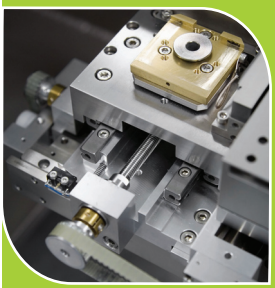
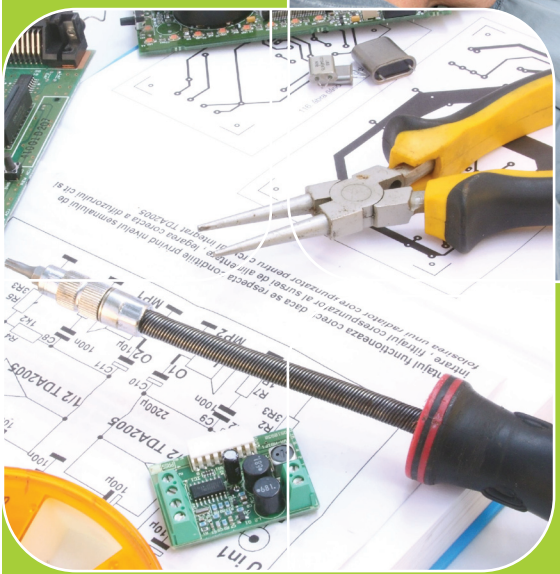
Electro-mechanical engineering

Comprehensive sectoral analysis of emerging competences and economic activities in the European Union





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Electro-mechanical engineering

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Executive Summary

The full study is available under the link
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Preface

Education and training, in the context of a life-long learning perspective, are an indispensable means for promoting adaptability and employability, active citizenship, personal and professional fulfilment.

Investment in human capital through better education, and the development of skills and competences should be increased. It is important to anticipate skills needs — and also skills gaps — which are emerging in the European labour market, as well as to improve the matching of knowledge, skills and competences with the needs of society and the economy, as a means to increased competitiveness and growth, as well as to greater social cohesion, in Europe.

This is more important than ever in the current situation of crisis that will undoubtedly lead to substantial changes in economic activities in Europe coming years.

With this in mind, the Commission has elaborated a set of analysis of emerging competences in 18 sectors. Those analysis are available to all economic, social and professional organisations, educations and training institutions, etc. They can help them to refine their strategies and to engage into forward-looking actions.

Robert Verrue

Director-General, Employment,
Social Affairs and Equal Opportunities DG

Aims and methodology

The renewed Lisbon strategy and European Employment strategy stress the need for Europe to place more emphasis on a better anticipation of skill needs together with the need to reduce labour markets mismatches. These policies aims also at minimising social costs and facilitating adaptation during restructuring processes through a better anticipation and positive management of change. Globalisation, technological change, climate change and demographic developments (including ageing and migration) in that respect pose huge challenges, comprising both risks and opportunities. In that context, the Commission has launched recently the New Skills for New Jobs initiative together with other related European projects aimed at identifying future job and skills needs using quantitative modelling approaches. While having advantages of robustness, stakeholders as well as the European Commission identified a clear need for complementary more qualitative forward-looking analysis. Consequently, the European Commission commissioned in 2007 a series of 18 future-oriented sector studies (horizon 2020) on skills and jobs following a uniform, qualitative methodology. Results of these studies have become available in summer 2009, and will be followed by a number of other initiatives over the oncoming year and beyond. The current economic crisis calls for the reinforcement of policies aimed at developing the employability of the workforce. This project fits within this policy objective.

18 sector studies, one methodology

The results of this study aim to serve as a guide in launching further EU and other actions to promote the strategic management of human resources and to foster stronger synergies between innovation, skills and jobs, taking into account the global context and encouraging adaptations to national and regional level.

To validate, add and complement the findings of the project and to make sure that results are disseminated as broadly as possible across Europe, relevant stakeholders including European social partners, other services from the Commission with the expertise in the sectors analysed, representatives from the European Parliament, the European Economic and Social Committee, the Committee of the Regions, Eurofound and Cedefop were involved in the project from the beginning.

Sectors Covered
Automotive industry
Defence
Textiles, wearing apparel and leather products
Printing and publishing
Chemicals, pharmaceuticals, rubber and plastic products
Non-metallic materials (glass, cement, ceramic…)
Electromechanical engineering
Computer, electronic and optical products
Building of ships and boats
Furniture and others
Electricity, gas, water & waste
Distribution, trade
Hotels, restaurants, catering and related services
Transport
Post and telecommunications
Financial services (bank, insurance and others)
Health and social work
Other services, maintenance and cleaning

A standard predefined methodology was developed by a panel of experts under the direction of Prof Maria João Rodrigues and applied to all 18 studies to ensure consistency and comparability of the results, the studies being produced by different contractors.

Based on the basic methodological framework, each contractor executed 7 defined steps, starting with the mapping of main trends, key drivers of change, leading to scenarios of plausible evolution and their implication for employment at the year 2020 time horizon, the identification of implications for emerging competences and occupation profiles in terms of jobs expanding, transforming or declining, and their implications in terms of strategic choices and subsequent recommendations for companies, education and training systems, social partners and public authorities at all levels. This foresight methodology implies an approach combining desk research and expert knowledge.

At the end of each sector study a final European workshop for the sector was organised by the Commission to validate results as well as refine recommendations. In

addition to European Commission and Eurofound staff, about 20 experts per workshop from industry, academia and sector organisations including workers and employers' representatives with a sound knowledge of jobs and skills were invited to comment and provide recommendations to the report as part of the methodology.

Brief description of the methodological steps

Mapping

The main purpose of this analysis was to provide factual background to identify key drivers used in the subsequent scenario development. Consequently, the Report analysed recent sector developments and trends and, at the same time, depicts the current state of play in the sector with an emphasis on innovation, skills and jobs. It was based on an analysis of available time series data and relevant existing studies. It analysed 1) structural characteristics (production, value added, employment in various dimensions, and related factors); 2) the value chain; 3) technological change and innovation; 4) trade and international competition as well as 5) regulation. The results of all sections were summarised in a SWOT analysis and were used as input to identify key drivers.

