follow-up treatment at home
- Miniaturisation and massive deployment of implants: stents (for artery enlargement), ICD, neuro-modulators, insulin pumps for diabetics, hearing aids, ocular implants, etc.

These developments are changing the nature of the medical electronics market. Formerly a market for professional equipment and embedded systems, medical electronics are moving towards an increasing share of stand-alone home-care products, and implantable systems.

Medical embedded systems market development

(million euro)	2012	2020	Growth rate (%)
World	40 526	56 955	4.4
Europe	9 403	10 111	3.7
European share	23.2 %	17.8 %	

Source DECISION

New enmeshed and implanted system markets

This is an entirely new domain for smart systems. Autonomous smart devices can be “enmeshed” or implanted in clothing and textiles, buildings and building materials, medical and bio applications in the human body or in animals... New “meta-systems” such as the Internet of Things, or Smart Cities, will both be enabled and driven by the availability of these devices.

The market potential here is enormous, and it will develop when it makes sense in economic terms, or when environmental pressure or social constraints impose it.

For the moment implantable medical applications are the most advanced market, and represent nearly all of these new applications. Textile, clothing, building materials and other applications are multiplying at the experimental stage, but today still remain marginal in terms of actual markets.

The development of these markets for autonomous smart systems, in enmeshed or implanted configurations, will cause a change in the ecosystem. New players are appearing on the scene, with little or no prior involvement in electronics. This has started with power and energy suppliers, and should spread to logistics operators, the food industry, clothing and textile manufacturers, building and building materials companies... EURIPIDES² can help through innovation support to enable the take-off and growth of these new markets in Europe. This will generate employment, as well as enabling Europe, in a pioneer position, to raise market entry barriers against its competitors.

Enmeshed and implanted systems market development

(million euro)	2012	2020	Growth rate (%)
World	13.4	40.2	14.7
Europe	3.4	10.0	14.4
European share	25.4 %	24.8 %	

Source DECISION

The new meta-systems

In the coming decade and beyond “meta-systems” will acquire an economical, technical and organisational reality. This corresponds to the rising awareness to societal needs, which can now be answered thanks to the availability of new technologies enabling new functionalities in our increasingly complex society. It also affords great opportunities for new markets, in particular for ubiquitous autonomous smart systems communicating into networks. A lot of these meta-system concepts overlap, as do smart cities, security, internet of things, traffic management, energy and water grids, health and medical care... The Internet of Things and Smart Cities are two standing out examples of such.

The Internet of Things

The idea is to make every single object identifiable and addressable, with smart components able to communicate and execute different set of actions. For instance, devices will be able to direct their transport, adapt to their respective environments, self-configure, self-maintain, self-repair, and eventually even play an active role in their own disposal.

This could become a reality over the next 20 years, provided that its cost is justified by real benefits. In a first stage, this will very likely be in the domain of logistics.

Smart Cities

The Smart Cities concept is to integrate information and communication enabled services and applications available to the citizens, companies and authorities into a city system. This aims to improve quality of life, and to enhance the efficiency and quality of the services provided by businesses and public and local authorities. This requires an integrated vision of a city and of its infrastructures, in all its components.

Inserting intelligence into distribution utilities (electricity, gas and water), roads, bridges and buildings, will help to optimise the flow of traffic and resources, minimise energy use, provide accurate billing for domestic and business consumers and schedule structural maintenance.

Operating such a widespread system will require a great number of sensors, which must be robust, cheap, easy to maintain and reliable, as their readings will be used to determine billing.

The smart city system will in particular require electronic networking in several fields such as:

- Urban mobility in electric vehicles, systems to manage fleets of shared vehicles (such as bicycle or car sharing), smart traffic
- Environmental quality control, measuring, supervising and controlling air quality and preventing noise pollution
- Smart health
- Public safety and security
- Energy efficiency and energy savings via sensing control
- New solutions for public lighting
- Smart metering

Europe must seize the opportunity of these radical changes to:

- Maintain and develop its position in its current strong domains inside the complete value chain of embedded systems
- Take from the start a leading position in the value chain of the emergin emmeshed and implantable device markets
- Regain activity in previous European strongholds (e.g. textile) thanks to the introduction of disruptive technologies (example of the Swiss watch industry losing ground at first after the quartz watch disruption, and then regaining a leading position with Swatch...)
- Position itself to answer the opportunities offered by the apparition of new meta-systems, and major paradigm shifts

4. Smart systems in Europe
Strengths, weaknesses and challenges

5.1 | Strengths and weaknesses of the European smart systems industry

Generally speaking, the European electronics industry has not specialised in mass-market innovative stand-alone electronic systems, unlike its Asian competitors. Mobile phones had been an exception to this, but the European companies have not succeeded in maintaining their dominant position on the new generation smartphones. The European electronics industry is increasingly focussing on professional and automotive embedded systems, where it benefits from Europe's strong position in the automotive, aerospace, and defence incorporating industries.

As a consequence the industry of packaging, integration and assembly has developed in Asia, in line with the fast developing Asian high-volume stand-alone electronic systems industry and market.

Europe in this field is strong in the activities linked to high requirements in quality, reliability, and security from the end customers, or to highly innovative technologies not yet available in other areas, or also to domains where the proximity of the end market is a key advantage, and this is precisely the characteristic of embedded systems.

However a potential weakness of Europe in the smart systems integration field is the fact that Asia now holds an important part of the value chain. This can turn into a problem, as it is not only true in the downstream levels of integration for mass market stand-alone systems, but also upstream, for materials and production equipment. Innovative products are more and more linked to new materials and processes, and so this could have a negative effect on European R&D and consequently on future production.

Strengths and weaknesses of European industry in Level 1 (materials, tools)

Segment	Strengths	Weaknesses
LEVEL 1.1 I Materials, processes, equipment and tool suppliers (including CAD/CAM, test tools)	- Customized machinery, high end, high specialisation, low cost of ownership - Germany is strong - Strong chemical industry and equipment industry in Europe - Better involvement necessary - Still present in CAD and test	- High volume machinery, high end especially in semi-conductor related machinery (exception ASML) - Main developments today are in Asia
LEVEL 1.2 I Substrate capabilities, PCB, ceramics	- Embedding technology (PCB), power (PCB & ceramics), high frequency (PCB) - Know-how by R&D, reliability, short time to market, flexibility	High end, high volume production in Asia

Source DECISION, Industry

Strengths and weaknesses of European industry in Level 2 (components)

Segment	Strengths	Weaknesses
LEVEL 2.1 I Devices and packaged devices (excluding semiconductors), passive, interconnection, packages, systems in package	- Customized production in Europe - High feedback and return on experiments	High volume production in Asia
LEVEL 2.2 I Microsystems and modules, MEMS, optoelectronic and printed/flexible electronics	Technology leadership	High volume applications (consumer) are based in ASIA

Source DECISION, Industry

Packaging activities still require a lot of labour and are now largely based in Asia. This is partly because of low labour costs, but mostly because of the large size and fast growth of the Asian markets, better productivity of newer facilities, and the emergence of new industrial hubs in Asia and other regions of the world. Europe mostly retains very high value added and low volume packaging where qualification is necessary (e.g. space markets).

Electronic components have for some time been manufactured collectively in Asian foundries. At the same time packaging operations were still mostly carried out individually, with components mounted after dicing. Recent innovations enable collective processes for packaging components directly on the substrates. This has led to the integration of packaging operations into the Asian foundries, away from Europe, for high volume applications with little differentiation. In this evolution, European industry must find its own specific place and role.

Indeed the European embedded systems (e.g. aerospace, defence, medical) industries require components made specifically for these markets. **These markets have particular needs concerning production lines, that must :**

- Be flexible
- Be compatible with special substrates or products
- Enable heterogeneous integration of non-standard components
- Enable very sophisticated packaging
- Be very near to the system integration and the incorporating manufacturers

European R&D and industry are particularly well adapted to these embedded systems markets, and here the impact on employment must be considered over the complete value chain, and not only at the component level.

Strengths and weaknesses of European industry in Level 3 (modules and assemblies)

Segment	Strengths	Weaknesses
LEVEL 3.1 I Subsystem assembly, boards, modules	Modules, particularly high-end and custom	Except modules, big portion of production in China/Asia
LEVEL 3.2 I Subsystem enabling technologies (e.g. SiP, MCM, other 3D assemblies...)	High-end and custom modules	Except modules, big portion of production in China/Asia

Source DECISION, Industry

On the end product level, Asian countries have developed new industries and taken the lead in most areas of mass market end products (and consequently components). Such leadership in innovative mass-market products is however possible also in Europe, and was succeeded with the first generations of mobile phones. It is certainly worth attempting such a pioneering strategy on the new markets for enmeshed and implanted systems. Examples could be body and brain-component interfaces, intelligent home, intelligent materials...

However priority should be given to the field of embedded systems where Europe is strong and better armed to face Asian and American competition. Innovation will be crucial in this field during this decade, in all its segments (automotive, aerospace, defence, security, industry, health...).

Strengths and weaknesses of European industry in Level 4 (systems)

Segment	Strengths	Weaknesses
LEVEL 4.1 I Enmeshed or implanted electronic products, systems (e.g. smart clothes, smart building materials...)	Emerging and world positioning not set	Need a strong innovative SME base
LEVEL 4.2 I Embedded electronic products/systems	- Strong cooperation along the value chain, for automotive, power electronics, aerospace - Strong actors in Europe - Europe well positioned but Asia starting, as usual with low end	Asian competition will emerge focussing on the low end
LEVEL 4.3 I Stand-alone electronic products/systems (e.g. smartphones, PCs...)	Innovative capacity when European standards can be developed (e.g. GSM)	- Consumer and ICT industry more or less based in Asia or America - Europe becoming a desert

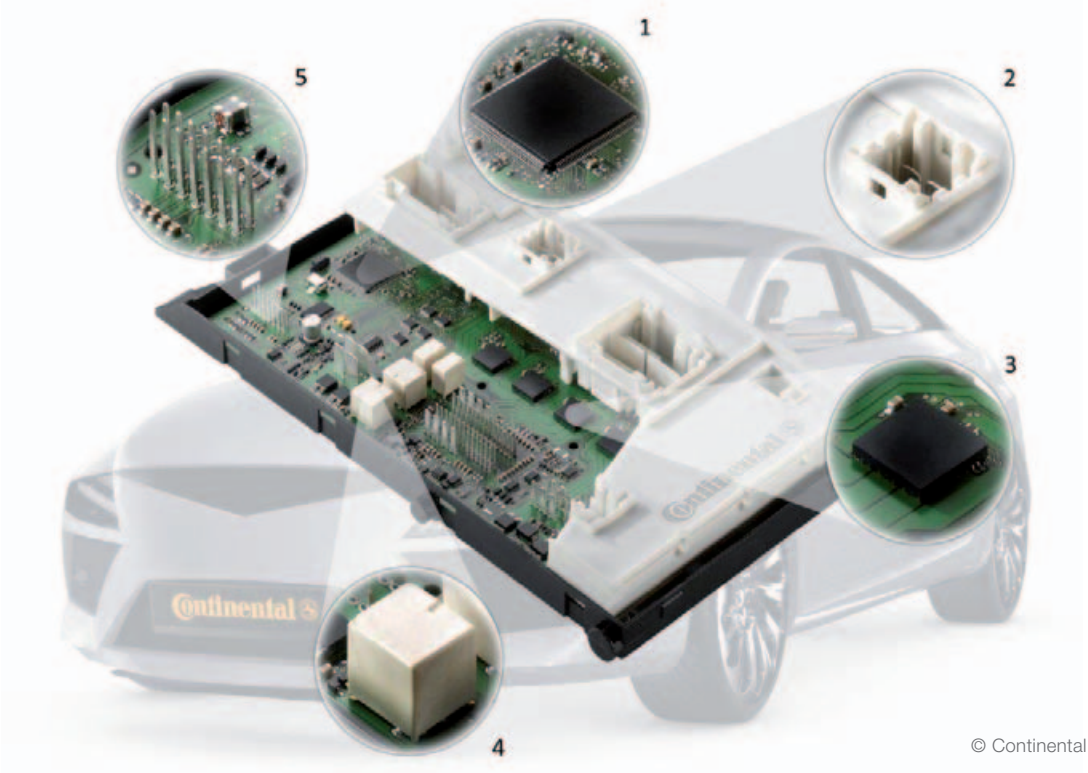
Source DECISION, Industry

5.2 | Manufacturing and production technology are key

The competitiveness of European manufacture and the will to produce in Europe must be on top of the priority list. This has become a question of strategic importance for Europe, if we are to participate in global growth, progress, and procure employment to our citizens.

Increasingly there is a consensus on the fact that production technology is the key to competitiveness and success, and product design and manufacturing cannot be totally isolated one from another.

The challenge is to ensure that results of European funded and realised R&D should generate production in Europe rather than elsewhere, attracted by high-growth markets and low cost manpower. To achieve this, **support for pilot lines and initial manufacturing lines in Europe is a key factor** for getting innovation from R&D all the way into competitive production. **This also means that we should innovate in the manufacturing area,** in automation, CAM, robotics, and this should also be supported by Europe and national public authorities. The cost of R&D is always less than the cost of unemployment.



