

An introduction to Mechanical Engineering: Study on the Competitiveness of the EU Mechanical Engineering Industry

Within the Framework Contract of Sectoral Competitiveness Studies – ENTR/06/054

Summary

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1.1 Understanding the project and its objectives

The Study on the Competitiveness of the EU Mechanical Engineering Industry (henceforth ME) has been led by the Munich based Ifo Institute. Cambridge Econometrics and the Dansk Technological Institute have been members of the team. The study was carried out in the context of the framework contract on Sectoral Competitiveness Studies (ENTR/06/054).

The scope of the study is ME, defined as the 2-digit group 28 in NACE Revision 2. To allow for a detailed analysis, a sectoral database had to be created for overall EU ME, ten of its subsectors, and eight selected member states.

The EnginEurope report is the most recent study on ME commissioned by the European Commission. However, the report was concluded just before the financial crisis shattered the global economy. The Terms of Reference (ToR) call for a new study to assess changes in the competitiveness of ME. This study is aimed at contributing to the initiatives of the European Commission to strengthen the performance of the EU ME in international competition. This is in line with the Communication of March 3 2010 on objectives to be reached by 2020¹ and the “Communication on a New Industrial Policy” - published in October 2010 - as a guideline for policy options and recommendations.

1.2 Comparative advantages of EU mechanical engineering

ME as one the EU's major branches

ME is one of the major branches of manufacturing in the EU-27, with a share of around 9.1% of all production in manufacturing industries. As compared to other industries, ME firms are characterized by a relatively high manufacturing depth. This is mainly explained by three factors: predominant small-batch and single-item production, high qualification requirements in manufacturing departments, and large communication requirements between manufacturing, engineering and design departments. As a consequence, the share of ME's value added of total manufacturing is higher than that of production, reaching around 11.5%. The higher share of value added is also reflected in employment that also comes up to a similar share of total manufacturing. (Table 1)

EU ME's growth in productivity is on average much higher than of total EU manufacturing. Only during the financial crisis, when ME was hit harder than other industries, productivity broke down. This is a typical cyclical pattern inherent to the nature of this industry, and output growth was below productivity growth for most of the period under consideration. For ME as well as for total manufacturing, output growth was not sufficient to prevent a reduction of workplaces.

¹¹ European Commission, Europe 2020 – A European strategy for smart, sustainable and inclusive growth, Brussels, March 3 2010.

Table 1: Key figures for EU-27 in Mechanical Engineering

Sector	Indicator	2010		Annual average growth rate in %			
				1995–00	2000–05	2005–08	2008–10
Manufacturing ME ¹⁾	Production, in current prices	bn €	5,885	5.3	2.1	6.7	-5.2
			502	4.0	2.3	10.4	-8.4
Manufacturing ME ¹⁾	Gross value added, in 2010 prices	bn €	1,504.0	2.1	0.0	1.5	-5.2
			157.5	2.4	0.3	6.0	-9.3
Manufacturing ME ¹⁾	Employees	1,000	30,063	-0.6	-1.3	-0.3	-4.8
			2,901	-1.6	-2.2	1.8	-4.8
Manufacturing ME ¹⁾	Productivity ²⁾	1,000 €	50.0	2.7	1.3	1.8	-0.4
			54.3	4.0	2.6	4.1	-4.7

¹⁾ ME = mechanical engineering ²⁾ Value added per capita and annum at 2010 prices.

Source: Eurostat; Cambridge Econometrics; Ifo Institute.

ME is vital for the EU's current account balance

The EU ME is not only one of the most important providers of workplaces within the EU, but contributes also significantly to a sound current account balance of the EU-27. In foreign trade with manufactured goods the EU ME shows a noteworthy deficit. In 2010 the extra-EU exports only amounted to 1343.9 bn € whereas imports reached 1500.6 bn €. For ME however, exports amounted to 200.4 bn € with imports of 81.2 bn €. In 2010 the trade deficit for total manufactured goods had reached 156.7 bn €. Without the surplus created by ME, it would have been more than three quarters higher and would have reached 275.9 bn €. Over the period under consideration, the EU ME's trade surplus had nearly tripled and more than compensated for the growing deficits in trade with manufactured goods. ME has become more important for the EU-27's current account balance.²

1.3 A global heavyweight among major competing economies

The most important competing economies for the EU ME are Japan, China and the US. The EU ME is by far the largest industry as compared to the US and Japan that only came up to 65.4% and 42.0% respectively of the EU ME's value added in 2010. However, the Chinese ME has caught up rapidly over the past decade and – as measured by value added – is on par with the EU (Table 2).

Between 2000 and 2010 the ME's outputs of the US, Japan, and the EU changed with annual average rates of -1.1%, -3.3%, and 1.0% respectively. To a certain extent the relatively favourable development for the EU is caused by stimulating domestic demand. However, trade analysis reveals that the EU also had performed better in international trade.

² Final Report (FR), Table 4.3

ME employment development has been better than manufacturing as a whole

Over the period 2000 – 2010, overall employment for the ME showed a decline with 2.6%, in the US, 3.3% in Japan, and 1.5% in the EU. This development cannot only be attributed to the global economic crisis and the slump in 2009. In fact, employment only grew in the period 2005 up to 2008 in the US as well as the EU. EU ME employment development has been better than for total manufacturing, despite the fact that ME was hit harder by the crisis than most other EU-industries.

The Chinese ME has enjoyed breath-taking growth over the past decade. In 2010 total output had reached 480.6 billion EUR. As measured by the value added, the Chinese ME had already overtaken the EU in 2010, amounting to 102.2% of EU's output level. Between 2000 and 2010 the workforce grew by an annual average rate of 5.8% up to 6.1 million employees, more than double the EU figure.