Drivers of change

On the basis of the mapping of the sector, a set of key drivers, sector specific or not, was identified. Literature review and expert knowledge of the sector were then used to define a conclusive list of sector-specific drivers. Drivers were classified as exogenous or endogenous depending on the ability for the sector's stakeholders and policymakers to influence them. These lists of drivers were also discussed in the experts' panel workshops.

Qualitative scenarios and implications for employment trends

The set of selected sectoral drivers of change served as an input to develop scenarios for the evolution of the sector and implications for different occupations (composition of employment / emerging competences) in the period 2008 to 2020.

Implications of scenarios and emerging competences

Scenarios were built to assess the implications for the level (absolute

demand) and composition (relative demand compared to other job functions) of employment of different job functions by 2020. New and emergent skills required by different job functions were identified based on the analysis of the evolution of past data on employment by occupation, on the analysis from the present situation and of experts' comments during the workshop. The focus was on identifying and describing key and critical competences for the future for each of the major occupational function in relation to the different scenarios elaborated. These formed the basis for the strategic choices identified in a next step.

Strategic choices for companies to meet emergent competence needs

Each sector study assessed possible strategic choices in terms of feasibility and actor involvement. The options comprised recruiting workers from other sectors, countries, recruiting graduates, re-training employed workers as well as changing work organisation.

Specific implications for education and training

Options to improve or to adapt education and training systems were looked at in this step of the methodology, focussing more particularly on the specific role to be played by sectoral organisations, educational institutions and governments such as a stronger cooperation between stakeholders or an increased flexibility through modularisation of education and training.

Recommendations

Each sector study contains specific recommendations to the sector. However, with the studies analysing Europe as a whole, the recommendations remain general and need a follow-up at the national and regional level. The intention of the project especially in the follow up phase is to use the results to stimulate stakeholders at lower territorial levels (national / regional) to work out results in more details, repeat and adapt this exercise to local needs rather than providing standardised solutions. Some general recommendations call for an intensified co-operation between relevant stakeholders, the need to invest strongly in human capital, more standardised regulations, enhanced VET to increase social mobility and coordinated National and European Vocational Qualifications.

Characteristics and quantitative trends

- The Electro-mechanical sector covers the manufacture of machinery and equipment (NACE 29) and the manufacture of electrical machinery and apparatus (NACE 31). The products manufactured include a wide range of mainly capital goods, including engines, turbines, lifting gear, machinery for various industries, domestic appliances, generators, transformers, switch-gear, batteries, cables and lighting. As such it is very diverse 'sector', linked to many different areas of the economy.

- The sector accounts for 21% of total EU exports of goods to the rest of the world, has a sizable trade surplus with third countries, and has increased its share of global markets for most products, while the US and Japan have lost out to China and the rest of Asia. EU producers account for a third of world exports of machinery and equipment, excluding intra-EU exports, and 18% of exports of electrical equipment.

- The sector is regionally concentrated and accounts for an especially large share of jobs in South-West Germany, Bavaria, Northern Italy and South-East Czech Republic, as well as parts of the new Member States. Large firms are relatively important, especially in electrical equipment, those with over 1,000 employees accounting for 37% of value-added and 33% of jobs.

- The sector is particularly affected by cyclical economic fluctuations, and job losses tend to be large during economic downturns. A shift of labour-intensive sub-sectors and activities from EU15 to EU12, especially in electrical machinery, has resulted in more jobs for machines operators and fewer jobs for skilled workers.

- The sector accounted for close to 3% of total value-added in 2005 and employed some 5.5 million people in the EU - 3.8 million in machinery and equipment and 1.7 million in electrical equipment and apparatus, but employment has tended to decline (Tables 1 and 2). Manual workers, skilled, semi-skilled and unskilled, make up over half the workforce - over 70% in EU12 where more work as machine operators on production lines than in the EU15 (Table 3).

- Within the sector, there is an ongoing shift from manual workers (apart from electricians) to managers, professionals and technicians, including business and finance experts, and engineers and computer programmers. Within all occupations there is a continuing increase in the importance of computer skills and know-how.

Table 1 Value-added: developments in the electro-mechanical sector, 1995-2005

	% total value-added			Percentage point change		
	1995	2000	2005	1995-2000	2000-2005	1995-2005
Machinery and equipment (NACE 29)						
EU27	2.2	2.1	1.9	-0.2	-0.2	-0.3
EU15	2.2	2.1	1.9	-0.2	-0.2	-0.3
New Member States	1.8	2.1	1.9	0.3	-0.2	0.1
Germany	3.3	3.3	3.4	0.0	0.1	0.1
Electrical machinery (NACE 31)						
EU27	na	0.9	0.9	na	0.0	na
EU15	na	0.9	0.9	na	0.0	na
New Member States	na	1.3	1.3	na	0.0	na
Germany	na	1.7	1.9	na	0.2	na

Source: Eurostat, National accounts by branch plus Structural Business Statistics

Table 2 Employment: developments in the electro-mechanical sector, 1995-2005

	numbers (000s)			% change		
	1995	2000	2005	1995-2000	2000-2005	1995-2005
Machinery and equipment (NACE 29)						
EU27	4130	4060	3821	-1.7	-5.9	-7.5
EU15	3102	3138	3034	1.2	-3;3	-2.2
New Member States	1028	922	787	-10.3	-14.6	-23.4
Germany	1159	1119	1063	-3.5	-5.0	-8.3
Electrical machinery (NACE 31)*						
EU27	1679	1804	1692	7.5	-6.2	0.8
EU15	1325	1377	1227	3.9	-10;9	-7.4
New Member States	354	427	465	20.6	8.9	31.3
Germany	649	569	487	-12.3	-14.3	-24.8
Total - Electro-mechancial engineering						
EU27	5809	5864	5513	0.9	-6.0	-5.1
EU15	4427	4515	4261	2.0	-5.6	-3.8
NM12	1382	1349	1252	-2.4	-7;2	-9.4
DE	1808	1688	1550	-6.6	-8.1	-14.2