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5.3 | Focus R&D for greater benefits for European industry

Focus research and support on Europe's strengths

Europe should focus public support for R&D in the fields where European industry is strong, and where large sales volumes, and consequently production and employment, can be generated. Focus should also be brought on emerging markets where Europe can benefit from favourable factors to acquire a leading position, as in the health and environment fields.

Today the established position is that Europe is strong in low-medium volume and custom designed and made systems, whereas Asia is strong in high volume, and mostly consumer systems.

This corroborates a second positioning. Europe is strong in embedded systems, and Asia is strong in stand-alone systems.

Embedded electronics account for about one third of the global electronic systems market. They are a fast and steadily growing domain. They are also a key factor of competitiveness for the European incorporating equipment industries (automotive, aerospace, defence, transport, machinery…)

By the end of this decade embedded systems will be rapidly outpaced by the new emerging markets for "enmeshed" and implanted electronic devices. In these emerging markets positions are not yet established, and **smart systems and heterogeneous integration will play a decisive and enabling role.**

Develop and extend focussed cooperation

European R&D needs more focussed cooperation in R&D. If Europe is to remain a frontrunner in its electronic strongholds, an important increase in R&D in interconnection, packaging, miniaturisation of electronic systems or devices, silicon sensors and integration of all electronic systems will be required. This substantial increase must be the result of a common, cross-border effort by public authorities and private enterprise in Europe. This effort must associate all players, SMEs, universities and research institutes, as well as the large companies.

Today no single country, university or company can pretend to dominate a field of R&D such as interconnection, packaging, and smart systems integration. And indeed companies that compete in the market do often cooperate in R&D, with the result that the competitiveness of all partners involved is increased. In R&D, sharing knowledge, efforts, costs, rewards and risks has become a necessity, and this must involve all the actors, including the downstream players (incorporating industries, transport and utility operators).

In this collective effort, the different players have different roles and needs. SMEs are the key to growth, employment and competitiveness. But this means they need to innovate and to have access to the results of R&D.

Universities and institutes have a key role in research and development of new technologies and processes. For this they need to ensure that their R&D is in phase with the customers' needs.

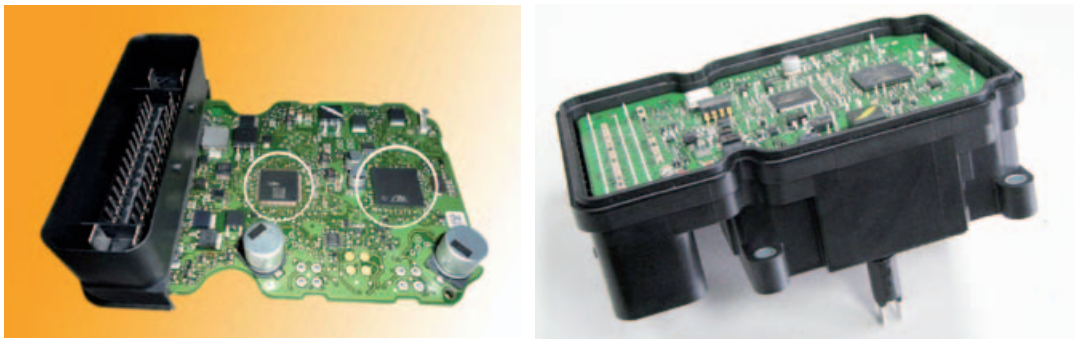
Large companies need to have a global strategic view, to invest in strategic procurement programs, and to establish strategic partnerships.

Europe needs to have an industrial strategy for smart systems integration, elaborated and implemented at the European level, and this is what EURIPIDES² can help to do. This strategy should provide a focus on the key strategic axes, and clear guidelines for the different countries to develop complementary activities all contributing to the global electronics value chain. Europe at the industrial level is still sometimes a sum of individual ambitions and rivalries, which makes the European innovation process less productive than it should and could be.

Thus Europe has excellent R&D institutes (e.g. Fraunhofer, LETI, VTT, CSEM, Imec), and is very competitive in some segments (e.g. MEMS), but rivalling national policies, and frequent rivalry among actors, rather than investment in towards developing complementarities, often hinder better R&D productivity.

Hence the idea that if at the level of countries, institutes, and industrial partners a common strategy is difficult to agree on, the European Programmes (FP7, Eureka clusters,…) could take the lead, and propose, instead of a wholly bottom-up approach accepting all R&D programmes, a balanced mix of a selective focussed top-down approach, completing and directing the bottom up innovation demand.

EURIPIDES² has an important role to play in this elaboration and implementation of a European industrial strategy. This needs to integrate all levels of the value chain, including the integrating industries (e.g. automotive, aerospace, clothing, construction...) in order to be really efficient.



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Smart systems integration a critical focal point

Electronic board and module production activities, although providing a large number of jobs, contribute very little to the entire R&D and innovation effort in the electronics value chain as shown by the following table (Level 3)

	LEVEL 1 Materials and equipments	LEVEL 2 Components	LEVEL 3 Boards and Modules	LEVEL 4 Systems
World Leaders	ASML, ASM, Applied, Orbotech...	Intel, Samsung, STM, Murata, TDK, Ibidem...	Foxconn, Flextra, Sanmina, Jabil...	Apple, HP, Bosch, Schneider, Valeo...
Global Revenues (billion €)	100	345	696	1395
Gross Margin	40%	40%	5%	20-40%
% R&D	10%	15%	1%	5%
R&D Value (billion €)	10	52	7	70
% Total R&D	7%	37%	5%	51%
European employement	150k	180k	610k	1510k

This is where smart systems and heterogeneous integration can make a difference. They are labour intensive, and because of this have a large socio-economic impact.

They are not very capital intensive, and do not have very high entry barriers. Thus each euro invested in R&D in this field exerts a strong leverage on sales, production and employment.

They have a double enabling role. Downstream from semiconductors their role is essential to enable them to do their job. And upstream from the incorporating industries, smart systems and embedded electronics are crucial for their progress and competitiveness.

[4] The 1% R&D intensity in Level3 is based on traditional Electronic Manufacturing Services and does not integrate modules activities which are more R&D intensive.

6. What EURIPIDES² can bring

6.1 | The role of EURIPIDES²

EURIPIDES² is a EUREKA cluster.

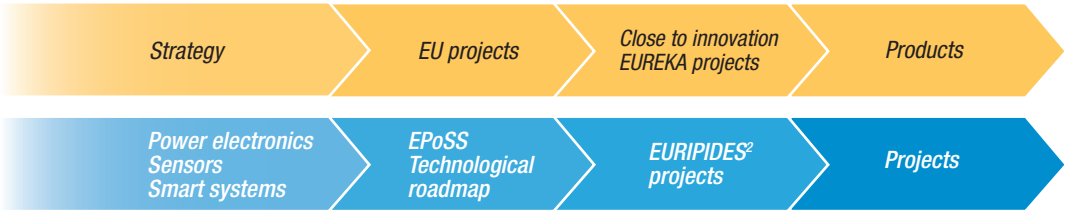
The EURIPIDES² cluster deals with R&D projects in the domain of Packaging and Assembly of Smart Systems, with the aim, through technology innovation, to:

- Organise functionalities and generate new uses
- Allow heterogeneous integration for product miniaturization, cost, quality and reliability improvement

All components are involved in this multi-level micro-technology integration process, and particularly MEMS, MOEMS, power electronics, and optical components.

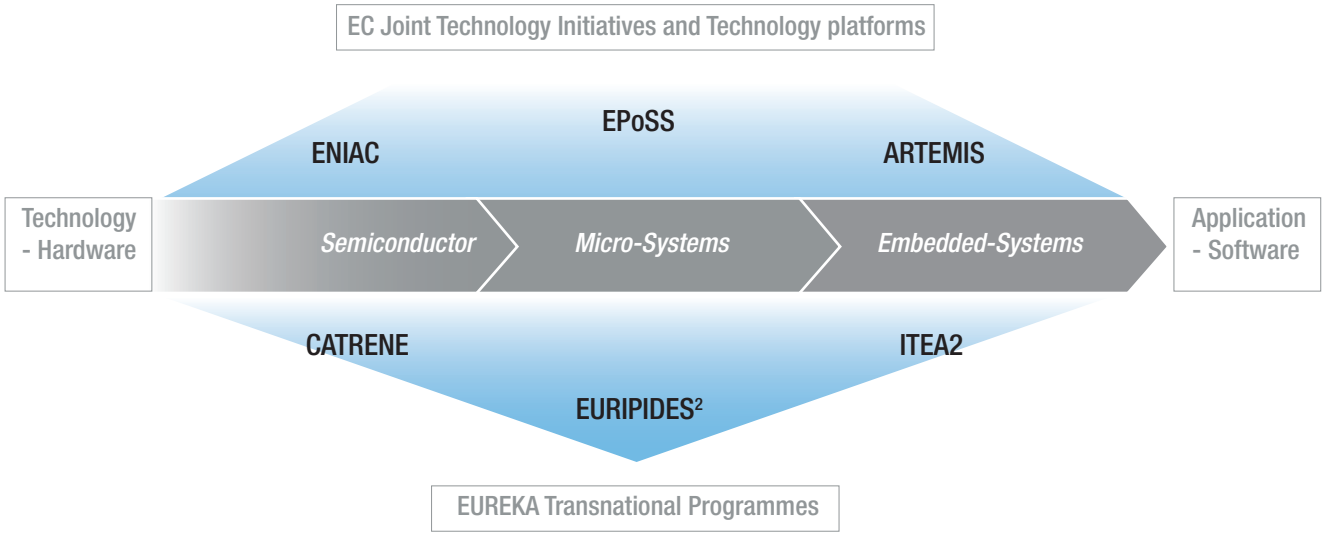
EURIPIDES² has a crucial role to play in the European innovation process. It supports European R&D at the junction between innovation, product development, and production, the critical zone where many innovations die, never to reach the market place.

The EURIPIDES² role



As such, EURIPIDES² complements the other organisations of the R&D framework in Europe, and in particular the Framework Programmes, the EC Joint Technology Initiatives and Technology Platforms, and the other EUREKA clusters.

Mapping of the European cooperative R&D framework for the electronics industry



In general, EUREKA clusters have proved their efficiency in achieving strong proximity with the end market needs, in line with the overall Horizon 2020 objectives.

Delineation of the respective domains of the different R&D organisations involved with the electronics industry follow fairly specific zones of competence. There are naturally some fuzzy boundaries, in particular between EURIPIDES² and CATRENE on MEMS and advanced packaging activities.

Smart sensors and smart power are natural specialties where EURIPIDES² is complementing activities taking place in the neighbouring CATRENE cluster.

These boundary problems can successfully be solved with cross-program cooperation, as shown in the THOR project on power electronics.

The strategy and roadmap EPoSS has elaborated on smart systems also serves as a guideline for EURIPIDES².

On the international level, enlarging cooperation beyond the boundaries of Europe, EURIPIDES² has undertaken to develop innovation relationships with countries having a high development potential such as Turkey, Canada and South Korea. Europe could also establish a clear guideline for cooperation with other countries in this perspective, such as Russia, Brazil, or India.

The idea would be that introducing a common technology, and hopefully European standards, can help to favour, and in some cases ensure, production in Europe, or at least production in common.

6.2 | A review of selected EURIPIDES² projects

The concrete role of EURIPIDES² is best shown through actual examples of project case studies through impacts the EURIPIDES² programme and its predecessors (EURIMUS, PIDEA) have had and continue to have on the European smart system and more generally the European electronics industrial base.

Mapping of EURIPIDES success stories

Project	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4	Major Challenges and markets
1. 3DICE	●	●	●		Telecom, mobility
2.Canopy	●	●	●		Aeronautics, Space
3. Ceramjet	●	●			Renewable energy
4. Cosy3D	●	●	●		Mobility, Security
5. Enerpack		●	●		Energy autonomy, efficiency
6. Flexilvia	●	●	●		Security (RFID)
7. Imicimo	●	●	●		Communication
8. Ipitech	●	●			Security
9. IQfuel		●	●		Automotive, Environment
10. Memsors		●	●	●	Medical
11. Midass	●	●	●		Automotive, Medical, Security
12. Restles	●	●	●		Automotive
13. Smart		●	●		Security, Communication
14. Thor	●	●	●	●	Medical, aeronautic
15. Uvip		●	●	●	Medical
16. Visiopack		●	●	●	Security
17. Walpack	●	●	●		Security, Communication, Medical

These successful projects highlight four specific characteristics of the EURIPIDES² program, which make this EUREKA cluster key tool for the consolidation and progress of the European electronics industry:

Focus on societal challenges
All projects have a clear societal focus. They address innovation topics in systems integration that are related to societal markets like Mobility, Security, Energy, Medical etc.

EURIPIDES² thus fully supports the focus of the EU Horizon 2020 towards tackling the great societal challenges of the 21st century.

Multi-level projects and cooperation
Consortia within EURIPIDES² projects generally regroup at least three consecutive levels of integration in the value chain, from Level 1 (materials and tools) to Level 3 (sub-systems) or from Level 2 (components) to Level 4 (electronic systems).

This inclusive characteristic of EURIPIDES² consortia shows the breadth of the EURIPIDES² domain and cooperation network, and it also highlights the usefulness and even necessity of cooperation between several stages of the value chain in order to achieve significant progress in smart systems integration.

