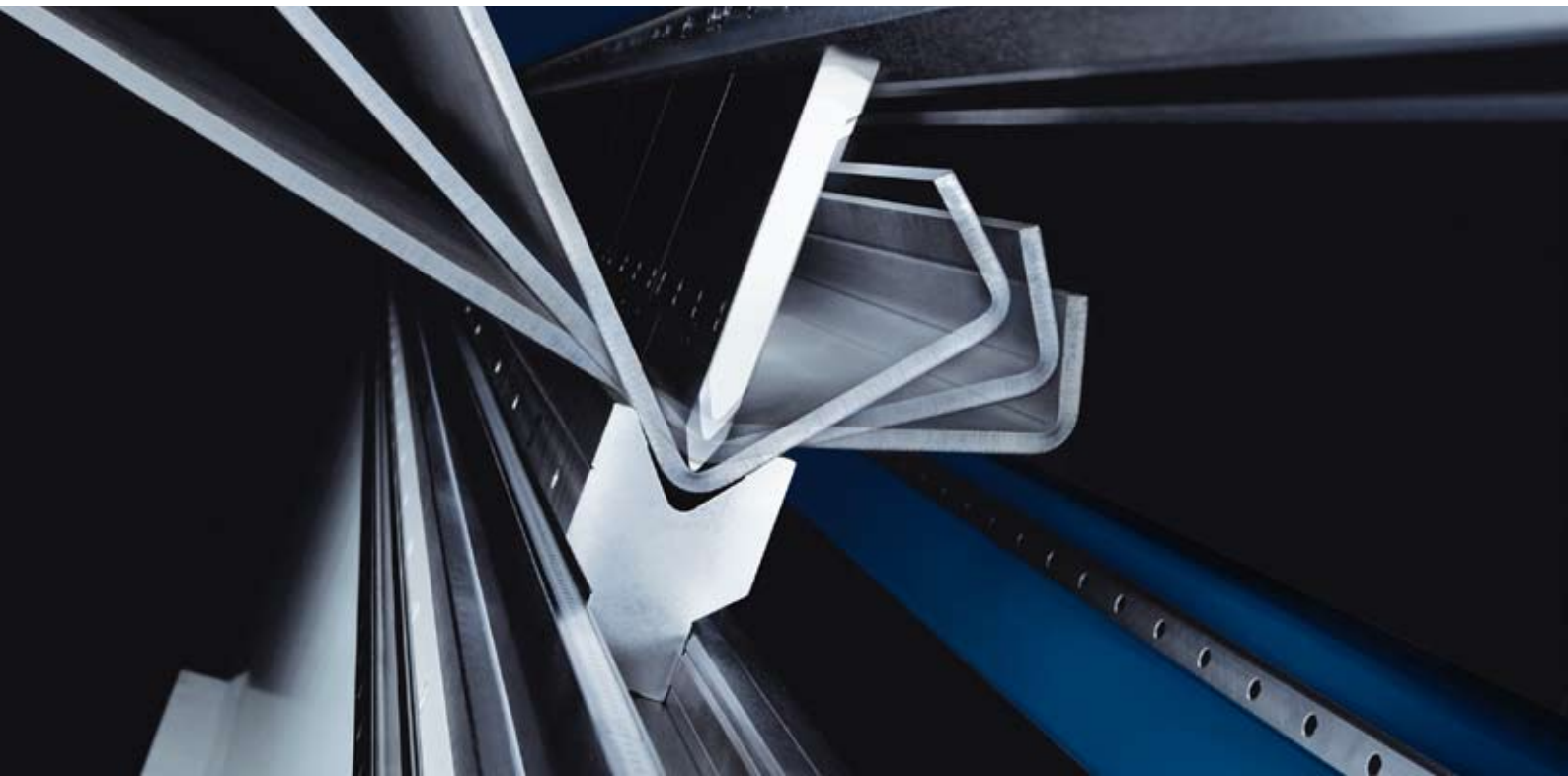


Study on

COMPETITIVENESS OF THE EUROPEAN MACHINE TOOL INDUSTRY



Where manufacturing begins



CECIMO
December 2011

CECIMO study on the competitiveness of the European machine tool industry

CECIMO would like to pay tribute to Mr. Michael Hauser, who held the Presidency of CECIMO between fall 2010 and 2011, for his invaluable services to the European machine tool industry, and his great contribution to the making of this report.