1.4 Poor performance in price competitiveness

Table 2: Key figures on the economic performance of major competing economies in mechanical engineering

2010 ¹⁾			EU-27	USA % EU		Japan % EU		China % EU	
Output ²⁾	Current prices	bn €	502.1	221.6	44.1	151.9	30.3	480.6	95.7
Value added	Constant prices	bn €	157.5	103.0	65.4	66.2	42.0	161.4	102.5
Employees	Numbers	1,000	2,900.5	1,130	39.0	684.6	23.6	6,113	210.8
Labour productivity	Value added per employee ³⁾	€	54,290	91,125	167.8	96,700	178.1	26,399	48.6
Labour costs	Per employee	€	33,243	39,815	119.8	32,420	97.5	3,700	11.1
Gross operating rate ⁴⁾	Share of value added	%	38.8	56.3	145.2	66.5	171.5	86.0	221.8
Unit-labour costs ⁵⁾	Labour costs per output unit	€/€	0.61	0.44	71.4	0.34	54.8	0.14	22.9

¹⁾ 2010 prices and exchange rates; ²⁾ Turnover /production; ³⁾ At constant prices; ⁴⁾ (Value added-wages)/value added); ⁵⁾ value added at constant prices per 1 € labour costs.

Source: Eurostat; national Statistical bureaus; Cambridge Econometrics; Ifo Institute.

The EU ME-industry faces a major productivity challenge

An investigation in the performance of the major competing economies in ME disclosed large differences in performance (labour productivity defined as value added per employee) that can be taken as an indication for price competitiveness. Japan is in the lead in terms of labour productivity, closely followed by the US. Third in this ranking is the EU-27, but at a much lower level. This could be caused by heterogeneity within the EU-zone, which includes member states with substandard economic performance.

However, intra-EU regional differentiation discloses that none of the member states comes close to the US or Japan. For the EU-countries under investigation, Germany shows the highest labour productivity at a level of around 70,000 €, still more than 20% below the US ME labour productivity (Table 2).

Similar to labour productivity, wages vary among competing economies. The US ME is in the lead, with wages per employee about 20% above the EU average. Despite a much higher labour productivity, Japan's wages are only close to those in the EU. China lags far behind, with wages of 11% of the EU average.

The economic performance and profitability of the ME industries under investigation has been assessed by the gross-operating Rate (GOR) and the unit-labour costs (ULC). The EU is lagging behind its competitors when looking at the GOR - the share of value added that remains to pay for other input factors and profits once labour costs have been deduced. The GORs for the US and Japan exceed the EU by 45% and 72% respectively. The Chinese GOR is more than double as high. For the ULC the picture is quite similar.

The major reason for the poor performance in indicators for price competitiveness of the EU ME lies in the high wages as related to low labour productivity. This poor result is well-known and not limited to ME. Since many years it has raised concerns and led to initiatives taken by the European Commission as well as national governments to catch up to the US lead in productivity.

Resilience during the crisis has improved the EU's ME relative position

The analysis of the economic performance has disclosed that the EU ME's labour productivity grew stronger over the period under investigation than that of the US. The Japanese labour productivity had declined. For the whole period under investigation, EU ME's labour productivity grew at an average yearly rate of 1.5%, whereas the US only reached 0.8%. The EU lead stems from a less dramatic breakdown during the global crisis in 2009. For the period 2000 and 2008 the US was leading the development at an annual rate of 3.5%, whereas the EU ME's labour productivity advanced by 3.2% yearly. (Table 3)

Table 3: Changes in the mechanical engineering's price competitiveness

Sector	Indicator	2010 ¹⁾		Annual average change rate in %		
				2000 – 05	2005-08	2008 - 10
EU-27						
Labour productivity	Value added per capita ²⁾	€	54,290	2.6	4.1	-4.7
Labour costs	Per employee	€	33,243	3.1	3.7	1.9
Gross operating rate ³⁾	Share of value added	%	38.8%	-0.6	0.5	-8.6
Unit-labour costs ⁴⁾	Labour costs per output unit	€/€	0.61	0.5	-0.5	6.9
USA						
Labour productivity	Value added per capita ²⁾	€	91,125	5.5	0.3	-9.3

Sector	Indicator	2010 ¹⁾		Annual average change rate in %		
				2000 – 05	2005-08	2008 - 10
Labour costs	Per employee	€	39,815	3.7	1.8	-8.5
Gross operating rate ³⁾	Share of value added	%	56.3%	1.4	0.1	0.6
Unit-labour costs ⁴⁾	Labour costs per output unit	€/ €	0.44	-1.7	1.5	0.9
Japan						
Labour productivity	Value added per capita ²⁾	€	96,700	1.7	1.6	-6.0
Labour costs	Per employee	€	32,420	0.5	-2.4	-3.0
Gross operating rate ³⁾	Share of value added	%	66.5%	0.1	2.1	-1.5
Unit-labour costs ⁴⁾	Labour costs per output unit	€/ €	0.34	-1.2	-3.9	3.1
China						
Labour productivity	Value added per capita ²⁾	€	26,399	10.2	19.0	9.2
Labour costs	Per employee	€	3,700	16.1	17.6	11.6
Gross operating rate ³⁾	Share of value added	%	86.0%	-0.7	0.2	-0.4
Unit-labour costs ⁴⁾	Labour costs per output unit	€/ €	0.14	5.3	-1.2	2.3
1) 2010 prices and exchange rates; 2) At constant prices; 3) (Value added - wages) / value added; 4) value added at constant prices per 1 € labour costs.						

Source: Eurostat; national Statistical bureaus; Cambridge Econometrics; Ifo Institute.

But increasing labour costs put EU ME's gross operating rates under pressure

Nevertheless, the EU ME wages grew between 2000 and 2010 at an annual rate of 3.0%, much stronger than for the US ME with 0.6%. The gap was caused by different labour market regimes and collective wage contract agreements. Until 2008, wage increases were at a similar pace. During the crisis, US wages per capita fell, whereas EU wages did not stop growing. The EU ME's price competitiveness worsened dramatically and had not fully recovered until mid-2011. The Japanese' price competitiveness had been improved only by shrinking wages per capita. Rigid labour market regulation is considered a threat for industries in a volatile market environment, such as ME.

New member states will face growing competition from China

Chinese ME's labour productivity grew in the period 2000 – 2010 with an average rate of more than 10% per annum, reaching around half the EU-27's level. Current Chinese labour productivity levels are comparable to those in Poland, the Czech Republic and Slovakia, whereas labour costs in these new member states are much higher. This gives Chinese enterprises an edge and challenges these (new) member states that are more focused on production than on R&D, design and marketing. They will therefore experience growing competition from China.