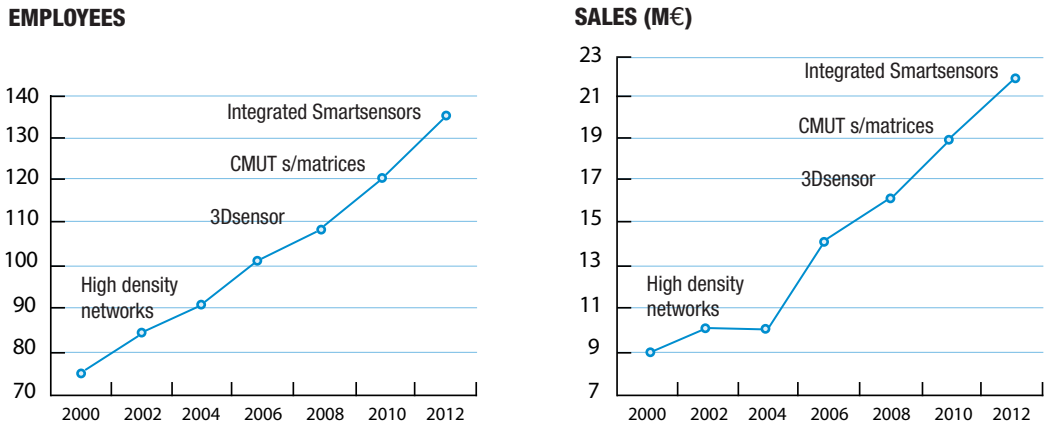
Product and market orientated
EURIPIDES² project outcomes are functional modules and even end-products addressing a clear application and market demand as indicated by the presence of end-users, large groups and SMEs in almost every project.

Furthermore, competitive manufacturing in Europe is always set as an objective at the beginning of the project either through cost performance and increased manufacturing efficiency, or through innovation and heterogeneous integration pushing the manufacturing value added a step forward.

Large impact
Finally, the selected case stories all demonstrate strong quantitative and qualitative impacts in particular for SMEs which translate into new business developments, job requirements, and continuing R&D&I relationships and opportunities with the partners after the end of the project.

In particular the possible impact of EURIPIDES² projects on SMEs, the following graph shows how sales and employment in a small enterprise involved in several EURIPIDES² projects has grown hand-in-hand with innovation, with both sales and employment doubling over the last twelve years.

Impact of EURIPIDES² R&D projects on sales and employment in an SME



Difficulties and success factors

Looking at difficulties encountered and success factors, there is a wide consensus that:

- Technical difficulties had to be faced, but that is normal, it is the object of the R&D effort
- Funding could be a difficulty to obtain, but when obtained is the main success factor
- Complementariness of partners is practically always a success factor, even though managing a number of partners is sometimes a difficulty
- The motivation, energy and determination developed by the cooperative team is always a major success factor

Difficulties and success factors

Project	Difficulties	Sucess factors
3DICE	Technical, number of partners, administrative tasks	Funding, partner complementariness, team motivation
Canopy	Technical	Experience in space applications
Ceramjet	Partner failure, funding	SME lead project with large companies
Cosy 3D		
ENERPACK	Technical, design for market	Partner complementariness, motivation
FlexILVIA	Technical, planning	Partner complementariness, motivation, team
IMICIMO	Technical, funding	Efficient team, funding
IQFuel	Partner cooperation, funding	Partner complementariness, motivation, funding
MEMSORS	Technological	Cooperation
MIDASS	Technological, funding	Preparation: less constraints than FP7 cooperation, correct and efficient procedures, industry focused positioning
Restles	Funding	Cooperation synergy, efficient project management, simulation
THOR	- Many changes in the project due to funding issues - No IGBT, GaN, Supercap development due to lack of funding - Very tough PCA negotiation due to different interests from industry and universities	- THOR has received both a EURIPIDES² and CATRENE label enabling fruitful cooperation between the programs (a first for Europe!) - Excellent cooperation between various partners, which had no cooperation before THOR - THOR has successful cooperation with other European funded projects - THOR has brought three application areas together and common technology is developed - Spin-off from THOR technology is already available as product - CATRENE and EURIPIDES² procedures are lean (compared to FP7 and ENIAC)
UVIP	Project definition	Cooperation, funding
VISIOPACK	Partner changes, technical	Partner complementariness, motivation
WALPACK	Number of partners	Funding, team energy, determination

Source DECISION, project members

Role of EURIPIDES²

The role of EURIPIDES² was seen as important on the following points:

- Help with funding
- Help with administrative tasks (project proposal, proposal change...)
- Help with project organisation (meetings, project support and evaluation...)
- Help with finding partners and expertise, and creating a consortium
- Help with promoting results

Project	Role of EURIPIDES²
3DICE	EURIPIDES² office helped a lot with support for huge and long administrative tasks and actions
Canopy	Experts evaluation
Ceramjet	
Cosy 3D	Initiate, assess and manage international funded R&D project
ENERPACK	Help to create the consortium, advice for Project Proposal Support project during its progress
FlexILVIA	Facilitate a Change Request (Brand name and budget) Pushed to advertise results
IMICIMO	Helping to find expertise and Partners, helping to obtain funds Creating a confidence-inspiring frame for European partnership
IQFuel	Networking, organisation of meetings all along the project Good vector to promote results after the end of the project Meticulous and efficient funding, planning and technical follow-up
MEMSORS	Address marketable products, simplified submission procedure Possibility of early stage project presentation
MIDASS	Project expertise at the beginning
Restles	Facilitated the project scope definition Finding and formation of the consortium Creation of optimal funding conditions EURIPIDES² label qualified the Finnish partners without further application for public funding
THOR	EURIPIDES² safeguarded the participation of French partners in the THOR project During the execution active support was offered by EURIPIDES² to resolve issues, in particular with respect to the PCA
UVIP	Support of stakeholders in submission process and funding negotiation Monitoring meetings to discuss project outcomes and difficulties
VISIOPACK	Help to create the consortium, advice for establishing the Project Proposal Support the project during its progress
WALPACK	Help of technical expert, dissemination of results

Source DECISION, project members

A selection of successful EURIPIDES² projects

Canopy

High performances carbon nanotubes and epoxy adhesives for boards assembly

Canopy was a project to develop **high performance carbon nanotubes and epoxy adhesives** for circuit board assembly and die attach applications, with improved electrical and thermo-mechanical characteristics (in particular high thermal conductivity) compared to traditional epoxy adhesives currently used in the microelectronics industry.

CeramJet

Ceramic electronic components by inkjet printing

CERAMJET was a project launched in 2006 to bring dramatic competitive advantages to the main ceramic component and interconnection manufacturers in Europe, using a **highly innovative production technology**. CERAMJET was directly targeted at MLCCS (capacitors) and fine-line thick-film circuitry.

In each of these domains, several manufacturing technologies are necessary to design electronic components (screen printing, tape casting, cutting, and lamination). These technologies request specific tools and set limits to the design, and to the level of achievable discrete resolution. **Inkjet printing technology** dedicated to electronic materials was developed to this end, by the cooperation between CERADROP, SPCTS, Heraeus, IKTS, Eurofarad, c-Mac and EGIDE.. This technology enables users to **digitally design 3D multi-material electronic components in one single step of contact-less and tool-less manufacturing**. Its discrete printing resolution level is below 50µm and its additional features enable the production of elements with new and more competitive and challenging designs. This project has in particular had a major impact on machine sales by CERADROP (3 million euro cumulative sales so far, 10 new jobs created).

COSY-3D

COmpact Secured sYstems in 3D

COSY-3D was launched to create a **structured 3D system** which will enable memory, CPU, a stable oscillator (MEMs or CMOS based), passive components and some RF blocks to be integrated into the smallest possible footprint block, for advanced telephony, multimedia, and secure transactions. 3D integration shows a huge market potential for assembly equipment manufacturers such as Datacon. The earlier an equipment manufacturer explores the integration processes, the faster the requirements and implications on the machines of tomorrow are understood.

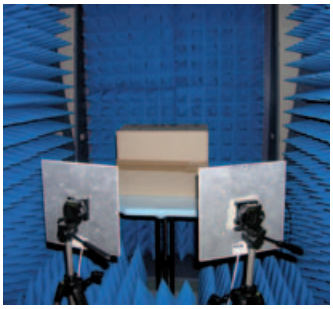
ENERPACK

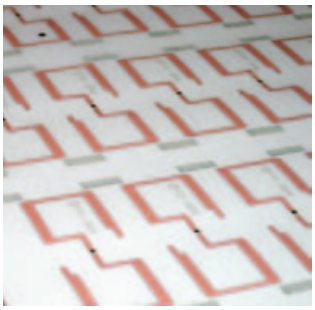
Multi low power energy source packaging

The ENERPACK project aims to provide an **autonomous low power multi energy source** for sensor applications. The power source was successfully developed, and it is expected to bring new markets, sales and employment to the industrial partners ERYMA and ATERSA. The product is manufactured in Europe : ATERSA, near Valencia in Spain and ERYMA in France.

FlexILVIA

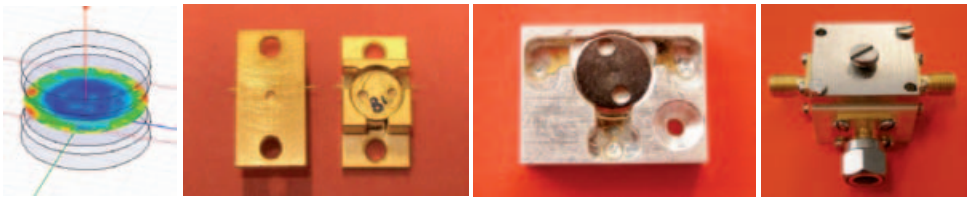
Flexible Inlays in Large Volume for Identification Application





The FlexILVIA project aimed to develop **flexible RFID (radio frequency identification)** antennas based on innovative additive reel-to-reel high volume technologies.
As a result all partners have increased their knowledge and filled technology gaps in their area of interest to reinforce their competitiveness. FCI has acquired a much better understanding of the RFID technology to develop its position in the market, and gas investigated an alternative technology now deployed in the printed electronics area.
After the completion of the project, FCI has pursued its investigation in the additive domain in view to promote low cost solutions for antennas on flex.
Meco, Datacon and Paragon have capitalized to upgrade their equipments and associated design rules to address the roadmaps (flex thickness, chip size, high volume and yield).
AT4 wireless has worked out a full reference document for RFID testing
The project has also led to study an alternative green technology that could be proposed to the market in the future even beyond the targeted RFID application (ex. Flexible substrates).
The project has enabled to develop an accurate cost estimate of the additive technology versus competing technologies (Etched Aluminium, Etched copper), which makes appropriate market positioning possible.
FCI has leveraged the results of the project to build a design office to support its customers. Meco has put on the market plating equipment able to handle substrates with thickness down to 23µm.

IMICIMO
Integrated Miniature Circulators for microwave Modules



The aim was to develop **new materials and manufacturing technologies for microwave ferrite circulators and isolators**, in order to reduce device size, weight and cost, and facilitate integration and packaging in new generation mobile telecommunication equipment. This application requires low cost and high volume reproducibility.
For this the project explores low temperature co-fired systems (LTCC) for low cost, multi-layer ferrite device structures, integration of ferrite devices with active semiconductor and/or advanced microwave interconnection and packaging techniques for future large volume applications. This should also open markets such as space applications to higher frequency bands (Ka, Q) to save mass, volume and costs.

IPITECH
Innovative PCB Integration Technologies for HDI board

There was a need to address density levels above 7000 interconnects /dm² with very reliable solutions. No European PCB manufacturers had such a technology in their portfolio. The IPITECH project was to develop an emergent technology for very high density and high speed digital boards- 4+core +4 Cu filled µvia stacked and buried.

IQ Fuel
Integrated sensor for determining the quality of fuel

CONTINENTAL decided to initiate the project to develop an **on board automotive sensor intended for fuel analysis** for the following reasons:

- Worldwide fuel variability increase
- More stringent emission regulation
- Fuel Quality Sensor (FQS) allows system to adapt engine parameters accordingly to respect emissions level and to protect key components from potential fuel pollution

This project has found growing interest from all OEMs, and engineering samples have been delivered and successfully tested at OEM facilities. The coming regulations in Europe and elsewhere will help to make this sensor device difficult to avoid in the future.

MEMSORS

Micromachined electrostatic membranes for acoustic sensors monitoring

Capacitive Micro-machined Ultrasonic Transducer (CMUT) is a **new concept for emitting and receiving ultrasound energy with membranes under electrostatic stress.**

The principle has been known for long time, but the manufacturing technologies have only become available in the mid 90's with the development of micro fabrication processes. VERMON in collaboration with advanced microelectronic research laboratories started investigating CMUT potentialities in 1999 and decided after four years preliminary research to launch an ambitious RTD programme (MEMSORS) for the development of an intra-cardiac catheter probe using CMUT as an ultrasonic device.

MIDASS

Molded Interconnect Devices Applied to Smart Systems

The MIDASS project aims to develop innovative smart products by **integrating electronic functions directly on 3D plastic surfaces**, such as antennas, connectors, PCBs, … One way of doing this is by developing new processes of metallization on plastics. The project has strongly impacted *Pôle Européen de Plasturgie* (PEP) in France, who created in 2010 a new Business Unit called "Plastronics", in order to develop smart plastic products, and provides product development services, prototypes and small series based on MIDASS processes. PEP now has 7 employees on this topic in France, with a budget of 600 k€ per year. PEP is looking to create a spin-off next year on this topic. And recently PEP also obtained an award for one of the demonstrators co-developed with Radiall in MIDASS (Q-MID).