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Thanks to Alexandrine Gauvin and Magdalena Garczynska

CECIMO, November 2011, Brussels

Dear reader,

There are many lessons that we have learned from the recent economic downturn. We have discovered that manufacturing is the core of the economy which creates real economic and societal value. The financial system, which was designed to serve the manufacturers, grew far larger than the real economy, but this has proved to be a balloon which did not create any benefits that trickle down to society and the economy on the whole. The financial markets' balloon exploded in one night with devastating consequences on the western economies, particularly on their manufacturing industries, which had a detrimental impact on almost the entire society.

FOREWORD

Western economies have intensively invested in financial services over the last decades and today, without any surprise, they are the ones which suffer the most from the consequences of the global economic meltdown. Asian economies which placed, on the contrary, the manufacturing industry at the heart of their economic development strategy, now enjoy high economic growth rates. They look into the future with hope as their manufacturing industry climbs up the value chain to reach the level of developed economies, even surpassing it.

As the golden years of the financial services industry come to an end, the manufacturing industry is back on the rise. Only manufacturing can help create the solutions that live up to global societal challenges such as climate change, resource efficiency and ageing population. Jobs created by manufacturing do not vanish over night.

This does not suggest, however, totally abandoning the financial services sectors which are a fundamental element of the European economy. However, the financial system must serve, first and foremost, the real economy. We need to create the right economic mix to achieve sustainable economic growth. Manufacturing has the answers to most of the challenges we are faced with today. We should take a new look at manufacturing, because it offers full potential to reboot our economy and to create new jobs.

Manufacturing has been overlooked for some years, but not totally abandoned in Europe. In some other developed Western countries, decades of off-shoring have left their manufacturing industry without the means to create the next generation of high-tech products that are key to rebuilding their economy. Once the manufacturing base is lost, it never comes back. Europe is in a more fortunate position as we still have world-competitive manufacturing industries that build on a long-standing engineering expertise, unique performance and a highly skilled workforce. Now, it is time to re-mobilize our strategic assets and resources to build the future European economy.

The report that you are holding in your hands is a voluntary initiative of the European machine tool industry represented by CECIMO. As you will read throughout the report, you will see that the machine tool industry is one of the key assets of Europe. It is a key enabling industry. I would like to thank the members of the CECIMO Sherpa Group and the CECIMO Secretariat for their valuable work in the preparation of this study. I hope that this document will be a valuable guide for European decision-makers which strive to make the right policy decisions for the future of European citizens. We also hope that industrialists will reflect on this document and initiate or endorse necessary actions in the right time.

Michael Hauser, CECIMO President



This study is a voluntary initiative of the European machine tool industry. CECIMO made use of numerous tools to complete the study, such as questionnaires, conference calls and face-to-face discussions with European machine tool manufacturers.

It builds mainly on the contributions of the CECIMO Sherpa Group for the Study on the Competitiveness of the European Machine Tool Industry and internal sectoral knowledge which has been honed within CECIMO, the unique global representative of the European machine tool sector for over 60 years.

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Introduction

The machine tool industry is one of the most globally competitive sectors in Europe. Europe generates more than one third of the world machine tool production and half of world exports originate from Europe. You may be asking to yourself: "What do all these figures mean and why are machine tools so important? What does it mean for Europe to have the world's largest and state-of-the-art machine tool production base?". Another question which may arise in your mind is: "What is the point of writing about the competitiveness of a European industry which is already world competitive?"