1.5 Impressive performance in international trade

EU ME exports amount to 15% of all exports from manufactured goods

As already mentioned, EU ME contributes to a noteworthy surplus in foreign trade, thereby reducing the large deficit in trade with all other manufactured goods. The extra-EU exports of ME amounted to 200.4 bn € in 2010. This is around 15% of total manufactured goods, a much higher share than ME's weight of total manufacturing's output. This underscores the EU ME's strong dependency of global markets. The EU ME's exports grew at an annual average rate of 5.8% between 2000 and 2010, whereas the exports of non-ME goods only increased at a rate of 5.2%.

Table.4: EU machinery trade with major competing economies important sales markets

Destination	Mechanical engineering EU exports to...			Total manufacturing EU exports to...		
	bn €	Share ¹⁾	Performance ²⁾	bn €	Share ¹⁾	Performance ²⁾
Major competing economies						
USA	27.3	34.2	+	240.3	16.8	-
Japan	4.2	22.0	+	43.8	8.5	-
China	28.0	37.2	+	75.3	10.9	=
Major sales markets						
MENA	17.7	69.2	-	111.9	43.2	-
Russia	14.1	92.7	=	86.3	53.7	=
Turkey	8.1	76.6	+	61.1	43.8	-
South Korea	7.6	41.5	+	27.9	10.3	=
India	7.0	57.3	-	34.8	12.9	-
Brazil	6.9	50.0	+	31.1	22.9	-
Taiwan	4.2	37.4	+	14.7	19.0	+
Australia	4.2	31.9	=	26.7	19.3	=
Canada	3.7	15.2	+	26.5	9.1	=
Mexico	3.6	20.0	+	21.4	9.6	=
Indonesia	1.6	15.0	-	6.4	6.2	-
1) Of the destination country's imports in %; 2) For the period 2000 to 2010 the EU's import share was growing (+), about stable (=), declining (-)						

Source: Eurostat; national statistical bureaus; Cambridge Econometrics; Ifo Institute.

US and Japans' shares in global trade have fallen drastically

The EU's share in global trade with ME products amounted to 37.2%, to a level of 539.0 bn € in 2010, and around 3% above the share in 2000. As compared with the major competing economies, the EU ME has performed very well. This development contrasts to the performance of the US and Japan that lost global trade shares. The US share fell from 25.6 to 17.4% and the Japanese' share fell from 21.3% to 15.6%. Over the period under investigation China was the outstanding winner. Its share in global trades was only 3% in 2000, but it increased up to 13.0% in 2010. The comparison of the EU with its most important competing nations underscores the strength of its ME enterprises – well-established suppliers in the global market – that successfully expanded their trade shares although emerging competitors tapped into the market.

Developed industrial nations can keep up comparative advantage in ME

Although the US and Japan have lost shares in global trade with ME products, ME has remained of outstanding importance in limiting the EU's deficit in foreign trade with non-ME products. Analysis in foreign trade shows that both the US and Japan command comparative advantages in ME by specializing in ME products. It is noteworthy that the US, a country leading in ICT technologies, show comparative advantages in related ME products. By the same token, Japan, a leading economy in ICT technology as well as the automotive industry, also shows comparative advantages in such ME products. This finding supports the assumption that ME is an industry with comparative advantages for developed industrial nations, even in the era of globalization. Indeed, the strong international performance of ME enterprises has turned out to be an asset for the EU in the era of globalization.

1.6 On the leading edge of technology

US and Japans' shares in global trade have fallen drastically – but specialize now

ME is one of the core EU industries, not only by its size but also by its performance in international technological competition. The “innovation intensity”, as measured by the share of innovation expenditure of total sales, shows a strong position of the EU ME as compared with major competing economies in two aspects: The EU ME’s innovation intensity is higher than for its US and Japanese competitors. Moreover, the EU ME’s innovation intensity is higher than the average of all EU industries. For Japan and the US the comparison of ME with their national industries discloses a below average innovation intensity. This is a clear indication for a comparative advantage of the EU ME in international competition on a lead in the state of R&D.

The EU ME is particularly strong in mechanical technologies and material sciences

The EU ME commands an outstanding position in international technology competition, in particular in mechanical technologies. This position is less outstanding in some advanced technologies supplied by upstream industries, above all electronics and optoelectronic components, an area in which the EU had to struggle to catch up the state of the art in the US and Japan. Although the EU has caught up, a certain dependency on deliveries has remained, in particular from Japan.

In material sciences the EU is among the global leaders, be it nano-technologies, carbon-fibre-reinforced polymer (CFRP) etc. In CFRP, the EU commands a strong global position. This can be attributed to know-how in different technologies and the ability of EU companies to co-operate in multidisciplinary projects. In particular, the EU strength in manufacturing technologies provided by ME, for instance by manufacturers of textile machinery, gives the EU an edge over competitors from Japan and the US. A widespread dissemination of CFRP applications beyond aerospace will be strongly dependent on process innovation towards more automation.

1.7 ME as an enabler for a range of other sectors

ME boosts resource efficiency across economic sectors

The supply of ME is not only of importance for all of the manufacturing industries, but also for agriculture, mining, construction and even the service sector. ME has been

characterized as “the enabling industry”. This means that it supplies machinery and equipment as well as process know-how to all its client industries, enabling them to produce their goods and services with an optimized use of input factors at an extraordinary quality. For some time policy makers put much emphasis on resource efficiency to reduce the impact of economic activity on the environment. Resource efficiency has always been a focus of ME. Over the past decade ME companies’ permanent product and process innovations contributed much to CO2 emission avoidance by their clients investing in the latest available technology. This know-how will become an even more persuasive factor in making purchasing decisions when natural resources will become even scarcer.

ME-firms become full-value suppliers

One of the long-term tendencies of ME enterprises has been its specialization on certain market segments and its focus on clients with specific needs. Simultaneously, ME firms strive for an expansion of their product programmes to become full-value suppliers, i.e. to offer all the products and services a client could ask for. This has increased the importance of system engineering and provided a broader focus on product as well as process innovation. The integration of diverse technologies and the co-operation of technicians from different disciplines have been perceived as strengths of the EU ME. These abilities are well-suited to provide EU companies an edge in global competition and growing price pressure.