Source: Eurostat national accounts by branch plus Structural Business Statistics
* Partly estimated

Table 3 Occupational structure of employment, 2007 and over time

	2007 % Total		1999-00 to 2006-07 % point change	
	EU15	NM	EU15	NM
Managers	**8**	**4**	**0.2**	**0.0**
Professionals+technicians	**28**	**19**	**3.2**	**0.0**
Engineers	17	11	1.3	0.3
Computer specialists	2	1	0.3	0.4
Other professionals	9	7	1.7	-0.7
Business, finance, sales	4	2	0.8	0.3
Aministrative+other	5	5	0.9	-1.0
Office workers	**10**	**5**	**-1.3**	**-0.9**
Sales+service workers	**1**	**1**	**0.1**	**-0.3**
Skilled manual workers	**33**	**37**	**-1.5**	**-5.2**
Metal moulders	5	8	-0.3	2.8
Tool makers	6	13	-0.5	-7.2
Mechanics	10	5	-1.3	0.7
Electricians+others	12	11	0.7	-1.4
Semi-skilled workers	**17**	**29**	**-1.2**	**8.4**
Machine operators	16	28	-1.2	9.1
Driver	1	2	0.1	-0.7
Low skilled workers	**5**	**5**	**0.3**	**-2.0**

Source: Labour Force Survey, Eurostat, Alphametrics

Table 4 SWOT Analysis

Strengths	**Opportunities**
The industries and the large European multinationals in them are leaders in global markets	Globalisation and industrialisation of Third World provide new growing markets for European producers
European firms and workforces have a long established reputation for quality	Continued exploitation of technological advances in production techniques
Leading edge technological and organisation advances are revolutionising capacity of industry to meet new customer needs	Growing concern with environmental problems around the world opens up markets where EU companies have competitive edge
Close links between large companies and research and technology centres in many parts of Europe	Leadership in renewable energies provides new markets for EU electrical engineering industries
Strength of European computer engineering and software design gives industry an added advantage as computerisation and digital control systems become more important	Opening up of the EU internal energy market improves competition in electrical engineering and stimulates increased efficiency
Weaknesses	**Threats**
Industries have been badly affected by recessions in the past and are likely to be so again in the future	Lower labour costs threaten a continuing shift eastwards in location of production , including from the new Member States
Lack of close links between companies and research and technology centres in parts of EU	China and others buyers of European capital goods in industrialising could establish their own industries
Ageing workforce means prospective recruitment difficulties when present generation of skilled workers retires	Possibility of deep and prolonged recession certain to damage industry both in short and longer run
No coherent EU-wide strategy on skills and limited mutual recognition of qualifications hindering development of EU-wide labour market for skills	Job losses in the current recession could make it harder to recruit new generations of qualified people, including women
Relatively fewer engineers and scientists graduate from European universities as compared with other parts of the world and little sign of growth	Lack of resources for investment could mean EU industries failing to exploit technological advances
Significant gender imbalances in employment, especially in EU15 with limited sign of change	Sector is heavily concentrated in a few EU regions making them vulnerable to decline

Source: Alphametrics, Ismeri Europa

Qualitative characteristics of the sector

- Value-chains in the sector vary. Closeness to end-users is important for many parts of mechanical engineering (such as component suppliers for automobiles and white goods) and is a major factor behind plant relocations from EU15 to EU12 or Asia. There is less relocation at the 'heavy' end of the electrical engineering sector, although more European companies are establishing facilities in Asia.

- Brand image and intellectual capital are important competitive elements for established companies, and while much imitation is legitimate – best practice, training, technology - theft is a significant concern for European manufacturers, creating some doubts with respect to outsourcing.

- Research and development strategies are difficult to determine in such a diverse industry, with significant developments mainly taking place in large companies, often linked to end-user needs. Electrical engineering may have become complacent given protected national markets, notably regarding energy production, although this could change with market liberalisation.

- Mechanical engineering is more varied than electrical engineering in terms of end-user markets, size of firm, and importance of R&D, with leading-edge innovative companies working next door to traditional firms serving local or niche markets. Many SMEs are also primarily suppliers to larger companies in the value chain.

- Raw materials are important for these industries since companies increasingly provide solutions to customer problems in a range of alternative forms and materials. Energy is a particular concern since the industry is not only a major user of energy, but also a major user of energy-intensive inputs (notably materials).

Drivers of change

Drivers can be characterised as economic, technological and occupational, plus regulation. In general, economic drivers tend to determine the volume of employment in the sector, while other drivers tend to determine the structure and composition of employment.

Economic drivers are largely exogenous in the sense that the industry depends on:

- The rate of European and world economic growth and development
- The geographical location of the end-product producers who generate the demand for the industry's suppliers

Suppliers, and their sub-contractors, often need to locate their facilities close to those of their customers. This works to the advantage of European producers when end-users are European, and may help offset cost disadvantages relative to low-wage economies, but it also encourages the relocation of facilities as domestic markets expand elsewhere, notably in Asia. Exogenous forces that are of particular current concern are:

- The immediate and longer-term impact of the current recession
- Whether China and other Asian countries will develop their capital goods industries in the future in competition with established EU firms and industries.

Output in both sub-sectors is driven by both global and European demand, but the electrical machinery sector is more focused on European markets, and more influenced by national market conditions, which tend, in general, to favour national producers. Liberalisation of the energy production sectors could, therefore, bring significant changes.

The importance of the sector varies considerably between Member States, with differences in structure, organisation and competitiveness (as revealed by trade performance). Hence drivers of change are likely to impact differently on counties, with differing responses.

Currently, changes in the structure of sectors in EU12 appears primarily driven by out-sourcing from the EU15 and changes in product specialisation following enlargement. This is reflected in the expansion of demand for semi-skilled workers and the decline in demand for traditional, apprenticeship-based, engineering skills. However, the sustainability of these activities de-

pends on maintaining competitiveness relative to non-EU suppliers.