Restles

Reliable system level integration of stacked chips on MEMS

The RESTLES project was designed to investigate newest **microsystem packaging technologies for applications in automotive speed and inertial sensors**, with special focus on cost savings compared to the state of the art technologies, and increased reliability and robustness.

This also included the development of new inertial sensor structures with robust control circuits. The Restles project was in particular a success for Okmetic. During the project a new silicon wafer product for MEMS industry, a C-SOI wafer, was developed and introduced into the market.

SMART Smart Antennas system for Radio Transceivers

The SMART project aimed at achieving global leadership of Europe in wireless markets and applications by studying and developing a **new generation of antennas system** dedicated to radio equipments for voice and data wireless networks.
One major challenge was to find low cost and efficient solution required by the market. The defined products had to be able to offer a high efficiency based on the adequate Interconnection and Packaging technologies for antennas.

UVIP Ultra sound versatile probe

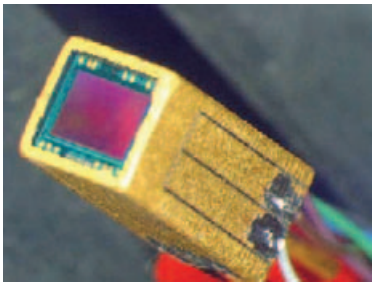
In the recent past, 3D procedures with rudimentary articulated probes or first generation mechanical scanning devices were neither ergonomic nor providing sufficient image quality to compete with conventional systems. VERMON as a major actor in Ultrasound devices initiated the UVIP European project in 1999 with a limited consortium to face this challenge and to **provide the market with integrated, low profile and cost effective 3D scanning probe solutions.**

VISIOPACK Vision system in one package

The project aimed to develop an **autonomous video sensor for security applications**. The development of the demonstrator was a success.

WALPACK

Packaging process at wafer level

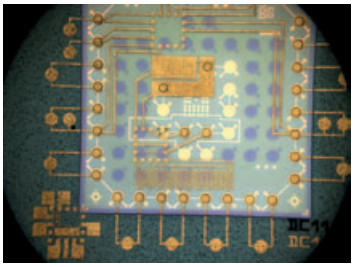


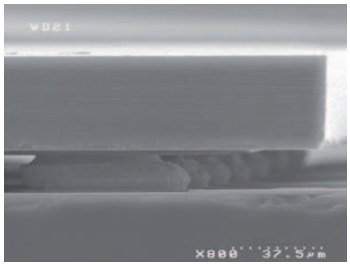
Wafer Level Packaging is all about **generating the device packaging (encapsulation and contact forming) on the wafer before it is separated into individual finished ICs.** The major interest is in minimizing the cost of back-end packaging processes by using a collective process instead of the individual operations currently necessary to finalize the individual package: i.e. individual chip bonding, wire bonding, etc… are eliminated.

In parallel with the collective or batch processing strategy, the introduction of new processes proposed here will allow optimization of the active silicon area down to package chip dimension (chip scale packaging). Maximum benefit of WL-CSP methods is obtained when out-of-fab wafers have high functional yield. These new back-end process developments also open up opportunities to integrate new functions into the CSP by adding embedded passive or active devices.
For 3D-Plus the impact has already been a threefold increase in employment since the completion of the project.

3DICE

3D Integrated of Chips using Embedding Technologies





3DICE project targets the **development of technological bricks for embedding dice into organic or silicon substrates**, with single or multi layer configurations, in order to perform unprecedented smart system integration at wafer level for industrial high volume manufacturing.

6.3 | Policy and initiatives for the future: EURIPIDES²

R&D is insufficient at the smart systems and integration level

In the electronics industry the value chain and the competitive landscape has turned from a vertical model to a horizontal model. Companies in the last century favoured vertical integration, and this meant competition was for the most part only waged at the final, end-product level.

Today this has changed, the "core business" paradigm has taken over, and companies specialise in the different levels of the value chain with the natural consequence that, today, competition affects each level specifically. This does have beneficial effects on costs all through the value chain, but the competition also means whole segments of the European value chain and industry can become threatened by more competitive industries in other regions, and in particular in Asia.

Maintaining and developing production in Europe in critical segments of the value chain will in particular require a major effort in R&D, both for innovative products and for more competitive production. This R&D effort must be cooperative at the European level, but it must also involve partnerships across the value chain. There are significantly unequal situations across the value chain as concerns R&D investment.

R&D investment varies according to value chain levels

LEVEL	Gross margin (%)	R&D on sale (%)	R&D investment (Bn euro)	% of total R&D	% of employment in Europe
LEVEL 1 I Materials and tools	40	10	10	7	6
LEVEL 2 I Components	40	15	52	37	7
LEVEL 3 I Boards and modules	5	1	7	5	25
LEVEL 4 I Systems	20-40	5	70	51	62

Source DECISION

The figures in the table shows a very low R&D investment in level 3 of the value chain, this is partly due to the "electronics manufacturing service" (EMS) companies, who do contract assembly. But nonetheless they show that even in the sophisticated smart systems assembly field, R&D is not as high as it should be. And in level 2, the figures reflect the very high R&D investment in the semiconductor industry, hiding the fact that in the other fields of the component industry R&D is again not as high as it should be.

The figures for level 3, whatever the distortions, remain worrying: 1% of sales invested in R&D, 5% of the total R&D investment in the industry, for 25% of the workforce!

This alone shows how necessary it is to have a dedicated R&D support instrument for smart systems integration and assembly, to facilitate the required effort, and to promote cooperation at the European level.

More smart systems integration R&D for production in Europe

The action of EURIPIDES² will rest on two pillars:

- **Promoting smart systems** (including sensors and power) and heterogeneous integration (bio, photonic, flex, printable, plastronics, energy…)

  This is to be done in a way consistent with, and taking the most advantage of the existing roadmaps and R&D priorities.

  It will also involve enlarging the scope of EURIPIDES² project partnerships to new players, and to new technological branches, beyond the historical scope of EURIPIDES² and its ancestors EURIMUS and PIDEA.

  EURIPIDES² could help stimulate European innovation in key societal topics such as health, environment, new energies through specific calls, while at the same time enabling bottom-up proposals from all levels of the electronics value chain.

- **Promoting production in Europe** through cooperation all across the EURIPIDES² value chain.

  One of the great strengths of EURIPIDES² is that its projects gather partners all through the value chain, from materials and tools to final systems. It will be increasingly important in the future to include downstream players in these partnerships, in line with the EU strategy to bridge the gap between R&D, innovation, and the final product.

  Correct focussing on strong points of European industry and product targeting to serve developing societal needs through cooperation, both international and across the value chain, should facilitate the will and the means to manufacture in Europe.
  The involvement of SMEs at all levels of the innovation process will help to optimise the impact of the programme on activity and employment in Europe.

This answers the R&D gaps and needs in the value chain, and is in line with the ENIAC/ARTEMIS/EPoSS stated vision/mission/strategy, to “provide Europe (…) with the controlled access for creating the indispensable technology basis for new products, systems and services essential for a smart, sustainable and inclusive European 2020 society”.

The EURIPIDES² vision, mission and strategy

EURIPIDES², generally speaking:

- Favour industrialization of results embedded in project calls, resulting in manufacture in Europe
- Possibe longer project timeframe (5-6 years)
- Requirement for consortia to represent comprehensive value chains
- SME involvement: 2 phased projects enabling gradual involvement of SMEs
- Addressing new ecosystems (enabling technologies), this will particularly concern the emerging markets for enmeshed and implanted systems, where the coming period will be critical for gaining early market footholds.

EURIPIDES² Vision: European Leadership in Smart Electronic Systems Integration design development and manufacturing

This is a global strategy to set up a virtuous cycle of R&D-innovation-manufacturing in Europe, focussed on the fields where European industry is powerful. A strong leading-edge European capability will have the greatest downstream impact on incorporating industries or in every new domain where market positions are still to be established.

EURIPIDES² Mission: Innovation hub for smart sensors, smart power modules and more generally heterogeneous electronic product integration for all leading industry sectors in Europe

In this global strategy, EURIPIDES² plays a crucial role in enabling cooperative R&D in the key domain of Smart Systems Integration, bringing the benefits of evolving semiconductor technology to complex end-system applications. The analysis of EURIPIDES² projects shows the efficiency of cooperative R&D, which enables complementary partnerships and considerable team motivation. It also shows how important the EURIPIDES² support all along the project is, from finding partners, setting up the consortium, getting the funding, going through the administrative tasks, to evaluating and promoting the results.

EURIPIDES² Strategy:

- Focus on heterogeneous electronic products integration, advanced smart sensors and power electronics
- Increased participation of SMEs building on EURIPIDES² “savoir faire” and network
- Involve European industrial leaders in supporting the definition of the innovative electronic hardware platforms
- Capitalize on its partnership with DG Connect (European Commission) to further cooperate with the EU Horizon 2020, the R&D&I framework and Key Enabling Technology area (printed electronics, robotics, photonics, ...)
- Promote multi-sectorial projects through the EUREKA cluster co labelling
- Priority stress on following-up European innovation for manufacturing in Europe

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Annexe 1: Methodology

There are no statistical aggregates available covering the entire breadth of the electronics industry. Therefore all market figures, forecast and estimates provided in this report are based on company information, market research companies and professional organizations considered as acknowledged sources in their respective domains.

This includes market data and forecast extracted from DECISION annual multiclient reports covering the World Electronic Equipment Industry (Level4) and the World Passive and Interconnection Component Market (Level2) which have been extensively used in the report.

Other sources per level of the value chain include:

LEVEL 1 | SEMI
LEVEL 2 | WSTS
LEVEL 3 | MMI, IdTechEx, IMS Research, iSuppli, ABI Research, Avicennes, DisplaySearch

DECISION also took assumptions and hypothesis when necessary in order to fill the existing gaps in the value chain coverage and enable to build a complete and cohesive picture of the electronics value chain.

This is notably the case for the employment figures that have been calculated by applying a ratio (production value per employee) to the value of production estimates for Europe. These ratios were calculated from various sources including annual company reports and global employment figures published by European professional organisations when available.

Production ratios applied are the following:

LEVEL 1 | Tools and Materials: **130 k€** per employee

LEVEL 2 | Semiconductors: **190k€** per employee,
Passive and Interconnection: **150k€** per employee

LEVEL 3 | Board assembly: **120k€** per employee
Modules: **150k€** per employee

LEVEL 4 | Electronic systems: **150k€** per employee

Annexe 2: EURIPIDES² domain figures

PRODUCTION

Electronics and EURIPIDES² domain: end product level and input levels

(production in billion Euros)	WORLD		EUROPE	
	2012	2020	2012	2020
Input levels (semiconductors)				
Materials, tools	68.1	135.8	13.0	26.8
Components	204.1	319.1	16.2	16.0
Input levels (EURIPIDES²)				
Materials, tools	31.7	47.4	6.9	9.9
Components	149.3	224.5	14.7	17.8
Boards & modules	695.5	1 089.7	78.5	126.4
Input levels (all areas)				
Materials, tools	99.9	183.2	20.1	36.6
Components	344.4	534.7	30.9	33.8
Boards & modules	695.5	1 089.7	78.5	126.4
Electronic end-product level				
Embedded systems	471.9	673.1	140.8	174.4
Enmeshed & implanted systems	13.4	40.2	3.4	10.0
Total EURIPIDES² end products	**485.3**	**713.3**	**144.2**	**184.4**
Stand-alone systems (not in EURIPIDES² domain)	91.4	1 363.9	82.7	74.0
Total electronic end products	**1 395.8**	**2 077.2**	**226.9**	**258.4**

Source DECISION

Annual growth rates 2012-2020 (%)

	WORLD	EUROPE
Total GDP (1)	3.3	2.0
Electronics industry production		
Level 1	7.9	7.9
Level 2	5.7	1.1
Level 3	5.8	6.1
Level 4	5.1	1.6
EURIPIDES² domain production		
Level 1	5.2	4.5
Level 2	5.2	2.4
Level 3	5.8	6.1
Level 4	4.9	3.1
Employment		
Electronics industry		3.3
EURIPIDES²		4.2

Source DECISION except (1) 2011-2020, Economist Intelligence Unit

Total production, Electronics industry, World, million Euros

LEVEL	DOMAIN	2010	2012	2015	2020
1	**Materials & Equipment**	**94 246**	**99 878**	**126 204**	**183 230**
1.1	Materials	28 316	31 190	38 411	55 299
1.2	Tools	40 395	41 346	53 983	79 826
1.3	Substrates, packages	25 535	27 342	33 810	48 105
2	**Components**	**326 270**	**344 367**	**400 688**	**534 663**
2.1	Active	229 474	238 595	278 287	376 576
2.2	Passive	31 569	33 023	35 866	41 708
2.3	Interconnection	65 227	72 748	86 535	116 379
3	**Subsystems**	**652 996**	**695 545**	**846 641**	**1 089 708**
3.1	Boards	506 665	527 861	649 220	795 807
3.2	Modules	146 331	167 684	197 421	293 901
4	**Systems**	**1 267 654**	**1 395 766**	**1 611 579**	**2 077 130**
4.1	Stand-alone	829 606	910 439	1 054 483	1 363 876
4.2	Embedded	427 139	471 887	538 729	673 097
4.3	Enmeshed	10 909	13 440	18 367	40 157