The answer of the first questions is simple. Look around you and count one by one which objects you see in your environment. Computers, mobile phones, watches, cars, trains, planes. Then think of the objects which you do not see in your daily life, but which make your life easy and comfortable: wind turbines and solar panels that generate carbon-free energy to power your houses and devices, medical implants which improve the quality of life for people with health problems, satellites that enable us to communicate faster and cheaper, construction machinery used to make buildings, bridges and skyscrapers... If you wonder how these objects are made, they are made thanks to machine tools. Machine tools are the main driving force of the industrialization of a country or a region. They are the cornerstone of economic development and progress. We owe to machine tools the modern industry which produces the goods that are an indispensable part of our everyday life.

What is the motivation for writing this report? It is true that Europe is the world's largest manufacturer of machine tools and the industry's technology leader. However, this position has been seriously challenged recently. The emergence of Asian countries as global economic powers and their keen interest in developing their local manufacturing base has fueled their motivation to invest in the development of their domestic machine tool industry. There is no industrialization and there is no economic progress without machine tools. Developing a strong machine tool industry allows a nation or a region to take control of its own economic development. As a consequence, a new group of large and strong machine tools companies have come out of developing countries. Furthermore, the break-out of the global economic crisis was a slump on European machine tool builders as the order intake collapsed. Europe has, since then, lost its significance as a market for machine tools. The emerging Asian economies which rose out of the crisis stronger than Europe continued to increase their machine tool consumption as they ramped up their investments in large infrastructure projects.

Europe is now faced with a two-fold challenge. Firstly, the shift of machine tool consumption to other regions of the world which are too far to reach for some European SMEs. Secondly, companies from emerging countries which receive strong support from their governments and which enjoy an impressively large domestic market are challenging European exporters in their home markets. Therefore, this study aims to analyze the new global industrial trends and to provide insight on how they are likely to affect the European machine tool industry.

Furthermore, it discusses how industry and public-decision makers should react to these changes and new challenges to help maintain a sound competitive machine tool manufacturing base in Europe.

The creeping economic growth in Europe and the grand societal challenges which we are faced with show us one single direction to go to maintain the wealth that we have enjoyed so far in Europe: we need to rebuild our economy and our industry to get the economic machinery running again and to produce new products and services that provide significant savings in natural resources and energy. We need to be endowed with the right tools to rebuild our economy; in other words, we need to master the advanced production technologies. Mastering advanced production technologies, such as machine tools, enables Europe to be the first to translate new ideas into market products and services. Machine tools, as such, qualify as a strategic key enabling sector which underpin the productivity and competitiveness of virtually all manufacturing industries.

As Europe seeks for ways to revitalize its economy and to build a viable future for new generations, this study aims at reminding of a strategic asset that we possess and that we need to care for. The recommendations in this report should be seen as a roadmap for Europe not only to stop the declining role of the European machine tool industry in the world, but also to help maintain and further develop this strategic sector. Europe cannot afford losing the machine tool industry and become dependent on other countries' willingness to share advanced production technology, something which has happened with many other advanced sectors.

We have all the elements available in Europe to unleash the full growth potential of the machine tool industry. We have a large Internal Market which is home to five hundred million people; we have world-class technical universities and research centers, and a highly skilled workforce. All we need to do to tap the full potential of our assets is to coordinate action at European level. Only coordinated action can help us use our limited strategic resources effectively and to ensure the competitiveness of the European economy in an era of globalization. That also explains the reason why this study has a strong European dimension and focus.

Filip Geerts, CECIMO Director General

I. The strategic importance of machine tools for Europe



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a) History and evolution

WHAT IS A MACHINE TOOL?

A machine tool is a stationary power-driven machine which is used to cut or form parts made of metal and other materials as wood, ceramics or stone. The definition adopted by CECIMO for metal working machine tools is as follows: "A metal working machine tool is a power driven, not portable by hand, powered by an external source of energy, designed specifically for metal working either by cutting, forming, physico-chemical processing, or a combination of these techniques." This definition is widely accepted by the sector and is used for the biggest European machine tool exhibition, EMO. Machine tools are known as 'mother machines' and they enable the production of all other machines including themselves.