Technological and occupational drivers are essentially endogenous and more under the control of the industries and individual firms, although influenced by public policies, for example in relation to R&D. The main explanation of changes in the division of jobs in EU15 appears to be technological changes (notably hybrid technologies changing the producer-consumer relationship) coupled with organisational changes.

This has resulting in reduced demand for traditional manufacturing skills, and increased demand for managers and professionals, plus electricians (computer effect). This influence is expected to persist, but with the pace of change influenced by the fortunes and demands of end users. Table 5 identifies some specific technological and organisational drivers.

The regulatory environment is important, notably given that the sector is a major energy user, and user of energy-intensive inputs such as metals. This could, however, give European firms an early lead in delivering energy-efficient products, with positive consequences clearest for Electrical engineering, but also parts of Mechanical engineering.

The reputations of companies – their innovative capacity, product quality, respect for delivery times, etc - are important determinants of business performance, and changes in perception can have a significant impact on market position. Perversely, this may discourage European producers from competing at the lower end of the European market, leaving it more open to producers from outside the EU.

Intellectual property rights (IPR) - the extent to which company products and brands are respected and protected around the world - represents a competitive advantage for European-based companies and is a significant factor affecting market position. Concerns about protecting intellectual property and know-how may discourage companies from pursuing outsourcing strategies based on cost/quality factors alone.

The current **geographical location** of many production plants and other facilities is well established, but may pose a problem in terms of recruitment of further highly qualified personnel - given the preferences of many young professionals to seek a better work-life balance by locating in more urban environments – and lead to pressure for change.

Table 5 Structural drivers of change in the electro-mechanical industry

Exogenous drivers
• Changes in the global/European distribution of industry through competition • Market liberalisation, notably of EU energy markets • Political priorities on climate change and eco-sustainability
Endogenous drivers
Changes in the relationships between industry producers and consumers, involving: • Technological 'hybridisation' (mechatronics – electronics and mechanics) and increasing 'openness' to innovative methods and processes • Increasing integration of design, technology and management within companies, leading to new production paradigms
The machinery and equipment industry
New model of 'industrial operations'
• Agile and lean production - produce more with less • Just in time, 'kanban' stock control, and logistics systems • Teamwork culture and systems
Total quality
• Operational 'preventive control' systems throughout the industrial process
Diversified production
• Balancing customer 'value' benefits with benefits of mass production
Simultaneous engineering and reduction of time to market
• Enabling the design and product prototyping phases of product development to be carried out in parallel with the development of the equipment to produce them *New drivers* focus on: • Continued focus on integrating design, computer-aided production, new material and new standards of precision – emphasising links with R&D and universities and research centres
The electrical machinery and apparatus industry
Similarities with mechanical engineering sector regarding 'industrial operations' plus: • Pressures for greater standardisation • The development of technologies that can improve the efficiency of processes • Co-design project planning within the factory *New drivers* focus on: • New 'best technologies' investment in energy generation • The need to exploit alternative energy sources – wind, sea, ground etc • The need to support energy consumption reductions – among producers and consumers.

Source: Alphametrics, Ismeri Europa

Emerging skills and competences

Evidence from the period 2000-2007 (see charts below) shows that the **structure of employment** in the electro-mechanical sector is moving towards higher qualified jobs, away from traditional skilled manual jobs. The changes that have occurred in the occupational structure of employment across the EU show both common features and differences as between the two parts of the electro-mechanical sector.

The major trends in the structure of jobs over the period 2000-2007 in the machinery and equipment sector were:

- In the EU15, an expansion in engineers and other professionals as well as in electricians and low skilled workers, coupled with an a reduction in jobs requiring traditional skills – for tool makers, metal moulders and mechanics – as well as in jobs for office staff

- In the new Member States, an expansion in demand for metal moulder and mechanics among skilled workers but a reduction for other skills, as well as for semi-skilled operators, especially for machine operators, coupled with a slight reduction in demand for managers and professionals and a bigger reduction for tool-makers (implying an overall decline in jobs for skilled manual workers)

The differences between EU 15 and EU 12 for the same period were even greater with respect to the electrical equipment industry:

- In the EU 15, expansion of jobs for managers and other professionals, but also for electricians and, to a lesser extent mechanics, coupled with a decline in those for offices workers and, above all, for machine operators

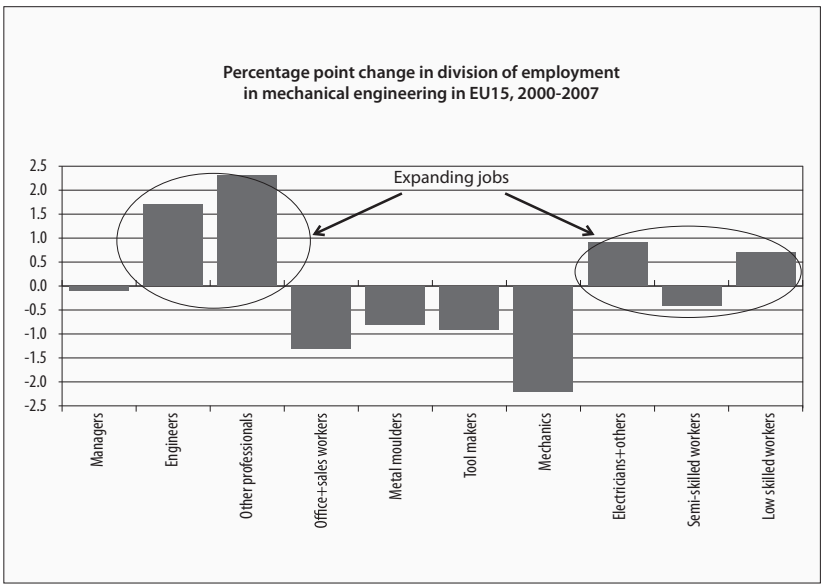
- In the new Member States, some growth in demand for engineers as well as metal moulders, but above all for semi-skilled workers – i.e. for machine operators – combined with a substantial reduction in jobs for skilled workers.

The shift towards jobs for managers and professionals has increased the demand for people with relatively high levels of education, while the shift away from manual and semi-skilled workers has reduced the demand for people with vocational training qualifications. At the same time, there has been an increase in education levels within occupational groups.