Beyond system engineering, a range of pre- and after-sales-service are offered by ME enterprises. Most of these services are technical, closely related to physical products delivered to clients. Other services offered to clients go far beyond the technological competency of ME firms, such as the financing of clients’ purchases, the operation of plants and production sites for clients, contracting etc. These services create new business opportunities for ME firms. Even though these services do not present a noteworthy share of total supply in some ME market segments, these services have been offered successfully and have become relevant for the design of new business models. On average, for total ME, the share of services lies between 10% and 15%. Surveys carried out by stakeholders of the industry show that services have been growing stronger than output of physical products.

This development into full-value providers has certain implications on the performance of the EU ME. Firstly, comparative advantages of the EU ME with its qualified staff experienced in cross-disciplinary cooperation and its knowledge in process technology is a unique feature that differentiates the EU ME’s supply from competing emerging economies. Secondly, these services present additional value added and create new workplaces for highly qualified staff. These services are well-suited to compensate to a certain extent for relocation-driven losses of low-value added production. Thirdly, even totally new business areas can be accessed such as Build-Own-Transfer (BOT) and contracting. Fourthly, these new business areas are less dependent on the highly volatile investment cycles, therefore reducing the cyclicity of ME’s business activity.

1.8 Structural changes and value chains

Strong ties with upstream and downstream industries have both pro's and con's

ME is not only characterized by an intra-industrial but also by an inter-industrial division of labour. Upstream linkages to metal industries, electrical engineering, the electronics industry etc. ask for a good industrial infrastructure as a prerequisite for a competitive ME. It is a less “mobile” industry than for instance ICT, with its longstanding tradition of global production networks for the exploitation of low-wage supply. ME has always exploited the advantages of the broad industrial infrastructure in Europe. This has not changed even though global networks have been created to build on comparative advantages in other regions and to improve access to remote markets.

Likewise, downstream linkages are also important for the competitiveness of ME. Close ties to client industries and their specific needs have contributed to the EU ME as a global leader in manufacturing technologies. But loss of capacity, such as in the production of textiles and clothes in Europe, has also led to a loss in related global dominance and technology and production for the concerned ME manufacturers.

Since the late 1980s ME has evolved from less integrated national industries towards a pan-European ME industry. The transition and economic integration of the new member states economies has to a large part been concluded. However, the integration of the EU ME and its cohesion has been challenged by volatile macroeconomic developments in certain (southern) member states throughout the past decade. The financial and subsequent public finance crisis have brought the problems to light. Concerned member states' ME industries have suffered losses of competitiveness.

A consolidation of the EU ME industry has taken place

ME is an industry characterised by smaller family owned companies. The typical firm size is between 500 and 2,000 employees. Most of them do not fall under the EU SME definition (up to 200 employees).

Over the past decades a consolidation has taken place in the EU ME. Companies have merged or have been taken over by others. Medium-sized groups have been created that exist beside the typical medium-sized, family held and independent companies. These groups' advantages lie in the combination of smaller firms' flexibility with larger firms' potential to access global sales markets and to carry out larger research projects. Moreover, they can allocate the necessary resources to shoulder the increasing administrative burden by requests from clients and growing regulation. This development has strengthened the competitiveness of the EU ME in an era of globalization and larger markets.

The free circulation of products in the Single Market has tightened competitive pressure on smaller manufacturing firms that have been specializing in niche markets. Market shares are taken over by larger competitors that try to fully exploit their growth potential within the EU. In some of these market segments the very small industrial enterprises will have to put to test their business models and to decide if they can further run own manufacturing facilities. Better opportunities could be provided in the handicraft market, where services such as the installation, maintenance and repair of machinery require

regional proximity to clients, as for instance in the market for heating, ventilation and air conditioning.

The value chains within the EU ME have been adjusted to the opportunities provided by globalization. Suppliers within a value chain feel growing competition in bidding processes from non-EU competitors. More and more clients ask for a price/performance-ratio based on international tender procedures. If suppliers cannot meet the requirements, they have to relocate or to quit their role in a value chain. There are examples where clients support their suppliers to relocate or follow suit to overseas locations. Such initiatives can be of mutual interest and strengthen the EU ME.

In some areas, the tendency is that client companies focus their business activities on system integration. This provides opportunities for suppliers to become subsystem manufacturers and integrators. Companies that can allocate the necessary technological and financial resources will benefit from this development if they can build on sufficient management know-how. These companies are less exposed to international price competition than those with a lack of resources.

Asian suppliers can help the EU ME industry to remain competitive

Asia has become an important region for the EU ME. Production locations owned by EU firms and Asian manufacturers have become an integral part of the EU ME value chain. Asian deliveries consist above all of large batch, medium-tech products, whereas in Europe small batch production and customization as a share of total output grows. This division of labour between Asia and Europe provides European manufacturers with opportunities to remain price competitive in medium-tech serial production. They do not leave market segments that – not by margins – but by volume are of crucial strategic importance and could otherwise be used as a gateway by emerging competitors. Competitors from low-wage countries could more easily enter machinery markets and cause cut-throat competition by permanent upgrading. EU ME firms use locations in low-wage countries outside the EU to control the lower end of their product programme abroad and in the domestic market.

The on-going structural change of the EU ME in the face of increasing globalization is driven by a specialization on comparative advantages. Workplaces have been lost in low-value added areas and new opportunities have been created for more qualified labour. All in all, the competitiveness of the EU ME as compared to the USA and Japan can be evaluated as being strong with regard to the employment record and the performance in international trade. However, losses in low-wage labour have not been fully compensated by new opportunities. In particular, production locations in the new member states are endangered by competition from Asia. The comparatively rigid labour markets and collective wage agreement systems could contribute to a less dynamic structural adjustment of the EU ME to global needs.

1.9 Prospects are bright

1.9.1 Economic growth potential

The ME's future growth potential is assessed on the basis of projections for the EU-27, the US, Japan, and the BRIC countries by IMF's World Economic Outlook for the medium-term and from Goldman Sachs for the long-term. The growth momentum of the BRIC countries, above all China, will cause a shift of economic activity away from Europe to Asia.