Source DECISION

Total production, Electronics industry showing EURIPIDES² domain, World, million Euros

LEVEL	DOMAIN	2010	2012	2015	2020
1	**Materials & Equipment Total**	**94 246**	**99 878**	**126 204**	**183 230**
1.1	Materials	28 316	31 190	38 411	55 299
1.2	Tools	40 395	41 346	53 983	79 827
1.3	Substrates, packages	25 535	27 342	33 810	48 104
1	**Materials & Equipment (semiconductors)**	**65 207**	**68 147**	**89 484**	**135 804**
1.1	Materials	13 797	15 325	20 051	31 586
1.2	Tools	30 715	30 769	41 723	64 017
1.3	Substrates, packages	20 695	22 053	27 690	40 201
1	**Materials & Equipment (EURIPIDES² domain)**	**29 039**	**31 731**	**36 720**	**47 426**
1.1	Materials	14 519	15 866	18 360	23 713
1.2	Tools	9 680	10 577	12 240	15 809
1.3	Substrates, packages	4 840	5 289	6 120	7 904
2	**Components**	**326 270**	**344 367**	**400 688**	**534 663**
2.1	Active	229 474	238 595	278 287	376 576
2.2	Passive	31 569	33 022	35 866	41 708
2.3	Interconnection	65 227	72 748	86 535	116 379
2	**Components (semiconductors)**	**188 370**	**204 101**	**227 799**	**319 127**
2.1	Active	188 370	204 101	227 799	319 127
2.2	Passive	0	0	0	0
2.3	Interconnection	0	0	0	0
2	**Components (EURIPIDES² domain)**	**137 900**	**149 266**	**172 889**	**224 536**
2.1	Active	41 104	43 495	50 488	66 449
2.2	Passive	31 569	33 023	35 866	41 708
2.3	Interconnection	65 227	72 748	86 535	116 379
3	**Subsystems**	**652 996**	**695 545**	**846 641**	**1 089 708**
3.1	Boards	506 665	527 861	649 220	795 807
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4	**Systems Total**	**1 267 654**	**1 395 766**	**1 611 579**	**2 077 130**
4.1	Stand-alone	829 606	910 439	1 054 482	1 363 876
4	**Systems (EURIPIDES² domain)**	**438 048**	**485 327**	**557 097**	**713 254**
4.2	Embedded	427 139	471 887	538 729	673 097
4.3	Enmeshed	10 909	13 440	18 368	40 157

Source DECISION

Total production, EURIPIDES² domain, World, million Euros

LEVEL	DOMAIN	2010	2012	2015	2020
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2	**Components**	**137 900**	**149 266**	**172 889**	**224 536**
2.1	Active	41 104	43 495	50 488	66 448
2.2	Passive	31 569	33 023	35 866	41 708
2.3	Interconnection	65 227	72 748	86 535	116 379
3	**Subsystems**	**652 996**	**695 545**	**846 641**	**1 089 708**
3.1	Boards	506 665	527 861	649 220	795 807
3.2	Modules	146 331	167 684	197 421	293 901
4	**Systems**	**438 048**	**485 327**	**557 097**	**713 254**
4.1	Stand-alone	0	0	0	0
4.2	Embedded	427 139	471 887	538 729	673 097
4.3	Enmeshed	10 909	13 440	18 368	40 157

Source DECISION

Total production, Electronics industry, Europe, million Euros

LEVEL	DOMAIN	2010	2012	2015	2020
1	**Materials & Equipment**	**18 849**	**19 976**	**25 241**	**36 646**
1.1	Materials	5 663	6 238	7 682	11 060
1.2	Tools	8 079	8 269	10 797	15 965
1.3	Substrates, packages	5 107	5 469	6 762	9 621
2	**Components**	**34 207**	**30 898**	**31 939**	**33 784**
2.1	Active	22 947	19 088	19 088	18 829
2.2	Passive	3 157	3 158	3 208	3 337
2.3	Interconnection	8 103	8652	9 643	11 618
3	**Subsystems**	**73 383**	**78 544**	**96 024**	**126 350**
3.1	Boards	50 666	52 786	64 922	79 580
3.2	Modules	22 717	25 758	31 102	46 770
4	**Systems**	**222 201**	**226 881**	**236 497**	**258 512**
4.1	Stand-alone	88 154	82 727	80 644	74 037
4.2	Embedded	131 319	140 794	151 261	174 436
4.3	Enmeshed	2 728	3 360	4 592	10 039

Source DECISION

Total production, Electronics industry showing EURIPIDES² domain, Europe, million Euros

LEVEL	DOMAIN	2010	2012	2015	2020
1	**Materials & Equipment Total**	**18 849**	**19 976**	**25 241**	**36 646**
1.1	Materials	5 663	6 238	7 682	11 060
1.2	Tools	8 079	8 269	10 797	15 965
1.3	Substrates, packages	5 107	5 469	6 762	9 621
1	**Materials & Equipment (semiconductors)**	**12 230**	**13 034**	**17 328**	**26 788**
1.1	Materials	2 831	3 119	4 225	6 636
1.2	Tools	5 413	5 540	7 558	11 974
1.3	Substrates, packages	4 086	4 375	5 545	8 178
1	**Materials & Equipment (EURIPIDES² domain)**	**6 519**	**6 942**	**7 913**	**9 858**
1.1	Materials	2 832	3 119	3 457	4 424
1.2	Tools	2 666	2 729	3 239	3 991
1.3	Substrates, packages	1 021	1 094	1 217	1 443
2	**Components**	**34 206**	**30 898**	**31 939**	**33 784**
2.1	Active	22 947	19 087	19 087	18 828
2.2	Passive	3 157	3 158	3 208	3 337
2.3	Interconnection	8 102	8 653	9 644	11 619
2	**Components (semiconductors)**	**19 505**	**16 224**	**16 224**	**16 004**
2.1	Active	19 505	16 224	16 224	16 004
2.2	Passive	0	0	0	0
2.3	Interconnection	0	0	0	0
2	**Components (EURIPIDES² domain)**	**14 701**	**14 674**	**15 715**	**17 780**
2.1	Active	3 442	2 863	2 864	2 825
2.2	Passive	3 157	3 158	3 208	3 337
2.3	Interconnection	8 102	8 653	9 643	11 618
3	**Subsystems**	**73 383**	**78 544**	**96 024**	**126 350**
3.1	Boards	50 666	52 786	64 922	79 580
3.2	Modules	22 717	25 758	31 102	46 770
4	**Systems Total**	**222 201**	**226 881**	**236 497**	**258 512**
4.1	Stand-alone	88 154	82 727	80 644	74 037
4	**Systems (EURIPIDES² domain)**	**134 047**	**144 154**	**155 853**	**184 475**
4.2	Embedded	131 319	140 794	151 261	174 436
4.3	Enmeshed	2 728	3 360	4 592	10 039

Source DECISION

Total production, EURIPIDES² domain, Europe, million Euros

LEVEL	DOMAIN	2010	2012	2015	2020
1	**Materials & Equipment**	**6 519**	**6 942**	**7 913**	**9 858**
1.1	Materials	2 832	3 119	3 457	4 424
1.2	Tools	2 666	2 729	3 239	3 991
1.3	Substrates, packages	1 021	1 094	1 217	1 443
2	**Components**	**14 701**	**14 674**	**15 715**	**17 780**
2.1	Active	3 442	2 863	2 863	2 824
2.2	Passive	3 157	3 158	3 208	3 337
2.3	Interconnection	8 102	8 653	9 644	11 619
3	**Subsystems**	**73 383**	**78 544**	**96 024**	**126 350**
3.1	Boards	50 666	52 786	64 922	79 580
3.2	Modules	22 717	25 758	31 102	46 770
4	**Systems**	**134 047**	**144 154**	**155 853**	**184 475**
4.1	Stand-alone				
4.2	Embedded	131 319	140 794	151 261	174 436
4.3	Enmeshed	2 728	3 360	4 592	10 039

Source DECISION

EMPLOYMENT

Total employment, Electronics industry, Europe

LEVEL	DOMAIN	2010	2012	2015	2020
1	**Materials & Equipment**	**144 995**	**153 658**	**194 161**	**281 893**
2	**Components**	**195 837**	**179 200**	**186 138**	**198 800**
2.1	Active	120 775	100 462	100 462	99 099
2.2	Passive, interconnection	75 062	78 738	85 676	99 701
3	**Subsystems**	**573 664**	**611 601**	**748 365**	**974 969**
3.1	Boards	422 221	439 884	541 017	663 172
3.2	Modules	151 443	171 717	207 348	311 797
4	**Systems**	**1 481 337**	**1 512 542**	**1 576 645**	**1 723 416**
	Total	**2 395 833**	**2 457 001**	**2 705 308**	**3 179 078**

Source DECISION

Total employment, EURIPIDES² domain, Europe

LEVEL	DOMAIN	2010	2012	2015	2020
1	**Materials & Equipment**	**50 147**	**53 396**	**60 871**	**75 834**
2	**Components**	**93 178**	**93 808**	**100 746**	**114 566**
2.1	Active	18 116	15 070	15 070	14 865
2.2	Passive, interconnection	75 062	78 738	85 676	99 701
3	**Subsystems**	**573 664**	**611 601**	**748 365**	**974 969**
3.1	Boards	422 221	439 884	541 017	663 172
3.2	Modules	151 443	171 717	207 348	311 797
4	**Systems**	**893 644**	**961 026**	**1 039 020**	**1 229 835**
	Total	**1 610 633**	**1 719 831**	**1 949 002**	**2 395 204**

Source DECISION

Annexe 3: EURIPIDES² domain players

AEROSPACE, DEFENCE AND SECURITY

Main players in aerospace, defence and security electronics

Company		Aircraft	Aerospace electronics	Space	Defense	Security
EU	Airbus	●				
USA	Boeing	●				
Can	Bombardier	●				
Braz	Embraer	●				
EU	Eurocopter	●				
EU	EADS					
EU	Thales		●	●	●	●
EU	Smith		●		●	●
EU	Safran-Morpho		●		●	●

Source DECISION

With an average annual rate of 3.5% for the 2010-2015 period, growth in world demand for aerospace, defence and security electronic systems is less dynamic than the electronics industry globally (4.9%), because of the slow growth of the military segments. The civil segments all grow faster than global world electronics, civil aerospace around 6%, and security at 6.5%. The prospects for European production are less favourable (2.7%), and this is because European industry is expected to lose market shares in the dynamic emerging market for security systems, with European production growing at no more than 3.8% on a world market growing at 6.5%.

Despite this difficult competitive environment and the current lack of a consolidated and dynamic European market, security is still a market where Europe occupies a leadership position with the presence of major producers and systems integrators coming from the aerospace and defence business (e.g. Thales, EADS, Smith, Morpho, etc.).

As the security market evolves to adapt to new security threats and a changing regulatory framework, new European leaders may emerge as well in large application market sectors (environment, energy, transport) where new security constraints may develop over the forecast period.

INDUSTRIAL AND MEDICAL ELECTRONICS

Main Industrial and Medical Electronics Players Core Businesses

Company		Vehicle systems	Power automation	Measuring & test	Medical	Lighting
EU	ABB	●	●	●		
USA	Agilent EMG			●		
EU	Alstom	●	●			
EU	Ansaldo	●				
Can	Bombardier	●				
USA	Boston Scientific (CRM)				●	
USA	Caterpillar Machines	●				
China	Chint group		●			
EU	CNH	●				
China	CNR	●				
China	CSR	●				
USA	Danaher			●	●	
China	Delixi		●			
USA	Eaton		●			
USA	Emerson		●	●		
Jap	Fanuc		●			
USA	General Electric	●			●	●
Jap	Hitachi	●	●		●	
USA	Honeywell		●			
EU	Invensys		●			
USA	JDSU			●		
USA	John Deere	●				
USA	Johnson Controls		●			
Jap	Kawasaki	●				
Jap	Komatsu	●				
Jap	Kubota	●				
EU	Legrand		●			
USA	Medtronic (CRM)				●	
CH/USA	Mettler Toledo	●		●		
Jap	Mitsubishi Electric	●	●			
Jap	Omron	●	●			●
EU	Philips				●	●
USA	Rockwell Automation		●			
USA	St Jude Medical (CRM)				●	
EU	Schneider Electric		●			
EU	Siemens	●	●		●	●
USA	Teradyne			●		
Jap	Toshiba	●	●		●	●
USA	Varian Medical				●	
EU	Volvo CE	●				
Jap	Yokogawa		●			

Source DECISION

Industrial Sales of the Main Industrial And Medical Electronics Firms, in million euro