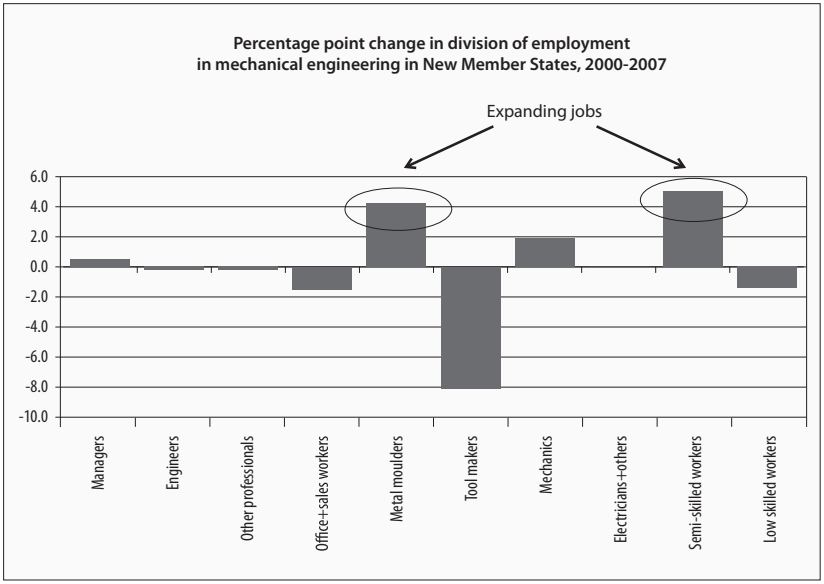
The scale of the overall effect, however, varies across countries. In the case of engineers, 65-70% of those employed in the sector have university degrees or the equivalent in Germany and Finland, but the figures in Italy and Czech Republic are only 15% and 24%.

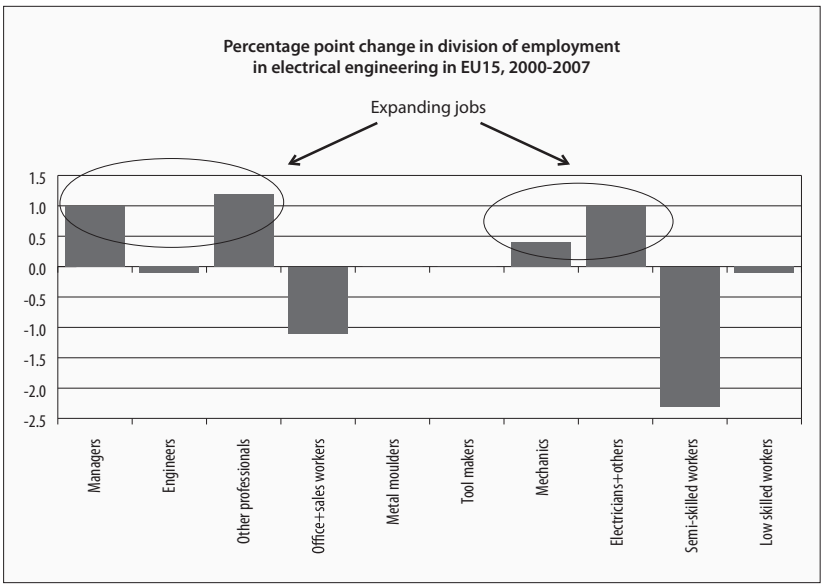
For other professionals, the proportion with tertiary education in the EU15 varies from 66% in Finland and 53% in the UK to 19% in Italy, while in the new Member States, it averaged 57%, though only 28% in the Czech Republic. A similar variation exists for skilled and semi-skilled manual workers.

Changes within occupational groups have also varied across countries, though there are common features. In particular, the proportion of workers with no qualifications beyond basic schooling has declined in recent years in all occupations in nearly all countries, in some cases, markedly, with a general increase in tertiary education in professional jobs.

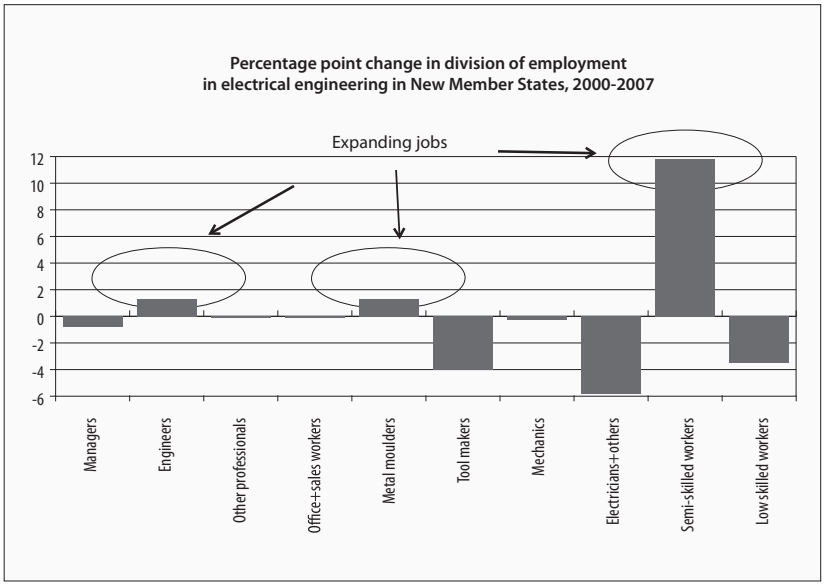


Source: Labour Force Survey, Eurostat, Alphametrics





Source: Labour Force Survey, Eurostat, Alphametrics



Source: Labour Force Survey, Eurostat, Alphametrics

Scenarios and implications for employment

Over the 10 years to 2005, employment in the industry fell as productivity grew faster than value-added. Employment scenarios are based on possible trends in output and the relationship between output and productivity growth, affecting both competitiveness and the demand for employees with different skills and competences.