Total production for ME of the seven analysed countries and the EU-27 will grow from 527 bn € in 2010 to 928 bn € in 2025, equalling an annual average rate of 3.8%. Even though all individual countries and the EU-27 are able to grow, China will be clearly dominating the world output of mechanical engineering products by 2025.

However, this growth scenario derives the development of the ME sector only from domestic GDP development and does not consider the special importance of trade for this sector. For the EU-27, around 40% of growth in ME can be accounted for by trade-induced demand. Therefore a second 'trade-adjusted' scenario is derived in which 60% of the growth is generated domestically, whereas the remainder is generated by increased demand of the world market. Using this second scenario, the EU-27 would be able to achieve a market size of 232 bn € by 2025, compared to the predicted market size of 204.7 bn € stemming from the base scenario.

Table 5: Expected development of mechanical engineering output by selected countries (trade-adjusted scenario)

	Value added in bn € ¹⁾					
	2000	2005	2010	2015 ¹⁾	2020 ³⁾	2025 ³⁾
Brazil	11.0	13.2	14.2	18.8	22.6	27.2
China	28.2	58.4	161.4	248.0	329.4	410.1
India	6.3	8.4	12.8	19.3	26.0	34.4
Japan	89.7	96.2	66.2	75.4	81.0	86.3
Russia	9.8	10.8	12.1	14.9	17.6	20.8
USA	123.7	124.5	103.0	115.5	129.7	144.9
EU-27	158.0	160.8	157.5	178.3	193.2	204.7
EU-27 with trade				183.5	208.4	232.0

¹⁾ 2010 prices and exchange rates; ²⁾ Based on GDP forecasts from IMF; ³⁾ Based on GDP forecasts from Goldman Sachs

Source: Own calculations.

In the long run, growth rates in other BRIC countries may well exceed those of China

When looking at expected growth rates, a more diverse picture arises. Although China is clearly leading in growth rates from 2000-15, those from other BRIC countries will become similar or even higher in the period thereafter. Japan, the US and the EU-27 are expected to have significantly lower growth rates throughout the whole period of analysis. Growth rates for the EU-27 differ between the baseline scenario and the scenario including trade by around 1%.

Table 6 Projected growth rates in mechanical engineering (trade-adjusted scenario)

	Annual average growth rate in %				
	2000-05	2005-10	2010-15 ¹⁾	2015-20 ¹⁾²⁾	2020-25 ²⁾
Brazil	3.8	1.4	5.8	3.8	3.7
China	15.7	22.5	9.0	5.8	4.5
India	6.0	8.7	8.7	6.1	5.7
Japan	1.4	-7.2	2.6	1.4	1.3
Russia	1.9	2.2	4.3	3.4	3.4
USA	0.1	-3.7	2.3	2.4	2.2
EU-27	0.3	-0.4	2.5	1.6	1.2
EU-27 with trade			3.1	2.6	2.2

¹⁾ Based on GDP forecasts from IMF; ²⁾ Based on GDP forecasts from Goldman Sachs

Source: Own calculations.

1.9.2 Productivity development

The long-term trend in productivity development – a prerequisite to longer term competitiveness - suggests a stable growth rate. Actual developments fit together very well with the long-term trend from 1995 to 2008. Average annual growth rates in productivity are 2.0% and 3.5% for manufacturing and ME respectively. As these growth rates have been very stable for more than a decade in the pre-crisis period, it is assumed that productivity will continue to grow at these growth rates after the recovery from the crisis.

Using these growth rates, EU-27 productivity can be expected to significantly grow throughout the forecasted period until 2020. Labour productivity in mechanical engineering is expected to reach 67,400 € in 2015, up from 54,300 € in 2010. By 2020 EU-27 labour productivity has the potential to go up to 79,900 €³

1.9.3 Employment implications

Having formed expectations about growth of the ME sector and about developments in labour productivity allows through triangulation to form expectations about development in employment. Such projections are made by multiplying existing employment with growth projections of gross value added and dividing by growth projections of productivity. As expected, GVA growth rates in the EU-27 manufacturing sector are consistently below the expected increase in productivity, declining employment is

³ All productivity measures are reported in constant 2010 Euro per employee.

expected. Projected ME employment is expected to shrink to 2.8 mln employees in 2015 and to 2.5 mln employees in 2020, which represents a significant decline compared to the 2.9 mln employees in 2010. Considering the more optimistic EU-27 growth scenario that includes trade-induced growth, reductions in employment level would be more moderate: 2015 employment would be 2.9 mln and in 2020 2.7 mln people would be employed in mechanical engineering.

Strong success on global markets are needed for securing jobs....

Even though the mechanical engineering sector is expected to achieve consistent absolute growth in the following years, this growth is probably not strong enough to more than compensate growth in labour productivity, leading to a net loss in employment. The evolution of EU ME must be valued against the background that domestic demand is expected to be dampened for several years by urgent measures to overcome the public debt and private banking crisis. Without success on global markets and stimulation by emerging economies' growth, the ME's perspectives would be worse.

1.9.4 Conclusions

.... and strong success means above all further penetration in emerging markets

Both of these paths of development highlight the importance of ME's global alignment. Strong growth can only be generated if EU companies are successful in emerging economies' markets. These countries do not only provide opportunities for growth but also for the exploitation of scale effects, a decisive factor for the companies' long-term competitiveness. The EU ME's success in foreign markets throughout the past decade was impressive and underscores that companies do have the products needed for the industrialization of emerging economies. They are on the leading edge of technology and have always been leader in the supply of resource efficient processes. In this respect, the EU ME is not only an enabling industry in the domestic market but also in global markets. The success in the latter markets will be decisive and require a strong focus on third countries' needs in products systems and services.

In the trade-adjusted scenario, the prospects for the EU ME are better than for total EU-27 GDP. The growth momentum for the period under consideration is higher. However, due to the wealth creating of noteworthy increases in labour productivity some losses in the labour market cannot be avoided.