Company		Net Sales 2010	Net Sales 2009	Growth 2009-10 (€)	Growth 2009-10 local curr.
EU	Siemens*	71 823	71 938	-0.2%	-0.2%
USA	General Electric*	50 078	49 376	1.4%	-3.6%
Jap	Hitachi*	35 521	30 505	16.4%	3.8%
Jap	Mitsubishi Electric	24 776	19 932	24.3%	10.9%
EU	ABB	23 823	22 792	4.5%	-0.6%
EU	Schneider Electric (Areva Distrib. excluded)	18 350	15 793	16.2%	16.2%
USA	John Deere	17 777	14 879	19.5%	13.6%
Jap	Toshiba*	17 401	17 868	-2.6%	-13.1%
EU	Alstom (Areva T&D excluded)	17 270	19 650	-12.1%	-12.1%
EU	Philips*	16 153	14 385	12.3%	12.3%
USA	Emerson*	14 543	13 173	10.4%	4.9%
USA	Caterpillar Machines	13 769	8 314	65.6%	57.4%
Jap	Komatsu	12 885	9 753	32.1%	17.8%
EU	CNH	10 916	9 164	19.1%	13.2%
USA	Honeywell*	10 369	9 040	14.7%	9.0%
USA	Johnson Controls*	9 655	8 955	7.8%	2.5%
China	CSR	7 124	4 788	48.8%	40.1%
China	CNR	6 931	4 247	63.2%	53.7%
Can	Bombardier*	6 861	7 168	-4.3%	-9.0%
USA	Eaton*	6 350	6 234	1.9%	-3.2%
USA	Danaher*	4 544	3 596	26.4%	20.1%
EU	Legrand	3 891	3 578	8.7%	8.7%
Jap	Fanuc	3 839	1 943	97.6%	76.2%
USA	Medtronic (CRM)	3 778	3 776	0.1%	-4.9%
USA	Rockwell Automation	3 663	3 106	17.9%	12.1%
Jap	Omron*	3 127	2 474	26.4%	12.7%
EU	Invensys	2 897	2 517	26.4%	12.7%
Jap	Yokogawa	2 801	2 429	15.3%	2.8%
China	Chint Group	2 773	2 557	8.4%	2.1%
USA	St Jude Medical (CRM)	2 293	1 985	15.5%	9.8%
USA	Agilent EMG*	2 100	1 733	21.2%	15.2%
USA	Varian Medical Systems	1 777	1 587	12.0%	6.4%
USA	Boston Scientific (CRM)	1 644	1 730	-5.0%	-9.7%
CH/USA	Mettler Toledo	1 484	1 233	20.4%	14.4%
China	Delixi**	1 480	1 343	10.2%	3.8%
EU.	Ansaldo	1 284	1 176	9.2%	9.2%
USA	Teradyne	1 213	587	106.6%	96.4%
USA	JDSU	1 208	857	41.0%	34.0%
Jap	Kawasaki*	1 128	1 151	-2.0%	-12.6%

Source DECISION

* industrial market activities only ** Delixi : estimate figure

TRANSPORT AND OFF ROAD VEHICLES

Railway Systems Market World Players, 2010

Company		Market share (%)
China	CSR	13%
China	CNR	13%
CAN	Bombardier	13%
EU	Siemens	13%
EU	Alstom	11%
USA	GE	5%
	All others	32%

Source: Manufacturers

Weaknesses

Agricultural Machinery was a 60 billion Euro market in 2010, increased 10% compared to 2009. This market is highly cyclical and 2011 is expected to reach a new high with a growth around 20%. For instance, Mahindra, the Indian group leader on the tractor sector has produced 480,000 units in FY 2011 versus 300,000 in FY 2009. The main world leaders of the sector are three US based worldwide companies: John Deere (US), CNH-Fiat (EU), and AGCO (US). Next come Kubota (Japan) and Mahindra (India). And the Chinese manufacturers leaded by YTO, Changzhou Donfeng, Foton Lovol and Shandong Shifeng, are now trying to penetrate outside markets, including Europe. For example, YTO has recently acquired McCormick France. In 2010, Chinese exports of agricultural machinery have reached 4,9 billion Euros, according to the China National Association for Agricultural Machinery Industry.

The main growth driver for the agricultural machinery market is the farm mechanization progresses in large populated countries such as India, China, or Brazil, or Indonesia. In North America and in Europe, the electronic content of agricultural machinery is particularly high and is continuing to grow with the development of “precision farming”. This enables the optimisation of the farming process, with significant economical and environmental benefits. Other factors such as economic conditions and weather also influence the market evolution.

Construction machinery (loaders, compactors, excavators, cranes, etc.) is more rugged and less sophisticated than farming equipment. Hydraulic technology is still the basic energy transmission system. But energy-efficiency issues and environmental concerns are offering new opportunities for new power electronics applications, for instance in hybridization of powertrains.

The US supplier Caterpillar dominates the market, followed by the Japanese Hitachi Construction Machinery and the Europeans Volvo Construction Equipment and Liebherr. Next come Komatsu (Jap), John Deere (USA) and CNH-Fiat (EU). Some Chinese manufacturers have grown rapidly during the recent years as LiuGong CM and Shantui CM. As China is becoming the largest construction market in the world, these companies are now, in the same way as in other industries, rapidly increasing their domestic market share.

After having dramatically fallen to 35 billion Euros in 2009, the world Construction Machinery market has strongly recovered in 2010 to 50 billion Euro (+41%). And, despite the economic uncertainty in the developed countries, 2011 will also be a good year for this industry, with a new expected growth of more than 20%. Nevertheless, it will not attain the high point reached in 2008 before the recession. As inventories of such expensive equipment had been drastically reduced all along the supply chain in 2009, and especially by dealers, they have been reconstituted in 2010 and 2011, and significantly contributed to the recent market recovery.

The same companies manufacturing construction machinery equipment often also manufacture **mining machinery equipment.** The world leader is again Caterpillar, who has increased its market share through its acquisition of the Chinese Bucyrus in 2011. Other players include Joy Global (USA), Komatsu and Hitachi (Jap), and Liebherr (EU). The world market is estimated around 20 billion Euros in 2010, and is on the way to recovery since the recession in 2009.

Industrial trucks (forklift trucks and other types) are part of the Material Handling Equipment market, which also includes other equipment such as storage and handling equipment, handling robots or conveyors. The world industrial trucks market has plummeted in 2009 by 33% in terms of units, from 874,000 to 549,000. The recovery in 2010 has been strong, reaching a total of 796,000 units. Even if 2011 will be also a very good year for this industry, the 2007 record of 953,000 industrial trucks sold in one year will be difficult to better!

In value, the market was 25 billion Euros in 2010, growing 31% over 2009, although the unit price of an industrial truck decreased by 12% on average. Market leaders are Toyota Industries (Jap), Kion and Jungheinrich (EU), Nacco and Crown Equipment (USA). Mitsubishi and Caterpillar have a joint subsidiary, Mitsubishi Caterpillar Forklift. Then come Komatsu (Jap) and the Chinese leading domestic manufacturer, Anhui Forklift.

World Off-Road Manufacturers, 2010

	Company		Agricultural Machinery	Construction & Mining Machinery	Industrial Trucks
1	USA	John Deere	●	●	
2	USA	Caterpillar		●	●
3	Jap	Komatsu		●	
4	EU	CNH-Fiat	●	●	
5	Jap	Hitachi CM		●	
6	EU	Volvo CE		●	
7	Jap	Kubota	●	●	
8	USA	AGCO	●		
9	EU	Liebherr		●	
10	Jap	Toyota Industries			●
11	EU	Kion			●
12	USA	Joy Global		●	
13	India	Mahindra	●		
14	EU	Jungheinrich			●
15	USA	Nacco		●	●
16	USA	Crown Equipment		●	
17	China	China Yuchai Int.		●	
18	EU	Cargotec			●
19	EU	JCB		●	
20	China	Guangxi Liugong CM		●	

Source DECISION

MARINE APPLICATIONS

After a dramatic fall in 2008 and 2009, the demand for new merchant ships has recovered in 2010, but is still far from the record level reached in 2007. China is now the n°1 of the world shipbuilding industry in new orders as well as in yearly completion of new ships. South Korea is n°2, and the market share of Japan, ranking n°3, is progressively declining. In Europe, Germany and Italy are the most important shipbuilders.

World Merchant Shipbuilding Industries, gross tons market shares

Country	2009		2010	
	New Orders	Completions	New Orders	Completions
China	45%	28%	44%	38%
South Korea	26%	38%	34%	33%
Japan	23%	25%	14%	21%
Others	6%	9%	8%	8%
Total	**100%**	**100%**	**100%**	**100%**

Source: The Shipbuilders Association of Japan

Leading world shipbuilders include:

- **China:** China State Shipbuilding Corporation (CSSC), Shanghai Waigaoqiao Shipbuilding Corp, China Shipbuilding Industry, Guangzhou Shipyard International Company, Dalian Shipbuilding Industry
- **South Korea:** STX, Samsung, Hyundai, Daewoo
- **Japan**: IHI Corporation, Universal Shipbuilding Corporation, Mitsubishi, Kawasaki

UPS, POWER SUPPLIES, POWER DISTRIBUTION

The market and production of power supplies, power conversion and power grid equipment are related to telecommunication infrastructures, data infrastructures (data centres), electrical or electronic OEM equipment conversion, and the increasing need for high quality and secured electric power in general.

The **global UPS (Uninterruptible Power Supply) market** has recovered in 2010 after the severe decline of 2009. Worldwide sales reached 6 billion Euros and should grow by an average annual growth rate of 8% between 2010 and 2015. Boosted by the growing need of powering and protecting sensitive digital equipment such as data centres, the UPS market is dominated by a group of large players including Schneider Electric (26% market share), Eaton (13%), and Emerson Network Power (12%). Other manufacturers include: Eltek, Mitsubishi Electric, Socomec, Riello UPS, Toshiba, Piller, and the recent entrant ABB through the acquisition of Newave, which may be completed in 2012 with the purchase of Thomas & Betts.

At almost 6 billion Euros worldwide in 2010, the general labs and **industrial power supplies** market has also recovered after the 2009 recession. Future growth opportunities for manufacturers will come from the increasing use of electronics throughout the entire industry, and advances in energy efficiency. Rapidly expanding LED lighting applications will be one of the drivers for growth on the AC/DC power supplies market. Leaders on the market in this AC/DC field are Delta Electronics (Taiwan) and Emerson, but the world leader for DC/DC is Murata (Jap) followed by Delta Electronics and Emerson.

2010 has been an exceptional business year for the **solar inverter** manufacturers with a worldwide market reaching 4.7 billion Euros, to compare with 2.3 billion Euros in 2009. In terms of GW, the growth means 23 GW installed in 2010 to compare with 8 GW installed the year before. But with a capacity of 40 GW, rising to 50 GW in 2011, the price-per-watt for these devices is rapidly declining.

Solar Inverter Manufacturers

Manufacturer		World Market share 2010
EU-Ger	SMA Solar Technology	40%
USA	Power One	11%
EU-Ger	Kaco New Energy	9%
EU-Ger	Fronius	5%
USA	Satcon	3%
EU-Fra	Schneider Electric (Xantrex)	3%
USA	General Electric	3%
CH	Sputnik	3%

Source: DECISION

Due to this excess capacity and the resulting inventories all along the supply chain, the worldwide market for solar inverters has been flat in 2011 in terms of GW installed. And price decrease has caused the market value to decline by 10% in 2010 to 4.2 billion Euro. During the period 2010-2015, the world market will grow by 8% in average per year.

The penetration of electronics in **power distribution** networks remains slow. The historical power utilities were not very keen on such innovations, and the privatised power companies have not yet realized that more electronics actually increases their profitability. However, during the coming years, the urge for energy saving and increased power quality and reliability will foster the use of electronics in power networks. Good examples are the need for communication equipment required by the smart metering (concentrators) and by the smart power grid (in relation with renewable energy sources entering the power grid), and also for new monitoring and control functions on the power grid.

Power Distribution, Leading World Suppliers

Rank	Medium Voltage	Low Voltage
1	ABB	Schneider Electric
2	Schneider Electric	ABB
3	Siemens	Siemens

Source: DECISION

The **electronic lighting market,** globally, is a 14 billion Euro market, and will grow at a CAGR of 8% between 2010 and 2015. In the traditional light source market, the three main leaders: General Electric, Philips, and Siemens have secured a 60% to 70% market share. The solid-state lighting market is shared between other leaders: Nichia (Japan), Cree (USA), Osram (ex-Siemens, EU), Samsung (South Korea), Philips Lumileds (EU), Seoul Semiconductor (South Korea), Stanley Electric (Japan), Everlight Electronics (Taiwan).

AUTOMATION

The **automation** segment is still dominated by three European manufacturers (Siemens, ABB, Schneider Electric), four American (Rockwell Automation, Emerson, Honeywell, General Electric), and one Japanese (Mitsubishi Electric). New Chinese actors are progressively coming, such as the Chint group.

Factory & Utility Automation, Leading World Suppliers

Rank	Motion control	Manufacturing automation	Process automation
1	Siemens	Siemens	ABB
2	Mitsubishi Electric	Rockwell Automation	Emerson
3	ABB	Mitsubishi Electric	Honeywell
4	Rockwell Automation	Schneider Electric	Siemens

Source: DECISION

Building & Home Automation, Leading World Suppliers

Rank	Building Automation	Home Automation
1	Honeywell	Legrand
2	Siemens	Schneider Electric
3	Johnson Controls	Matsushita
4	Schneider Electric	Leviton

Source: DECISION

Growth in the Automation field is closely related to capital goods markets, and economic activity. Despite the slowing down of the global economy from mid-2008, the major automation systems manufacturers have still obtained a growth rate of their revenue in 2008. But new orders have started to decrease during the fourth quarter, and 2009 revenues have been sharply hit.The Automation market is classically segmented between Factory & Utility Automation, and Building & Home Automation. Some industry leaders are present in both segments (Siemens, Schneider Electric, Honeywell), others are more specialized (ABB, Rockwell Automation, Mitsubishi Electric, Legrand, etc.). As for the IT industry, software and services provided by manufacturers represent a much bigger - and growing - portion of the automation market than hardware.