The study focuses on skill needs in 2020, but the response to short-term developments is also taken into account, given the cyclical nature of the industry. In the 1991-1994 downturn, productivity grew at a particularly high rate and employment fell sharply – by 30% in Germany, 20% in the UK, and 10% in Italy. In the 2001-2003 downturn, on the other hand, the negative impact on employment was softened by a fall in productivity.

The impact of falling output on employment is highly uncertain:

- Will employers - as in 2001-2003 - try to maintain employment levels, and allow productivity to decline?

- Or will they, as in the early 1990s, undertake significant restructuring to maintain productivity growth, resulting in a sharp fall in employment?

In the 'positive' case, employment in **mechanical engineering** could still fall by close to 300,000 and, in the 'high productivity' case, by 450,000 or more (Table 6).

Under similar scenarios, **electrical engineering** is likely to be less affected by the downturn, but still with job losses of between 125,000 and 140,000. This would mean an overall loss in the **electro-mechanical** sector of some 400-600,000 over the next two years.

Scenarios 2010-2020

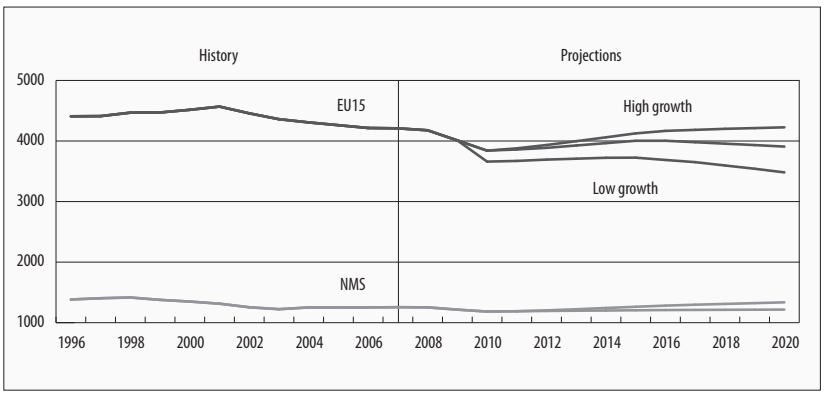
The pace of the **post-downturn recovery** depends on the competitiveness of the industries that emerge, as well as the market conditions they face. Three scenarios have been constructed for 2010 to 2020, with the employment implications set out in Table 6. In these scenarios, the impact of the various drivers of change on employment are, in effect, reflected in the assumptions about (endogenous) changes in productivity growth and (exogenous) changes in economic growth.

The **first scenario** assumes that the EU economy and the electro-mechanical sector continue in much the same way as they did over the past 10-15 years – business as usual. If past trends prevail into the future, little employment growth can be expected in either sub-sector, given the offsetting growth in productivity. The main areas of growth in the EU would be in electrical engineering in the new Member States.

The **second scenario** assumes that the sector achieves higher output due to both a higher rate of growth of the EU economy and increased competitiveness. In terms of employment, however, the positive effect on jobs would be offset by the increased productivity needed to increase competitiveness (more automated and less labour-intensive methods of production, greater use of R&D, improved energy efficiency etc).

The **third scenario** assumes that the sector increases its productivity and competitiveness, as in the second scenario, but that this does not lead to higher sales because of sluggish growth in demand. Under such a scenario, with growth no higher than in the past for example, job losses would continue.

Figure 1 Development of employment in the electro-mechanical engineering sector in alternative scenarios, 1995-2020



Source: Alphametrics based on Eurostat

Table 6 Consequences for employment in the alternative scenarios, 2006-2020

	Projection (1)			Projection (2)		Projection (3)		
	2006-10	2010-20	2006-20	2010-20	2006-20	2006-10	2010-20	2006-20
NACE 29	% change over the period							
EU27	-7.9	1.9	-6.2	10.1	1.3	-12.1	-3;7	-15.4
EU15	-8.3	2.4	-6.1	10.1	0.9	-13.6	-4.8	-17.8
NM12	-6.5	0.0	-6.5	9.9	2.8	-6.5	0.0	-6.5
DE	-9.5	-0.1	-9.6	10.1	-0.4	-13.9	-7.1	-20.0
IT	-3.2	7.6	4.2	7.5	4.1	-11.5	-7.1	-17.8
NACE 31								
EU27	-8.5	2.1	-6.5	12.2	2.7	-9.7	-1;4	-11.0
EU15	-10.3	0.0	-10.3	9.9	-1.4	-12.0	-5.1	-16.5
NM12	-3.8	7.3	3.2	17.8	13.3	-3.8	7.3	3.2
DE	-10.2	-11.2	-20.2	0.0	-10.2	-10.2	-11.2	-20.2
IT	-4.0	0.0	-4.0	4.9	0.8	-13.8	-28.5	-38.4
NACE 29	Change in number employed (000s)							
EU27	-302	67	-235	352	50	-462	-125	-587
EU15	-251	67	-184	279	28	-411	-125	-536
NM12	-51	0	-51	73	22	-51	0	-51
DE	-101	-1	-102	97	-4	-147	-65	-212
IT	-20	47	27	47	26	-74	-40	-114
NACE 31								
EU27	-141	33	-108	186	45	-162	-21	-183
EU15	-123	0	-123	106	-17	-144	-53	-198
NM12	-18	33	15	80	62	-18	33	15
DE	-50	-49	-99	0	-50	-50	-49	-99
IT	-9	0	-9	10	2	-30	-53	-83

Note: Projection (1) is broadly in line with past trends in the two sectors
Projection (2) assumes high growth growth of value-added
Projection (3) assumes the same growth as in (1) but higher productivity growth

Source: Alphametrics based on Eurostat

Implications of scenarios for competences/occupations

In the case of **mechanical engineering**, the relative importance of most jobs for professionals and technicians can be expected to increase up to 2020, at least in EU15 countries, and the relative importance of jobs for manual workers to diminish, excepting electricians (reflecting trends towards computerisation and digital control methods).

In the new Member States some jobs for skilled manual workers in mechanical engineering (metal moulders and mechanics) seem set to increase, along with significant increases for semi-skilled production workers, though long-run prospects are uncertain since the current migration of labour-intensive activities from the EU15 could shift further eastwards.