Climate change-related challenges provide important opportunities for the ME

Promising areas, such as resource- and energy-efficient products and technologies, technologies to fight climate change, etc. can add positive effects to the evolution of the EU ME that commands a leading position in international markets. However, public schemes – dedicated to support technical progress in these areas – will only provide noteworthy additional growth stimuli if they take into account international markets with their specific needs.

The success of Chinese manufacturers of solar cells in Europe highlights the necessity not only to become a technology leader. Simultaneously, it is necessary to trust in companies with the potential and the ability to raise the means necessary to pursue global strategies. Moreover, in contested markets it is extremely important for companies to supply budget-

priced products. This means that resource-efficiency is only one criterion. In the case of CO2 emissions, for instance, foreign clients' decisions will strongly be dependent on the level of CO2 avoidance costs. R&D efforts should be directed more on products and processes that are most efficient with regard to CO2 avoidance.

1.10 Recommendations

1.10.1 Organisation and industry structure

Only well-designed Cluster policies can provide solutions on how to better integrate SMEs in value chains

During the past decades, ME went through phases of consolidation. Larger companies and groups of companies have emerged through mergers and acquisitions. However, ME has remained an industry with predominantly medium-sized, frequently family-owned enterprises. These firms are the backbone of the EU ME. SMEs – up to the threshold defined by the EU – are not the predominant representatives of ME. Many SMEs face growing competitive pressures from EU and non-EU manufacturers that are about to gain additional market shares in the Single Market.

It is recommended that **SMEs** suffering from growing competitive pressure put their business model to test. There might be possibilities to extend the supply of service. Beyond maintenance, repair and overhaul even the installation and operation of trade products should be taken into account instead of own production. For instance, more sophisticated heating and air conditioning equipment provides additional opportunities for SMEs to enter new market segments which are more service driven.

It is recommended to **public authorities** who pursue cluster policies to find solutions how to integrate SMEs in value chains. However, there exists a major risk that industrial structures – non-competitive in the era of globalization - are preserved and must be subsidised permanently. An indispensable prerequisite for successful cluster policies lies in the existence of at least one enterprise with management abilities and financial resources to become a subsystem supplier. On the one hand, such an enterprise must be perceived as a reliable and risk-taking supplier by potential clients. On the other hand, such an enterprise must be willing and able to co-ordinate the subcontracting of regional SMEs.

EU ME companies are encouraged to focus more on non-price features and to become subsystem suppliers

ME is marked by a sophisticated division of labour. In the era of globalization the regional coverage of value chains has been permanently expanded. EU companies as members of former stable value chains have been increasingly confronted with potential competitors from other member states or even non-EU countries in bidding processes to apply for a subcontract. International price competition is a challenge for most EU companies. Non-price arguments such as flexibility, quality, know-how, just-in-time deliveries support successful biddings. But it is questionable if these arguments remain valid in the long-run with growing international competition.

It is recommended that **EU enterprises** as members of value chains try to change their business model and become subsystem suppliers. Opportunities are provided by larger client companies that show increasing interest in outsourcing parts of their own production. Simultaneously they want to employ only a limited number of suppliers. These subsystem suppliers become responsible for

several subcontractors, coordinate work, guarantee quality and timely deliveries. This provides opportunities to reduce price pressure and to win contracts. Other award criteria, such as the competency to provide sophisticated systems, access to cost-efficient subcontractors, management abilities and a stable, long-term reliable supply relationship gain much importance for companies with production sites in the EU.

Suppliers in value chains are vulnerable to price competition. Within the EU – even within the new member states – wages are high as compared to global levels and labour contracts are rigid.

It is recommended that **EU enterprises** with domestic locations strengthen their position with their clients by putting more emphasis on non-price features. An important factor for success on competition is based on life-cycle involvement. OEMs increasingly ask for the delivery of spare parts, coverage of guarantees and services throughout the whole product life cycle and; therefore valuing their suppliers based on viability and long-term reliability. OEMs themselves are more and more confronted by requests of their clients to provide services throughout the whole life-cycle.

Going global has become an important topic in strategic decision making. One obstacle lies in close ties to subcontractors that do not wish or cannot allocate the necessary resources and take the risks to follow suit and invest in remote production locations.

It is recommended that **EU enterprises** that are about to invest in remote markets try to convince and support their traditional subcontractors to follow suit as the selection of new subcontractors implies large risks. Well-known good quality suppliers should be lent a hand to stay in the value chain. In some member states good experiences have been made with trustful co-operations along the value chain. The willingness of suppliers to take the risks is strongly dependent on mutual trust and esteem.

A call for stable framework conditions – also for upstream suppliers

ME is an industry that builds its strengths above all on know-how and qualified labour. Energy input is a minor problem. However, ME is strongly dependent on upstream linkages and deliveries from energy-intensive industries, primarily steelworks, foundries etc. Beneficial framework conditions for these industries provide likewise advantages for ME. Moreover, in the area of new materials, cheap energy supply is an issue for location decisions on the set-up of production sites. In particular CFRP is a material that is valued as promising for application in many areas of ME, however, its production is energy-intensive and electricity prices play an outstanding role. In contrast to steelworks that had been set-up in Europe a long-time ago and cannot easily be dismantled and relocated, the investment in CFRP production sites can take full advantage of international price differentials. This has led already to investment in the US by European enterprises whose R&D efforts have been strongly supported by public funds from within the EU.

It is recommended that the **EU Commission** and **national governments** take into account the long-term effects of high energy prices for the attractiveness of the EU as a location for production. The non-relocation of already existing energy intense production sites is strongly linked to their high capital intensity and is not an indication for their long-term viability. These locations will be run as long as possible, otherwise the former investment had to be depreciated at once and treated as sunk costs. In contrast, investment in new production capacities will be based on an international comparison of framework conditions. In particular, locations for the production of new materials - of major importance

for the innovativeness of ME – will be affected by high energy prices. This will turn out to the detriment of the EU ME.

1.10.2 Market regulation

The EU has been fairly successful in market regulation and the abolition of barriers to trade. A focal point highlighted by representatives of the industry is market surveillance. Although only recently revised, market surveillance has turned out to be rather insufficient.