MACHINE TOOLS IN HISTORY

The sketch of a lathe drawn by Leonardo da Vinci's in the 15th century is thought to be one of the first examples of wheel-driven lathes in history. Later on, in the 18th century, machine tools played a key role in the Industrial Revolution and for the growth of industry. The canon-boring machine invented in the 18th century was used for boring large-diameter cylinders on early steam engines which were fundamental to the Industrial Revolution which started in Great Britain. Machine tools have been vital for modern manufacturing as they enabled

the mass production of standard high precision parts and components. With the development of measurement techniques, standardized parts produced by machine tools could become fully interchangeable all over the world.

Machine tools were a catalyst for the Industrial Revolution which broke out in Britain in the 18th century.

The Numerical Control (NC) machines were developed in the late 1940s and 1950s by linking computers to production machinery, which led to the automation of machine tools. This was followed by the introduction of computerized numerical control (CNC) machines in the 1960s, which utilized digital controls technology and computers to control the movements of the machines for performing the metal working process. CNC machines reduced the human interaction required in different steps of machining process. Moreover, they have removed the need for manual work to make complicated mathematical calculations required to produce shapes with high complexity and accuracy.

The computerization of metal working technologies continued by the introduction of computer-aided design (CAD) and computer-aided manufacturing (CAM) software which shortened the period between the design and production process and

provide efficiency gains in material consumption. Today, modern CNC machines are fully-automated sophisticated metal working tools controlled by computers and they combine different types of machine tools to produce even more complicated parts required by modern technology. These are called machining centers and represent the state-of-the-art technology in metal working.

Machine tools have had a direct impact on cost reduction, set-up and lead times, quality improvement and productivity. As such, the machine tool industry is the backbone of modern manufacturing; the prime mover of progress; and is the cornerstone of economic development. Today, machine tools have a wide range of applications in major industries of the economy ranging from automotive to aerospace, energy generation, mechanical construction and medical engineering.

Machine tools have had a direct impact on cost reduction, set-up and lead times, quality improvement and productivity.

b) The machine tool industry as a key enabling sector

The machine tool industry is a sub-sector of the mechanical engineering industry. Machine tools have a strategic place within the industry as they enable the production of all other industrial equipment and machinery which are covered by mechanical engineering. Machine tools are at the origin of almost any manufacturing process which includes metal. Most of the objects that one can see in his/her environment, from cars to planes, from wind turbines to satellites, and from watches to computers and to mobile phones are made thanks to machine tools.

The machine tool industry, as such, is fundamental to the productivity and the competitiveness of the entire European manufacturing base. Europe has the world's largest machine tool manufacturing base. Machine tools endowed with the state-of-the-art technology are shipped to countries all around the world and contribute to the industrialisation of countries.

ENABLING SECTOR

Machine tools *transfer production expertise* to other manufacturing segments. Companies supplying machine tools often join forces with their customers to work on developing new solutions for better production systems according to market requirements. Therefore, the presence of a strong machine tool industry in Europe is key to triggering innovative production technologies which enhance European industry's ability to develop and produce new products and services. There is no progress without enabling technology.

KNOWLEDGE-INTENSIVE

Machine tool industry is a knowledge- and technology-intensive sector with high R&D intensity. The EU 2010 Industrial R&D scorecard placed the EU industrial engineering and machinery industry in the medium-to-high intensity category with an R&D intensity of 3.1%.¹ R&D intensity is defined as the ratio of R&D investment to net sales. Building machine tools require a deep understanding and knowledge of mechanical engineering, hydraulics, process knowledge, software engineering, precision engineering design, kinematics and other disciplines. The machine tool knowledge base builds on a multidisciplinary scientific legacy and engineering know-how, therefore it cannot be easily acquired or copied by others.

Machine tools enable to transfer the latest technological developments in information and communication technologies or material sciences into production systems, which allow to increase the efficiency of the production process and to machine new materials which are used later in new fields of application. Those who master the engineering expertise in production technologies benefit also from first mover advantages in the development of future products and processes.