Changes in the skill structure of employment in **electrical engineering** are similar, though skilled manual jobs in EU15 countries are not expected to decline and could even increase. The shift from semi-skilled workers on production lines could become more pronounced.

Developments in the new Member States in electrical engineering are largely the mirror image of trends in EU15, with a sharp drop in demand for skilled manual workers as jobs in domestic firms are replaced by less-skilled production line work coming from the EU15.

Shifts in the composition, or relative importance, of competences however, do not, in themselves, say anything about **absolute changes in job prospects**. By combining trends in skill structure with projections of total employment, it is possible to indicate the extent to which the **demand for specific skills** is likely to grow or decline in the future (Table 7).

In **mechanical engineering**, demand in EU15 for skilled manual workers (except electricians) is expected to decline significantly up to 2020, even if higher growth in value-added were achieved than in the past. Indeed, if productivity growth were faster than in the past, there would be an absolute fall in demand for all types of skills, unless offset by higher output growth.

The demand for qualified business and administrative professionals, as well as engineers and computer scientists, is likely to be significantly higher in 2020, raising questions about the industry's ability to recruit qualified people in the numbers required in the face of competition from other parts of the economy.

The picture for **electrical engineering** is similar. In the higher productivity scenario, demand for all types of skill in the EU15 would fall between now and 2020. While the prospective demand for highly qualified personnel is less strong than in mechanical engineering, it is still sufficient to create potential recruitment problems.

In terms of age groups, around 25% of engineers in the EU15 and over 30% in the new Member States are aged 50 or over, and the same is true of skilled manual workers in a number of Member States. This could lead to future skill shortages and problems of recruitment if rates of retirement exceed the rate of decline in demand for such skills.

Table 7 Projections of changes in demand for particular occupations, 2007-2020

	% Change in employment									
	EU15			EU12 (NMS)		EU15			EU12 (NMS)	
	(1)	(2)	(3)	(1)	(2)	(1)	(2)	(3)	(1)	(2)
	Mechanical engineering					**Electrical engineering**				
Managers	-8	-1	-19	1	11	5	16	-7	-19	-11
Professionals+technicians	11	20	-8	-8	1	-5	4	-13	9	19
Engineers	6	14	-11	-8	1	-10	-1	-16	15	26
Computer specialists	11	20	-8	25	38	4	15	-7	22	34
Other professionals	21	30	-2	-16	-7	2	12	-9	-3	7
Business, finance, sales	18	27	-3	10	21	12	23	-3	-6	3
Aministrative+other	24	33	0	-29	-22	-9	0	-15	-1	9
Office workers	-23	-18	-28	-21	-13	-24	-17	-25	-4	5
Skilled manual workers	-17	-10	-24	-10	-1	-3	6	-12	-28	-21
Metal moulders	-22	-16	-27	26	38	-7	2	-15	34	47
Tool makers	-22	-16	-27	-40	-34	-8	1	-15	-84	-82
Mechanics	-27	-22	-30	12	24	2	12	-9	-15	-7
Electricians+others	5	13	-11	-6	3	-3	6	-12	-30	-23
Semi-skilled workers	-9	-2	-19	13	24	-21	-14	-23	27	39
Machine operators	-10	-3	-20	18	30	-22	-15	-24	29	42
Drivers	-2	6	-15	-39	-32	-2	12	-9	-20	-12
Other	11	19	-8	-51	-46	-11	-2	-17	-37	-31
Total	**-6**	**1**	**-18**	**-6**	**3**	**0**	**-1**	**-16**	**0**	**12**

Note: (1) Projection assumes past trends continue
(2) Projection assumes higher growth achieved by increased productivity and competitiveness
(3) Projection assumes higher productivity growth without higher output growth

Source: Alphametrics based on Eurostat

Strategic choices and recommendations

The electro-mechanical engineering sector has been highly successful in global markets but it will be badly hit by the current down-turn. Moreover, wide-ranging structural changes – embracing product markets, technological applications, workplace practices, and the regulatory environment (notably climate change and energy) – are affecting the sector.

This will have a major impact on the skills and competence requirements of those employed in the sector, whose performance to 2020 will depend on how the industry, and its sub-sectors, deals with the impact of the recession on its existing workforces, and how well it prepares for the **post-recession environment**.

It will also depend on how regulatory changes at EU level, notably the opening up of energy markets, work to the benefit of EU-based companies, and whether the EU develops specific policies for the sector, or leaves that essentially to Member States specialised in engineering.

The most pressing human resource problems for the electro-mechanical sector are that:

- the industry is **failing to recruit enough of the engineering graduates** who do leave universities with engineering or other appropriate qualifications
- engineering and scientific graduates emerging from university level institutions do not always have the right **combination of skills and competences**
- there are no clear or consistent indications of how the new kinds of **intermediate level technical and practical competences and skills** that are required in a 'post-manual work' workplace should be developed, taught and certified.

The shift in the electro-mechanical sector towards more jobs for **managers and professionals** is increasing the demand for people with relatively **higher levels of education**, while the shift away from manual workers, and semi-skilled workers in particular, reduces the demand for people with **vocational training qualifications**.

Differences in the educational background of professionals working in the sector vary enormously between Member States – only 15% of engineers and 20% of non-engineering professionals in Italy having tertiary level education, compared with over 60% and 40% in France and Germany respectively.

Strategic implications and priorities for national and regional education and training institutions

To **raise the output of engineering and science graduates** by encouraging more people to take the courses concerned (and to work in the sector afterwards)

To **encourage the study of technical and scientific subjects and mathematics** throughout all levels of education, beginning at the earliest possible age

To **work closely with local companies, sector associations and trade unions** to ensure the relevance of courses provided and their content, where these are related to local needs

To contribute to **enhancing the image of engineering and manufacturing** more generally in relation to other fields of study, and to encourage a positive attitude among young people

To develop **managerial skills related to the application of scientific and technical knowledge** for non-technical as well as technical students

To provide more **practical, vocationally-oriented options** as alternatives to more general education programmes of study

Strategic choices for companies

For **EU-based companies**, there are two important **options** concern their markets and their workforces: Do they work to strengthen their positions as global players in their respective markets, or do they retreat and become European, national or regional players? Do they retain existing workforces in anticipation of recovery from recession, or do they aim to attract more graduates and professionals for the post-recession era?