It is recommended that the **EU Commission** reviews Directive 765/2008. A more adequate solution is required, based on the same institutional incorporation in all member states and equipped with a staff satisfying by qualification and by capacity. Representatives of the industry have suggested market surveillance at border crossings. This would be perhaps be the most efficient solution to identify non-complying imports. Feasibility should be investigated (See: Chapter 5.1.2).

Public policies directed towards health, safety, resource-efficiency, and environmental protection are of general importance for a long-term sustainable economy and society. The corresponding directives are implemented in a way that national provisions can ask for even stricter rules. Moreover, national authorities sometimes use different criteria, for instance in assessing the safety of a workplace. In these policy areas, some barriers to trade have not been and cannot be abolished by legislative intent. It is therefore crucial to create stable and reliable framework conditions.

It is recommended that the **EU Commission** takes a cautious stance with the introduction and review of directives and closely communicates with stakeholders of the industry. It is suggested to avoid unnecessary changes of provisions and to agree upon a time span between changes. This time span must take into account the companies' efforts to find a technical solution for their products to comply with the latest provision (See: Chapter 5.1.8).

Take into account the limited capacity of SMEs to come to grips with new regulations

In particular smaller firms struggle to meet regulatory requirements. The preceding recommendation on long-term stable and reliable framework conditions is especially relevant for smaller firms. A good example for taking into account smaller firms' difficulties is given by waste gas provisions for internal combustion engines. For engines that are manufactured in smaller units per year the introduction of stricter rules was delayed. This gave smaller firms the opportunity to learn from experiences of larger companies.

It is recommended that the **EU Commission** takes into account potential problems of smaller enterprises with new regulation. For instance, smaller enterprises do not have the internal expertise to comply with the RoHS Directive and have to purchase external know-how. Timely information and a sufficient time horizon for the implementation are crucial prerequisites to adapt to coming provisions.

It is recommended that **industry associations** give a hand to smaller enterprises to comply with provisions. Associations provide services to their members. Associations can pool expertise that can be accessed by members at an affordable price (See: Chapter 5.1.9).

Voluntary agreements as a powerful policy tool

Self-imposed obligations (or self-regulatory initiatives, SRI) can become important tools by policy makers to pursue political objectives. Such procedures incorporate several advantages, such as the identification of enterprises with regulation and the opportunity to suggest solutions with regard to their scope of action.

It is recommended that the **EU Commission** is open towards self-imposed obligations and suggests the **European Sectoral Committees** to prepare proposals together with national associations and companies. (See: Chapter 5.1.7).

It has been reported that the EU Commission is open to CECIMO's initiatives to suggest such a SRI. However, European Sectoral Committees and industry associations do not have experience with that kind of policy tool and hesitate to apply it as the framework for policy development. Furthermore, the implementation of SRIs is not well defined.

It is recommended that the **EU Commission** takes self-imposed obligations seriously and provides a reasonable base to allow the industry to find and implement suitable solutions via SRIs.

In the area of technical regulations, the EU is a model for others with regard to its openness to international co-operations and its close contact with international organisations. However, in the area of mobile machinery the Commission pursues a different strategy even though EU-companies have been busy to develop internationally agreed standards together with UN-ECE and the OECD.

It is recommended that the **EU Commission** reviews its current position on this subject

1.10.3 Financial markets

A need to incite investors to fund ME companies, especially in the area of R&D

The European financial markets are not sufficiently developed as compared to the US. Banks have always played an outstanding role in enterprise funding. This is in particular true for medium-sized ME enterprises. Close linkages to banks have been beneficial in former times. Due to the banking crisis, it has become more urgent to exploit new funding channels.

It is recommended that **EU companies** – even smaller ones – become more transparent for financial players and be open to new funding channels. They should make publicly available reports on their business activity and outlook. This is understood as a preliminary step to make the company better known to potential investors.

It is recommended that **industry associations** inform the business press on a regular basis on business climate and expectations. An exchange of views between financial institutions and member companies should be arranged.

Large R&D projects and the production of pilot scale models to carry out feasibility studies on new products require long-term funding – something which has always been scarce in the EU. The situation has become even worse since the financial crisis. The

propensity of banks to fund companies has reduced. There is also a need for the strengthening of the European venture capital market.

It is recommended that the **EU Commission** and national **governments** introduce framework conditions that incite financial investors to fund manufacturing companies, with special attention to R&D activities. As financial actors have gained more interest in accessing borrowing companies directly, without a mediating bank, an improvement of framework conditions for direct innovation financing is valued as a promising opportunity.

The EU has made many efforts to ease funding for smaller enterprises. Much information has been circulated by the Commission.

It is recommended that **industry associations** use their close contact to member firms to a targeted spread of information.

1.10.4 Labour market

Despite many initiatives, labour mobility remains limited in the EU

One detriment of the EU labour market as compared to competing nations is less labour mobility caused by social, cultural and linguistic differences between Member States. In combination with the demographic development, bottlenecks in labour supply must be expected. Despite the Bologna process, cross-border flexibility of qualified staff has remained limited.

To better understand the present and future human resource situation, supply of and demand for skilled labour should be regularly monitored. The investigation in the labour market has unveiled that reliable statistics are scarce.

A need for better labour market responses to cyclical fluctuations

Another challenge for the EU labour market has been identified when analysing the recent time series on the economic performance in ME. The slump of output and the low capacity utilization caused by the financial crisis had no measurable impact on the increase of wages per capita for EU ME, in contrast to the US and Japan where wages decreased. The rigidity in collective wage agreements has led to a worsening economic performance and reduced price competitiveness against competing economies.

It is recommended that **industry associations** and trade unions find solutions to better comply with cyclical fluctuations of business activity that hurt ME from time to time. This is an important topic for ME as it is more affected by fluctuations than most other industries. Such a solution will contribute to the will of companies not to lay off qualified personnel during a crisis that will be urgently needed during the following recovery.

ME needs to compete on the labour market with well-known and large automobile and aerospace brands

As other manufacturing industries, ME suffers from reduced attractiveness of the manufacturing sector in general and technical professions in particular. Moreover, ME is a medium-sized industry that competes with the automotive industry and the aerospace industry to attract young professionals qualified for occupations in metal working industries. Not only wage levels, but well-known brand names give such transport equipment companies an edge.