THE GUARANTEE OF A COMPETITIVE EUROPEAN MANUFACTURING BASE

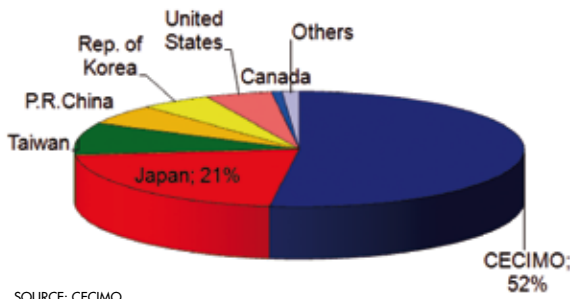
The machine tool industry is the backbone of European manufacturing and European leadership in metal working technologies is a key asset to build the competitive European industry of the 21st century. European machine tools meet the needs of customer industries for higher efficiency, speed and precision. They help reduce set-up time and lead time; optimize material use; minimize costs and improve the overall quality of final products. Major European industries such as automotive, aerospace, energy and transport vehicles rely on first-mover advantages provided by machine tool builders based in Europe, to ensure their global competitiveness.

Machine tool industry is a key enabling sector which boosts Europe's ability to produce new products and services.

STRONG EXPORT-ORIENTATION

The rapid industrialization process in emerging countries in Asia and South America is accompanied by high growth in industrial output in automotive, components, electronics and electrical sectors as well as increased investments in energy and transport infrastructure. These countries rely on imports to acquire the high-tech and productive machine tools. Europe is the leading machine tool exporter of the world. 79% of the European machine tool production is exported. European exports account for 52% of world exports (See Figure 1). There is a lot of untapped market potential in overseas markets. Europe holds a strategic asset that every industrializing country is in need of. European machine tool exports are poised to grow much further, which will help the European economy reboot and create jobs.

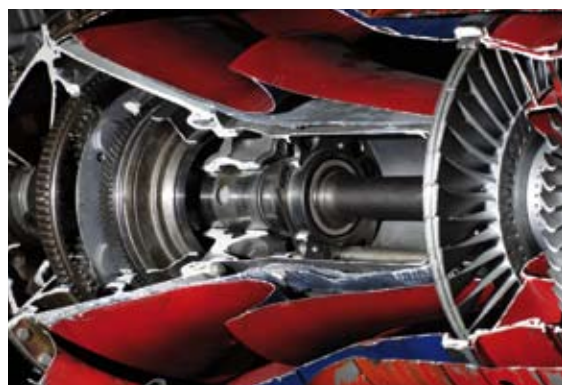
FIGURE 1: CECIMO SHARE IN WORLD EXPORTS



SOURCE: CECIMO

MACHINE TOOLS HELP EUROPE TACKLE GRAND SOCIETAL CHALLENGES

The machine tool industry is an important contributor to tackling *grand societal challenges* of the 21st century such as climate change, resource efficiency, ageing society and sustainable mobility.



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Both advances on the machine tools themselves (such as productivity, environmental performance) and advances in the processing technologies (such as higher precision and accuracy, processing new materials) have an impact on Europe's ability to live up to mega challenges of the 21st century. Some examples are depicted below.

Machine tools which are operated in European factories help customer industries achieve greater *resource efficiency*. Advances in production technology are poised to provide downstream industries with significant gains in material and energy consumption. Moreover, machine tool builders are key suppliers of production technology for building renewable energy generation plants and for retrofitting the existing conventional energy plants. Solar, wind, geothermal, hydraulic energy industries rely entirely on components produced by machine tools to build robust and safe power plants. Machine tools will play a key role in enabling Europe to build up the cutting-edge infrastructure required for the transition to low carbon energy sources.

Machine tools are a key contributor to *sustainable mobility*. 21st century society needs faster and safer transport solutions with the lowest impact on environment. Aviation, aerospace, automotive and rail vehicle industries will need to improve their environmental performance significantly to live up to this challenge. Machine tools are used on almost every stage of the manufacturing process of means of transportation, from the production of simplest parts to increasingly sophisticated and high precision components (engine turbines, bearings etc) which have a remarkable impact on the energy savings potential of transport vehicles. Railway vehicles, shipbuilding, aerospace industries achieve significant progress in weight reduction by replacing the materials they use in building vehicles and/or ships with new materials which are light and robust. They rely entirely on processing technologies provided by machine tools to process the new materials and use them in new products.