Whatever the impact of the current downturn, companies will need to **develop the qualitative workforce competences** adapted to changing technological, workplace organisation, and market requirements. It is not clear, however, whether new operational approaches (combining modern management techniques with new hybrid technologies) will spread throughout the industry or be limited to certain sub-sectors or large companies.

Companies need to continue to:

- Work together at EU and national level to promote the industry and address concerns about the **image of the sector** and the **attractiveness of the working environments** in order to be able to attract more highly qualified employees, including women, and in order to attract a larger share of university engineering graduates

- Work closely with universities, colleges and schools in their own localities in order to promote greater diversity of **university level qualifications**, so as to develop more hybrid qualifications in engineering and management alongside more highly specialised engineering qualifications, at both graduate and post-graduate levels

- Work closely with regional and local authorities as well as universities and colleges to **promote engineering and science** in schools, and expand arrangements for practical **work experience** for students at all levels

- Support progress towards the Europe-wide **certification of qualifications**, while continuing to work on raising and developing national standards, as part of a wider effort to build new qualifications to match emerging competence needs, including ICT

- Promote the modernisation of **apprenticeship schemes** where appropriate, including in countries where they are absent or under-developed

- Work with local and regional partners (government representatives at all levels and their agencies, employees and trade unions, universities and training agencies, as well as other businesses in the locality and sector) to address **specific local industry and business needs**, including access to, and finance for, training

This is obviously apart from all the other business activities, including R&D, that are designed to raise the competitive capacity of the industry, recognising that the bulk of these activities take place at national and regional level.

Strategic choices for the EU and national governments

For **EU level authorities**, the most basic requirement is to ensure that there is as level as possible a playing field at international and EU level for the industry. However, the EU also faces **options**. Does it:

- Leave national governments to do whatever they wish in support of nationally-based companies within the limits set by EU industrial and competition policy?

- Recognise the strategic importance of the sector for the Union as a whole – providing over 20% of its exports of goods - and take a more pro-active stance in encouraging a more coherent and competitive European industry to develop?

The heavy **regional concentration** of European firms is likely to persist. However, gains from concentration - local networks of suppliers, links with universities and research centres, availability of skilled labour, political support, etc – need to be weighed against risks – vulnerable to job losses in downturns, and possible long-term decline in some sub-sectors.

Also, do the gains from concentration limit the scope for **relocation of production**, or particular parts of the production process, to the **new Member States** and to low costs countries outside the EU? Should relocation be seen as a threat to the continued strength of the sector in the EU or as a means of enabling EU15 firms to focus on **higher value-added market segments** as and until productivity levels in the new Member States catch up?

More generally, are the **prospects of different Member States within the EU** likely to converge or diverge, notably between Germany and other counties, and between EU15 countries and the new Member States? Are the new Member States even at risk of losing large parts of the sector over the next few years as companies seek lower cost locations?

EU-level bodies and authorities address general economic, industrial and environmental policy issues that affect the sector, but much less is said in relation to human resource issues - employment, education and training policy issues. There are three basic explanations:

- The industry embraces a wide **range of diverse sectors and subsectors**, whose interests may well differ significantly one to another.
- National education and training practices are deeply entrenched in **national institutional arrangements**, which are complex, very specific, and subject to only limited influence at EU level.
- The sector's activities are very **unevenly spread across the Union**, further serving as a deterrent or discouragement to common action.

Given the strategic significance of the sector for EU trade, competitiveness, and economic performance overall, there are potential benefits from the development of a more **strategic EU-level approach to the industry**, including the development of a European approach to education and training provision. Given the enormous differences in national systems and provisions that exist, however, the prospect of achieving a progressive convergence of national education and vocational training systems has to be viewed as long-term.

Conclusions

On the basis of extensive statistical and documentary analysis, as well as in-depth discussions with industry experts during the Workshop of 3-4 November 2008 (see list of participants in annex to the main report), the following main conclusions can be drawn:

The electro-mechanical industry is, for the most part, strong, competitive and vital to the health of the EU economy. As a largely capital goods industry, however, it is particularly subject to cyclical fluctuations in the economy, as well as continuing productivity gains. Hence, while the industry is expected to recover without lasting damage from the current economic crisis, employment levels will continue to decline.

The skills of the work force are rising, with a growing demand for highly qualified staff, but there are important differences between Member States, most especially, but not only, between the EU15 and EU12 countries. These differences reflect the nature of the industry in the different countries. The process of acquiring the skills and competencies needed, however, also differs between countries, reflecting the education and training systems in place.

It is important that all actors - businesses, trade unions, governments, educational and training institutions and other agencies - work together, within their existing national contexts, to respond to managerial, technological, market and material developments that are driving changes in competence requirements in these increasingly complex industries.

Even with the development of a European qualifications framework (EQF), the pattern of competence development and skill delivery in this sector will remain essentially national for some time to come, and it is not realistic to attempt to offer detailed, as opposed, to general guidance about the directions in which particular national institutions should develop and adapt.

At the same time, given the extent of common underlying developments as regards technology, organisation and the nature and structure of demand, there is considerable scope and potential for trans-European cooperation in the form of 'mutual learning' and the transfer of 'best practice' regarding changing skill and competence needs and the ways of responding to these. This

could perhaps be based on the 'open method of co-operation' approach developed by the EU for inter-governmental co-operation and exchange of experience as regards employment and social policy.

Where to find more information?

The following information can be found on the Europa website under the address:
http://ec.europa.eu/restructuringandjobs

The other17 sector studies on the analysis of the sector's evolution and future skills needs
The Restructuring in Europe report
The thematic restructuring forums
The checklist and the toolkit on restructuring processes
The training guide for SMEs
The national seminars on restructuring in 27 EU countries
Official documents related to restructuring policies