It is recommended that **companies** and **industry associations** start image campaigns. Much focus should be laid on societal topics of major importance. ME is an industry of outstanding importance for sustainability, energy savings, CO2 abatement, and reduction of waste. This knowledge is not widespread and could attract young professionals that do not only want to protest against climate change but become an active environmentalist.

Attracting engineers in the future: more attention to the female workforce needed

Engineers have always been the backbone of the industry. Their share of total employment has strongly grown over the decades. Beyond the better than average development of workplaces for engineers in ME, demography contributes to the urgent need of the industry. Engineers are the drivers of important changes in the ME's product programme towards more sophisticated machinery, production systems and industrial services.

It is recommended that **companies** intensify their efforts to co-operate with universities, start job exchanges and try to become more visible in the public.

ME has remained a male domain and it is recommended that **companies** try to attract more women. **Public authorities** should contribute with horizontal measures to improve the infrastructure for childcare. In particular large companies have the potential to provide an attractive environment for women.

It is recommended to national and regional **governments** to improve working conditions in MINT disciplines at universities and to already give more room to natural sciences education already at the primary and secondary level.

A need for formal educational pathways

The combination of qualified labour on different levels is an important requirement for a competitive enterprise. Top qualifications have always been in the focus. However, medium qualifications sometimes present a bottleneck as well. Problems have been identified with qualified technicians such as machine operators, toolmakers, service personnel etc. The demand in member states that do not offer apprenticeship or similar curricula is most urgent.

It is recommended that **companies** and their **association** take initiatives supported by their governments to introduce formal educational pathways that can help to fill a gap in labour qualification that gains more and more importance for an industry that provides increasingly sophisticated machinery and technical service to clients.

1.10.5 Innovation environment

Growing constraints in public funding ask for more efficient R&D schemes. ME is an industry with a global reach and contributes much to the reduction of the EU-27 trade balance deficit. ME's growth potential is largely dependent on its access to large remote markets. Its products are urgently needed for the industrialisation of emerging economies. As a consequence, R&D should put more emphasis on enforcing ME's competitiveness in sales markets beyond the EU.

It is recommended that the **EU Commission** investigates in advantages provided by R&D locations and framework conditions outside the EU, in particular in research-intensive emerging economies that

attract business R&D from EU firms (see: Chapter 4.6.3). Special attention should be paid to Japan. Since long the economy is in the doldrums, but R&D efforts have remained on top of the OECD countries. Moreover, its share of private enterprises is well above that of other developed economies. The needs of global markets have always been in the focus of Japanese R&D efforts (see: Chapter 3.1.2). Such a stance could contribute to further improve EU ME's position in global markets. In particular with regard to the long-term prospects for the EU and the global economy as a whole it is quite important to continue past successes of ME in international trade in the future (Chapter 6.3).

Focus R&D support to focused and promising areas

Three areas of technology have been identified to be of outstanding importance for ME: Research on power generation, material sciences (in particular CFRP) and manufacturing technologies.

It is recommended that the **EU Commission** puts much emphasis on technological progress in these areas. Funds should be concentrated on projects most promising for strengthening competitiveness.

Promote investment in those technologies with lowest CO₂ abatement costs

ME is the key industry to meet the targets to become a low-carbon economy. All kinds of power generation technologies are based on its products. A broad range of technologies for low-carbon power generation and the use of renewables are available. However, not only progress in these technologies is challenging and expensive, but also the installation and operation needs a lot of subsidies to provide incentives for private businesses to invest. Capital intensity is much higher than for conventional power plants. Due to the public debt crisis and its long-term impact on public expenditure a more efficient allocation of financial resources is needed to maintain the ability to meet the EU's self-imposed targets on CO₂ avoidance.

It is recommended that the **EU Commission** puts much emphasis on those technologies with the lowest CO₂ abatement costs. A ranking of technologies by this criterion and an assessment on future savings and the economic breakeven should guide decisions on the distribution research projects and budgets. This will contribute to a most efficient use of scarce funds. The societal payback periods can be reduced. Above all technologies based on low CO₂ abatement costs will be attractive for clients from emerging economies and contribute to the EU ME's long-term success.

All economies under consideration compete on technological leadership in the same high-tech areas. In particular the US and the EU economies suffer from growing constraints that limit their public research budgets.

It is recommended that the **EU Commission** puts much emphasis on those technologies with the highest potential to become a global leader. A more focused approach that takes into account the EU-27's comparative advantages and the EU as a competitive location for production can provide two positive effects. Firstly, such a strategy raises the possibility for a unique position in technological competition. Secondly, the transmission of a leading position in advanced technologies feeds through to positive effects on workplaces in manufacturing.

1.10.6 Access to third markets

Bilateral trade talks with partners strategic for ME

The stalling of the multilateral WTO negotiations challenges the future success of the EU ME in international markets.

It is recommended that the **EU Commission** takes the initiative to reopen the proceedings.

The European Commission has successfully pursued the arrangement of bilateral treaties with numerous countries and contributed to the success of EU ME in international markets.

It is recommended that the **EU Commission** strategically identifies countries that are of special interest as valued by market size and growth potential. Those economies with few conflicting interest as for instance agricultural products should be selected for further bilateral trade negotiations.

Beyond strategic initiatives it is of importance to monitor the compliance of all players in bilateral trade with trade agreements. It is a problem if players that do not comply with provisions of an agreement do not have to take consequences.

It is recommended that the **EU Commission** introduces the possibility of sanctions against misbehaviour that can be put in force without delay.

In transatlantic trade, there are close contacts between public authorities to reduce trade barriers. In contrast to the EU market a major problem to access the US market exists by non-harmonization of provisions. Different requirements are set from state to state.

It is recommended that the **EU Commission** puts more emphasis on these internal problems of the US market.

Although China has become a member of the WTO in 2001 and incorporated most of the requirements of the World Intellectual Property Organization (WIPO) into national law much remains to be done for fair competition.

It is recommended that the **EU Commission** pursues a strict strategy to incite China to introduce all institutions and provisions to abolish the yet existing deficiencies in the protection of IPR.

It is recommended that the **EU Commission** closely monitors Chinese industrial policies and FDI restrictions to check if they are in line with WTO agreements.