An *ageing population* will seriously challenge the European labour market and it will have important social and economic consequences in the future. Progress in the medical instruments industry will play an essential role in ensuring a better quality of life for European citizens. Implants and medical devices are produced thanks to advances in ultra precision machining technologies. Machine tools contribute to raising standards of living and they help lower health-care costs. Moreover, advances in machine tools will facilitate work in factories for an ageing workforce. Cognitive capabilities, improved human-machine interaction and increased automation will play a key role to this end.



Tackling grand challenges

New challenges force each of us to shift to new life styles and habits. This calls for the development of new products and services. Advances in production technologies will enable Europe to produce new products efficiently and cost-effectively. Machine tools will play a fundamental role in tackling grand societal challenges including resource efficiency, sustainable mobility and ageing population.

II. General characteristics of the European machine tool industry



The European machine tool industry is characterized by its family-owned SME-dominated landscape, strong concentration on flexible and small-batch production of custom-built and high-precision machines, and the export orientation of companies. The production is spread over a wide geographical area, but is mainly concentrated in traditionally strong industrial centers such as South Germany, Northern Italy, Switzerland, Austria and the Basque country in Spain.

Europe has traditionally maintained the world leadership in technology and market share, which has made it the world's main supplier of manufacturing equipment and technology. The number of employees working for the sector may not be significant, however, the key enabling role of machine tools puts the workforce employed in the industry in a strategic position. Being a knowledge and technology intensive sector, the machine tool industry relies on a strong supply chain, a sound research base and an education system which is able to provide highly skilled engineers.

a) Production and employment

Countries represented under the umbrella of CECIMO generate more than 90% of production in Europe*. These countries include EU Member

States Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Italy, Portugal, Sweden, the Netherlands and UK, but also Turkey and Switzerland. The scope of the machine tool industry, as it is represented within CECIMO, comprises metal working which includes metal cutting, metal forming and electro-discharge machining (NACE 28.41).

DISTRIBUTION OF PRODUCTION AND EMPLOYMENT WITHIN THE EU

In 2010, the production of machine tools in Europe* accounted to 16.6 billion Euros and was stable compared to 2009, but significantly lower than 24.4 billion Euros posted in record 2008. The production of the sector is highly concentrated in Germany and Italy, which account together for two thirds of 2010's output. The other significant producers with share in the total output higher than 3% are Switzerland, Austria and Spain. (See table 1)

There were almost one hundred fifty thousands of employees working in nearly one thousand five hundred machine tool producing companies across Europe at the end of 2010. The structure of employment in the European machine tool industry reflects the share in the production. However, in some countries, especially in the Czech Republic the number of employees per unit of production exceeded substantially the mean value.

* Europe = EU27 + EFTA + Turkey

TABLE 1: MAJOR MACHINE TOOL PRODUCING COUNTRIES IN EUROPE

| Country | Share in production in 2010 | Share in employment in 2010 |
|-------------|-----------------------------|-----------------------------|
| GERMANY | 43.5% | 44.8% |
| ITALY | 23.0% | 20.1% |
| SWITZERLAND | 11.0% | 7.7% |
| AUSTRIA | 3.9% | 2.0% |
| SPAIN | 3.8% | 3.4% |
| TURKEY | 2.6% | 3.5% |
| FRANCE | 2.3% | 4.0% |
| UK | 2.5% | 3.8% |
| CZECH Rep. | 2.2% | 6.3% |
| NETHERLANDS | 1.5% | 0.4% |
| BELGIUM | 1.4% | 0.7% |
| SWEDEN | 1.1% | 2.1% |
| FINLAND | 0.6% | 0.5% |
| DENMARK | 0.3% | 0.3% |
| PORTUGAL | 0.3% | 0.4% |

SOURCE: CECIMO

REGIONAL SPECIALIZATION

European machine tool industry is characterized in global markets by its capacity to supply high-end machine tools. The machine tool product range is very broad and machines are generally named after their functions, such as boring, milling shearing machines or presses and bending machines. The size and functions of machine tools may vary according to their application fields. Regional specialization of the machine tool industry in Europe is thought to be mainly linked to historical reasons. The development of the machine tool industry in particular regions of Europe has gone hand in hand with the development of end-user industries.