FACTORY & UTILITY AUTOMATION

Industries using automation devices are split between discrete industries (Aerospace & Defence, Automotive, Electrical, Electronics & Semiconductors, Machinery, etc.) and process industries (Cement & Glass, Chemical & Petrochemical, Food & Beverage, Electric Power, Mining, Oil & Gas, Pharmaceutical & Cosmetics, Pulp & Paper, Textiles, etc.).

Among the main devices included in the various automation systems are the following:

- PLC (Programmable Logic Controllers) control machines, batch cells, conveyors, assembly lines, etc… The role of PLC is expanding due to increasing demands for real-time functionality, communication capability and the shift toward PAC (Programmable Automation Controllers), a type of industrial controllers combining the functionalities of a PLC and of a PC; Siemens is by far the PLC n°1 vendor.

- DCS (Distributed Control Systems) are used in many process industries like oil and gas, petrochemical, cement, papermaking, etc. Their main characteristic is to use decentralized controllers along the system, all connected together and to the different other components of the system. ABB is the n°1 vendor of DCS in the world.

- AC Drives control speed and other parameters of AC motors. As a large percentage of electric motors is still without electronic drives, this represents a large potential market;

- NC (Numerical Control) consists of coordinated computerized motion-control devices, used to pilot multi-axis machine-tools;

- Demand for industrial robots (over 100,000 units per year), is drawn by the Japanese market, which accounts for at least half of the total world demand. Europe is the second largest market with one quarter of total sales. There are a total of one million industrial robots in use worldwide, 40% of them are located in Japan. In the manufacturing industry, the density of robots in Japan is three times more than in the USA and almost six times more than in Europe;

- Industrial Networks, including field networks, are fuelled by the increasing penetration of Ethernet (IP) solutions, making possible to integrate the factory field system into the enterprise network, through 1Gb/s then 10Gb/s data output and real-time performances.

Wireless connections between devices are the main trend in factory and utility automation systems today. Industrial networks based on 802.11n standard, and field networks based on Ethernet protocols are the most popular.

BUILDING & HOME AUTOMATION

Automation systems in buildings and homes (enabling so-called smart building/homes) are deployed to provide occupants comfort, energy efficiency, and security. In the same way as factory automation systems, they are also based on bus networks connecting sensors and actuators to controllers and man-machine interfaces. They make it possible to monitor HVAC systems, Lighting systems, Fire & Alarm control systems, Access Control systems, and other Security systems. Heating and Air Conditioning systems are also incorporating more electronics for energy saving, silent operation, easy control and maintenance.

Until recently, the drivers of the Building Automation market used to be security and comfort, but energy efficiency has come as the first parameter for decision makers. Cloud computing also benefits facility and building managers as their automation Software can now be used As A Service (SAAS). Among the hardware devices, video cameras are used not only for security tasks but also, being connected to HVAC and lighting systems, to detect if a room is occupied or not, and even to count the number of occupants, for real-time adjustment of lighting and heating.

As for building automation, energy savings is the major trend influencing the growth of the Home Automation market. Since the 2009 collapse, this market has slightly recovered in 2010, but the global financial crisis and economic slowdown in 2011, resulting in global economic uncertainties, especially in developed countries, are offering limited growth prospects for the next coming years.

After a 16% decrease in 2009, the global worldwide demand for electronic automation solutions recovered slightly in 2010 with a 4% growth. A closer return to the former level of business only came in 2011 when market growth reached 13.5%. Over the 2010-2015 period, the automation electronic solutions market is expected to grow at a 5.8% average rate per year.

If Asia is becoming the first market area for automation electronics, Europe is still the main region in terms of production, representing 42% of the world total, thanks to the European manufacturing sites of leaders ABB, Siemens, and Schneider Electric. But this position will progressively reduce in the coming years.

MEDICAL SYSTEMS

Having ignored the crisis in 2009, the Medical electronics sector is experiencing a continuous development and represents a worldwide market of 37 billion Euros, and is expected to grow by 4.3% per year over 2010-2015. North America dominates the medical electronics market (47% of the world market), leaving Asia with 28% and Europe with 21%. With almost 23% of world production, the European medical electronics industry also has a positive trade balance, in other words European production exceeds the domestic market needs.

The medical electronics industry is changing very quickly and has to meet new demands, such as individual miniaturised diagnostic or healthcare solutions, with products like hearing aids, glycaemia testers, blood pressure testers, electronic thermometers, scales… and many innovating devices such as pill cameras, contactless power charging or communicating pace-makers/defibrillators, embedded chemical testers, etc.

These new needs for low-cost mass-market products will contribute to reduce expenditures for hospitals and the attendant social security systems. The leading medical electronics suppliers are naturally very keen to capitalize on these new markets, but in many cases the new products have been developed by start-ups or recent spin-offs.

New technologies will shortly arrive on the market in the following segments:

- Computer assisted surgery and robot aided surgery to improve precision and to reduce post-operative consequences ;
- Telemedicine for distant diagnosis, and follow-up treatment at home ;
- Miniaturisation and massive deployment of implants: stents (for artery enlargement), ICD, neuromodulators, insulin pumps for diabetics, hearing aids, ocular implants, etc.

Medical electronics comprise the following segments:

- Medical imaging equipment;
- Cardiac rhythm management (CRM);
- Medical sensors;
- Other diagnostic and therapy equipment;
- Home-care medical devices.

Telemedicine is just a part of what is emerging under the name of Telehealth or E-Health which is based on coordinated networks between all actors involved around the patient. New technologies, especially in the communications and data markets, are at the forefront of this evolution.

MEDICAL IMAGING EQUIPMENT

The medical Imaging equipment industry is subdivided into different technologies:

- Conventional and Digital Radiography (X-Ray)
- Scanners or Computed Tomography (CT)
- Magnetic Resonance Imaging (MRI)
- Ultrasound
- Nuclear Medicine
- Other technologies

The market is very concentrated: the first three players, General Electric, Siemens, and Philips corner 70% of the total market, and the fourth, Toshiba, is present mainly in Japan. Other regional actors include Hitachi and Shimadzu in Japan, Carestream Health and Hologic in the USA, Mindray and Wandong in China.

The medical imaging equipment market was 15.5 billion Euros in 2010. After three difficult years from 2007 to 2009, it has recovered in 2010 and is expected to see a 5% average annual growth rate between 2010 and 2015.

The main trends in the medical imaging market relate to the fast development of the ultrasound imaging technology, especially through compact ultrasound systems. Such systems are used in vascular radiology, in cardiology, and other branches of medicine.

Another trend is what is called the fusion-imaging technology which integrates real-time ultrasound with other modalities as CT or MRI.

The segment is pursuing its conversion from analogical to digital systems. The digitisation is growing by 15% to 20% annually, enabling institutions to get rid of analogue's reliance on paper film. Another trend is the development of the 3D (three dimensional) medical imaging technology, especially in MRI and CT applications.

Medical Imaging Equipment Market Leaders

Rank	Company	
1	US	GE
2	EU	Siemens
3	EU	Philips
4	Jap	Toshiba
5	US	Carestream Health (ex-Eastman Kodak Health Group)

Source: DECISION

CARDIAC RHYTHM MANAGEMENT (CRM)

The cardiac implants segment is composed of pacemakers and defibrillators. In 2010, the world CRM market has seen a modest growth of 3%. Over the period 2010-2015, it is expected to grow by an average 5% rate per year. Pacemakers and defibrillators are implantable or external.

- The world pacemaker market, around 3 billion Euro, is mature and will see a 3% to 4% growth per year, due to its development in emerging countries ;

- The defibrillator market is growing more rapidly. The most popular device today is the CRT-D (Cardiac Resynchronization Therapy Defibrillator), an advanced combined item which reduces heart failure and patient mortality, and whose market is experiencing a double-digit growth rate. This type of device is rapidly grabbing market shares on the defibrillator market against the IDC (Implantable Cardioverter-Defibrillator). All types of implantable defibrillators together make a 7 billion Euro world market, expected to grow at 6% per year over 2010-2015.

US manufacturer Medtronic with a 50% market share dominates the CRM market.

Cardiac Rhythm Management Market Leaders

Rank	Company	
1	US	Medtronic
2	US	St Jude
3	US	Boston Scientific

Source: DECISION

Derived partly from the CRM implantable devices technology, various implantable stimulator systems help to treat different diseases and to reduce patient pains. Neuromodulation is a fast growing segment for medical electronics manufacturers.

MEDICAL SENSORS

It is not easy to estimate the market size of medical sensors using electronics. It is likely that this market will grow rapidly as real-time permanent monitoring of patients physiological signals will be more and more required. 60% of world production is probably located in the US. Used as individual devices, medical sensors are also used as elements of complete patient monitoring systems, including IT hardware and software. Trends in this domain are miniaturization, integration, and wireless communication capabilities. Other medical sensors, specifically biosensors, are components integrated into medical diagnosis devices such as blood gas analysers or glucose meters.

OTHER DIAGNOSTIC AND THERAPY EQUIPMENT

A variety of medical devices, used for diagnostic and/or therapy applications, are also considered as electronic (or potentially electronic) equipment, such as:

- Anaesthetic / respiratory equipment: oxygenators, gas delivery units, etc.
- Dental devices: intraoral X-Ray, dental digital imaging, etc.
- Functional screening equipment: ECG, EEG, Holter (ambulatory electro-cardiography device), etc.
- Patient monitoring equipment: cardio/respiratory monitors, blood gas monitors, etc.
- Surgery equipment: OR (Operation Room) equipment, coelioscopy, endoscopy, medical lasers, etc.
- Functional substitutes: dialysis equipment, hearing aid, etc.
- Therapy equipment: lithotrity, incubators, sleep apnea, etc.

Most of these devices are manufactured in relatively low volumes. For instance, the world market for external haemodialysis machines does not exceed 50,000 per year. An example of low volume market possibly turning to a high volume one is given by the external defibrillators. In Europe, 500,000 persons die suddenly (most of them at home) from different cardiac diseases. A majority could be saved if treated in the first minutes with an external defibrillator. A trend is coming to equip not only all public places (airports, railway stations, hotels, etc…) with such devices, but also to prescribe any patient at risk to also have one at home. Globally, the cardiac external resuscitation market (including external pacemakers, fluid resuscitation pumps, automated external defibrillators, and associated IT) accounts for 1 to 2 billion Euro worldwide and is growing fast. Leading actors include Medtronic, Philips, and Zoll (USA).

A new promising area of development is now emerging with nanotechnologies, and with their applications in electronics grouped under the name of nanoelectronics. For drugs delivery pumps, for instance, new prospects for developing smart insulin pumps could revolutionize diabetes treatment methods and bring an unbelievable comfort to patients. Other applications are offering promising markets, such as, for instance, smart catheters used in cardiovascular surgery.

HOME-CARE MEDICAL DEVICES

Home-care will grow strongly in the developed countries, first because populations are ageing and will require more assistance, and secondly because governments want to reduce health expenditures and specifically hospital costs. However this market should also grow in the emerging countries where the population is large and health infrastructures are scarce.
Among the various aspects of home-care, the following include or will include medical electronic devices:

- **Instruments:** digital thermometers (world market > 60 million units per year, all designed and manufactured in Asia), blood pressure controllers, out-of-medical-centre dialysis (most is haemodialysis, requiring a specific machine to purify the blood and also able to warm it before reinjection)
- **Respiratory assistance:** oxygenators, ventilation, etc.
  perfusion and feeding
- **Telemedicine:** distance monitoring including medical sensors (see above §), transmission systems, tele-diagnostic, etc.

Medical devices designed for home use differ from devices designed for hospitals because they are not used by the same populations, for the same purpose, and in the same way. The growing importance of disease prevention, well-being and comfort, as well as disease management at home, will create new opportunities for medical electronics development. However, the home-care market requires clarification in social security policies to effectively start growing.

World Medical Equipment Market Leaders

Product	Rank 1 or 2	Other leaders
X-Ray systems	Philips, Siemens (EU)	GE (US), Toshiba (Jap), Carestream Health (US)
Special systems	GE (US), Siemens (EU)	Philips (EU), Hologic (US)
Computer Tomography	GE (US), Siemens (EU)	Philips (EU), Toshiba (Jap)
Magnetic Resonance	GE (US), Siemens (EU)	Philips (EU), Hitachi (Jap)
Nuclear Medicine	Philips, Siemens (EU)	GE (US)
Ultrasound	Philips, Siemens (EU)	GE (US), Toshiba (Jap)
Oncology Care systems	Siemens (EU), Varian (US)	Elekta (EU)
Electromedical systems	Philips, Siemens (EU)	Instrumentarium (EU), GE (US), Covidien-Tyco (US)
Health services	McKesson-HBOC (US) Siemens (EU)	Cerner, IDX Systems-GE (US)
Audiology	Siemens, Oticon (EU)	ReSound (EU), Starkey (US), Widex (EU)

Source: Siemens

INSTRUMENTATION, MEASUREMENT & TEST EQUIPMENT

The instrumentation, measurement & test equipment market includes a wide range of devices and applications, from general-purpose stand-alone oscilloscopes to semiconductor wafer Automatic Test Equipment (ATE); from high-tech silicon clean-room labs to dusty and oily garages.