Today, the main criterion for categorizing machine tools is not determined according to machine types, but based on the level of technology and customization. The market for high-end, customer-intimacy machines is remarkably different than the market for standard, low-cost machines. When speaking about the European machine tool industry, we are referring to the first group, as Europe competes globally in high-end range.

In defining regional specialization within Europe, the main distinction could be made as follows.

EU15 specialization in regions:

- Swiss, German suppliers: specialized in accurate production
- Southern Europe: bigger and more traditional machine tool solutions
- Germany, Italy and France: high customer-intimacy machines
- Northern Europe: flexible automated solutions, as well customer intimacy machines

Regional specialization has provided the machine tool industry with the high productivity and efficiency gains that it enjoys today.

b) Composition of the sector

European machine tool builders are predominantly small and medium enterprises (SMEs). The average number of employees per company in 2010 was less than 100. The size of the companies is determined by the high orientation on short series production of highly specialized machines. Most of the machine tool businesses are family-owned and the management positions are also held by family members. Meanwhile there is a strong trend towards institutionalization and many companies are run by hired managers and CEOs.

European machine tool builders are predominantly family-owned small and medium enterprises.

The European integration process, globalization and market trends have also stimulated a certain level of consolidation within the industry in the form of mergers and acquisitions. Some machine tool builders, which wanted to take advantage of the integration of value chain activities, have merged into large groups which provide complete manufacturing systems including production, engineering solutions, automation and software, after-sales services and others. Industrial consolidation, however, has not been a very significant trend in the European machine tool industry.

In recent years, the geographical shift in consumption from Europe to emerging countries, coupled with increased global competition, have created new competitive pressures on SMEs. SMEs fall short of capacity to tackle challenges of the new global business environment. The impact of this new environment on the size of these companies remains to be seen in the coming years.

c) A cyclical business

Being a provider of purely investment goods, the machine tool industry is a cyclical business. All the fluctuations in the general economy are immediately reflected in the investment goods sector, but with increased magnitude. Customers tend to postpone investment decisions during economic downturns and they increase their spending on new production equipment during upturns. The machine tool industry is usually the first to be affected by economic recessions as the first reaction of customers is to cut budget in capital expenditures.

The machine tool industry is often the first to be affected by economic downturns and is the last to recover.

In times of economic depression, the difficulties that machine tool companies and their customers face in accessing to credit strongly affect the sector as credits are critical for investments. Machine tool businesses are also the last to recover as business confidence takes some time to be restored. Another factor which delays recovery is that the time lag between orders and production changes is between six and nine months. (See figure 2)

d) Supply chain of the machine tool industry

The machine tool industry refers to manufacturers which specialize in the making of machine tools for selling to other industries. Machine tools are considered to be means to the final manufactured products, as they are used to produce parts and components which are later on assembled by other industries into final products. Historically, many manufacturing companies, such as car manufacturers, have developed their own machine tools to meet their in-house needs. In other cases, producers of machine tools could sell both the machines and parts that they produced by using these machines. A stand-alone community of machine tool builders has developed throughout the 19th and 20th centuries, mainly due to reasons linked to efficiency and profitability that specialisation provides.