We consider four different sub-segments in this industry, where economic cycles and growth factors are heterogeneous and depend on the application considered:

- **Automated Test Equipment (ATE)**
  ATE is a market dedicated to the electronic components industry. The semiconductor industry accounts for over 80% of ATE demand, which is, as a result, highly cyclical. After two disastrous years in 2008 and 2009, the market has recovered in 2010, reaching 2 billion Euros, still 20% under its level of 2007. Over the period 2010-2015, it will not experience more than 2% of growth per year in average. The ATE market is extremely concentrated, in fact a duopoly between Teradyne (US) and Advantest (Jap) (since Advantest acquired Verigy in 2011).

- **Labs, Education and Industrial general-purpose instruments and test**
  The market recovered in 2010 back to an 18 billion Euro market destined to various facilities, including public and private labs, high-schools, colleges, and universities technical class-rooms, discrete and process industry manufacturing sites. Automotive and aerospace are among the most important users of such equipment. In terms of products, this market includes:
  - General test instruments (oscilloscopes, analysers, etc.) ;
  - Specific dedicated instruments used for instance in geophysics or by the nuclear industry;
  - Electronic Weighing Systems (EWS) used by labs and industrial facilities.

  Globally, the sector is a mature and renewal market, directly related to the general investment level.

- **Communication & network test equipment**
  Communication & network test equipment is a 5 billion Euro market dedicated to all communication networks (Optical, Wireless, Broadcast, and others). Broadband and wireless applications have been almost the only ones to attract investments in 2009, and this market has suffered a world decline of 25%.

- **Metering**
  Metering is a 4 billion Euro market dedicated to utilities and homes. There are 1.7 billion electricity meters installed worldwide, and the number of “smart” meters installed by 2009 end is estimated at 76 million units (4.5% of the total installed base). Smart meters, combined with AMI (Advanced Metering Infrastructures) provide new functionalities allowing both energy supplier and user to monitor and optimise energy efficiency and consumption. Major programmes for the development of this technology have started in the recent years as in Italy which has achieved the replacement of 27 million meters. Other are starting as in France where the 35 million electricity meters would be replaced within the ten coming years, Spain with a 13 million meter programme, or California where a programme of 10 million smart electricity meters is being implemented.

  The 400 million gas meters and the 800 million water meters operating worldwide are also intended to progressively provide the same AMR/AMI capabilities as electricity meters. The main smart meter manufacturers include Itron (US), Elster (EU), Landis & Gyr (EU), GE (US), Sagemcom (EU), and a new comer, the Chinese Holley Metering.

Test & Measurement Leaders' Sales And Segments, 2010 in billion Euros

		Company	Sales 2010	ATE	General Purpose	Comms	Metering
1	Jap	Yokogawa	2.8	●			
2	US	Danaher	2.8		●	●	
3	US	Agilent	2.1	●	●	●	
4	CH	Mettler Toledo	1.5		●		
5	EU	Elster	1.3				●
6	US	Itron-Actaris	1.2				●
7	US	JDSU	1.2			●	
8	US	Teradyne	1.2	●			
9	CH-Jap	Landis+Gyr	1.1				●
10	EU	Rohde & Schwarz	1.0		●		
11	Jap	Advantest*	0.8	●			
12	Jap	Anritsu	0.7	●	●	●	
13	US	National Instruments	0.6	●		●	
14	Jap	Verigy-Advantest*	0.5	●		●	

Source:DECISION

The global world market for Instrumentation, Measurement & Test equipment amounted to 30.7 billion Euros in 2010, back to its level in 2008 before the 2009 drop. Over the 2010-2015 period, the market is expected to see an average annual growth rate of 5.3%.

The Japanese Yokogawa and the American Agilent are the world leaders on the market place. However, their market share does not exceed 10% of the global market. Agilent got 46% of its 2009 revenue from its bio-analytical and chemical analysis divisions, a market sector (usually known as Analytical Instrumentation) not covered in our survey, and extremely dynamic as is, globally, the life science industry.

AUTOMOTIVE ELECTRONICS

A changing competitive landscape

On the supply side, automotive electronics production is fragmented across automotive equipment suppliers who consider electronics as a major source of innovation and added value. Pure specialist suppliers of automotive electronics are indeed exceptions in the competitive landscape.

Robert Bosch, with a 29.5% revenue growth in 2010, has overtaken Denso to become the world n°1 supplier of automotive electronic solutions. Its successful strategy is based on full vertical integration from electronic component manufacturing (sensors) down to complete system integration (ESP, engine control, etc.).

The major US players (Delphi, Visteon, Lear) have emerged from their restructuring period under Chapter 11 and have benefited from the strong recovery of the car industry in 2010 and 2011. After the 2010 recovery, the Japanese car industry has been severely affected in 2011 by the earthquake and the tsunami. The domestic car production has decreased by 14%, and, as a consequence, the revenue of the Japanese automotive equipment suppliers has decreased too.

In the meantime, although most of the new production capacity in developing regions generally comes from foreign direct investments rather than local companies, new competitors have emerged that are benefiting from massive end-demand growth in these regions.

Top 14 Automotive Equipment Suppliers Sales 2009-2010, in million Euros

	Company		2010 Sales	2009 Sales	Annual Growth
1	EU	Bosch Automotive	28 100	21 700	29.5%
2	Jap	Denso	27 036	22 287	21.3%
3	Jap	Aisin Seiki	19 420	15 754	23.3%
4	US	Magna	18 176	12 449	46.0%
5	EU	Continental (Automotive)	15 917	12 042	32.2%
6	EU	Faurecia	13 796	9 292	48.5%
7	EU	ZF	12 907	9 371	37.7%
8	US	Johnson Controls	12 526	8 614	45.4%
9	US	TRW	10 847	8 325	30.3%
10	US	Delphi	10 420	8 427	23.7%
11	EU	Valeo	9 632	7 499	28.4%
12	US	Lear	7 085	5 601	26.5%
13	US	Visteon	5 523	4 602	20.0%
14	US	Autoliv	5 408	3 671	47.3%
		TOTAL	**196 793**	**149 634**	**31.5%**

Source: Press, company reports

All of the main automotive equipment suppliers have entered the electric vehicle business, from Valeo announcing that it concentrates 2/3 of its R&D investment on electric and hybrid platforms to Bosch who co-invests with Samsung SDI on Li-Ion batteries[6] while maintaining its effort on the optimization of combustion engines.

[6] This agreement between Bosch and Samsung failed in early 2012

Annexe 4: Abbreviations

AC	Alternating Current
ARM	Advanced RISC Machine, processor architecture
ARTEMIS	Joint Technology Initiative on Advanced Research and Technology for Embedded Intelligence and Systems
ASIC	Application Specific Integrated Circuit
ATE	Automatic Test Equipment
CAD	Computer Aided Design: systems used to design products
CAM	Computer Aided Manufacturing: systems used to manufacture products
CATRENE	EUREKA Cluster for Application and Research in Europe on Nano Electronics
Cluster	EUREKA instrument for long-term, strategically significant industrial initiatives
CMOS	Complementary Metal-oxide Semiconductor: technology used in transistors
CMUT	Capacitive Micromachined Ultrasonic Transducer (medical imaging)
CPU	Central Processing Unit
CSP	Content Service Provider
DBG	Data Bus Group
ECG	ElectroCardioGraphy
EEG	ElectroEncephaloGraphy
EEI	Embedded, Enmeshed and Implants systems
ENIAC	Joint Technology Initiative (JTI) on nanoelectronics
EPoSS	European technology Platform on Smart Systems
EUREKA	Intergovernmental initiative promoting research and technological development projects
EURIMUS	EUReka Industrial Initiative for Microsystems USes
eWLB	Embedded Wafer Level Ball Grid Array, packaging technology for integrated circuits
FP7	Seventh Framework Programme (2007-2013)
GaN	Gallium nitride, semiconductor material
GDP	Gross Domestic Product
HVAC	Heating, Ventilation, and Air-Conditioning
IDC	Implantable Cardioverter Defibrillator
ITEA3	EUREKA Cluster on software-intensive systems and services sector
JTI	Joint Technology Initiative
Ka	Microwave bandwidth ranging from 26.5 to 40 GHz
LIDAR	Light Detection And Ranging, optical remote sensing technology
LTCC	Low Temperature Co-fired Ceramic
MCM	Multi Chip Module
MEMS	Micro-Electro-Mechanical Systems
MLCCs	Multi Layer Ceramic Chip capacitors
MOEMS	Micro Opto Electro Mechanical Systems
OEM	Original Equipment Manufacturer
OLED	Organic Light Emitting Diode
PCA	Project Consortium Agreement
PCB	Printed Circuit Board
PIDEA	EUREKA Cluster on Packaging and Interconnection Development for European Applications
Q	Microwave bandwidth ranging from 33 to 50 GHz
R&D&I	Research and Development and Innovation
RF	Radio Frequency
RFID	Radio Frequency IDentification
SaaS	Software As A Service
SiC	Silicon Carbide, wide band gap semiconductor
SiP	System in a Package
SoC	System on a Chip
SoI	Silicon on Insulator
TSV	Through-Silicon Vias, chip packaging
WDoD	Wirefree Die on Die
WLCSP	Wafer Level Chip Scale Package
WVTR	Water Vapor Transmission Rate

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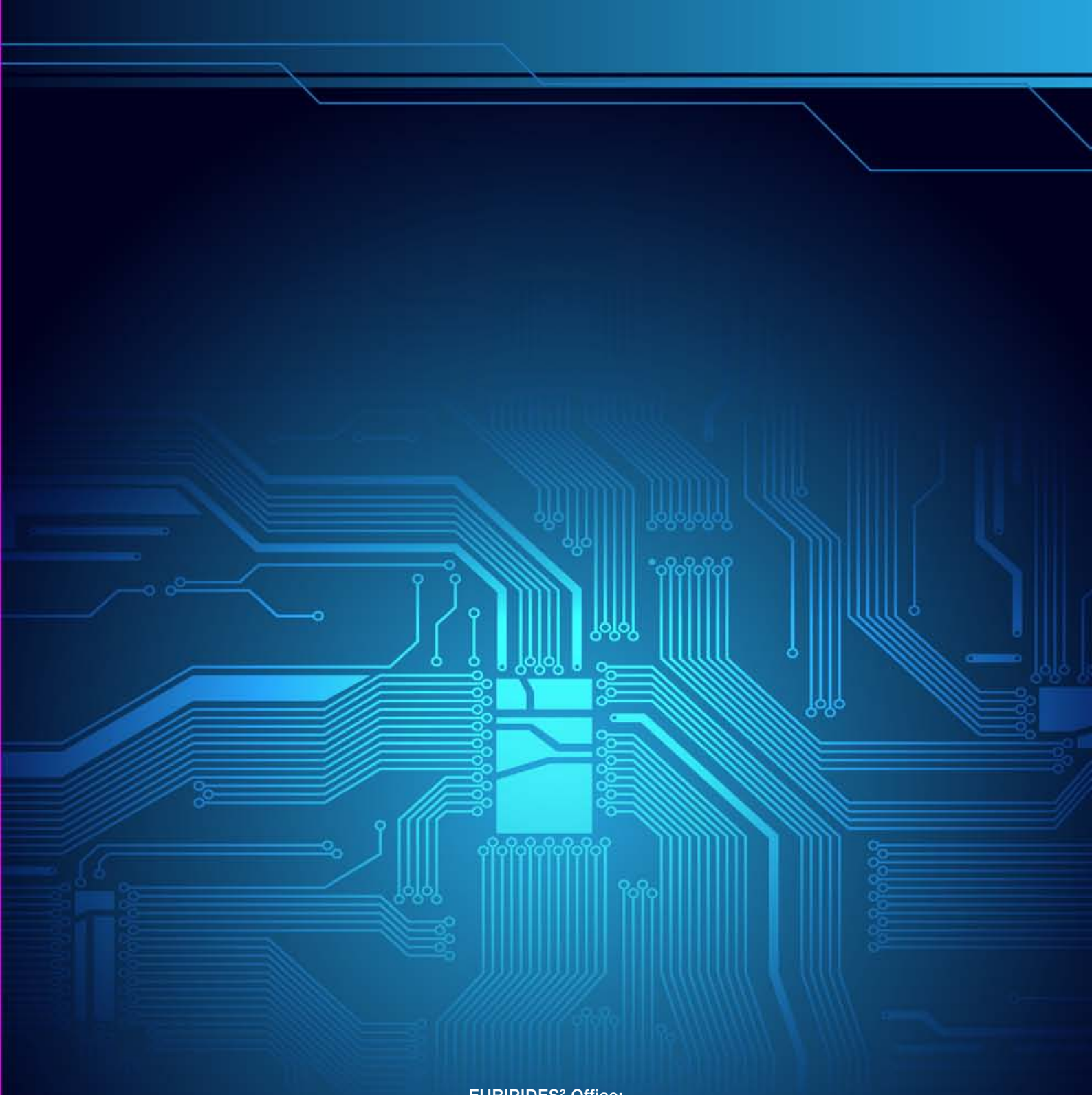

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