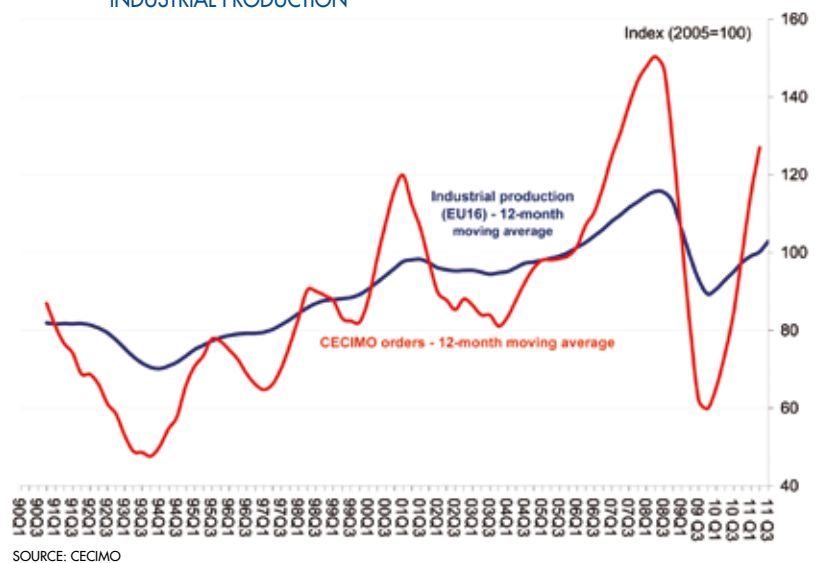
Today, the borderline between users and builders of machine tools is much clearer. Machine tool builders produce machines which are often customized according to needs of customer companies. This also requires that the machine tool builder offers a wide range of services to the customer including

application engineering, maintenance, repair and on-site training of operators. Today machine tool builders increasingly provide complete production solutions to their customers rather than individual machines.

Today, the production of machine tools is done more and more in networks and less in-house.

The upstream suppliers in the value chain of machine tool builders comprises primary material suppliers, key component suppliers, and also companies which provide R&D and consultancy services. Machine tool builders may have different value chains as some of them meet their needs by supplying certain parts and components in-house (e.g. companies manufacturing their own electronic controls), whereas some other companies may purchase it from third parties. Today, the production of machine tools is done more and more in networks and less in house, which highlights the importance of interlinkages and interrelations in the value chain.

FIGURE 2: INDEX OF MACHINE TOOL ORDERS AND INDUSTRIAL PRODUCTION



MACHINE TOOL BUILDERS

As in any other business, machine tool builders tend to concentrate on the operations which generate the highest added value and profitability, whereas they outsource low cost operations to specialized suppliers. Generally, the following critical stages of production are done in-house: design and development, machining of some parts, final machining, assembly including the sub-assembly of critical parts such as high precision components, spindle or head constructions, fine tuning and testing (quality assurance).

Other value chain activities of machine tool builders include procurement of material and key components, sales and marketing, and after-sales services such as maintenance, repair or training. Technology development may be done in-house, otherwise it is outsourced to third parties. The relationship of machine tool builders with their suppliers and customers is marked by the existence of close linkages and strong cooperation as they need to deliver production equipment which has to be carefully tailored to specific customer needs.

SUPPLIERS

Machine tool builders purchase components/parts from cheaper countries in small volumes. This includes the acquisition of low value added parts such as cast iron basements and frames. There is a heavy dependence on external suppliers for many high value added components such as numerical controls and drives, linear guides, spindles, clamps and tooling as well as specific automation components. Some of these parts and accessories are simply bought on the market from multinational companies (a typical example are NC and drives), others are produced by specialized companies working closely with machine tool builders (e.g. clamps and tooling).

The entire supply chain is present in Europe, but there is an increasing reliance on Asia for electronic units.

The most imported products procured from suppliers are electronic components, refrigeration units, hydraulic units and machined structural components. The entire supply chain is present in Europe and is able to deliver high quality components. However, there is an increasing reliance on

Asia, namely on Taiwan and Korea for electronic units, on Korea for electronic components, and on Japan for electronic, electrical and control parts. China is also becoming an important supplier.



CUSTOMERS

Almost all the fabricated goods available on the market with metal content are produced by machine tools. Therefore, the major clients of the machine tool industry cover a wide range of sectors:

- automotive industry and its supply chain,
- manufacturers of machinery and equipment, electrical and mechanical engineering,
- aerospace and aeronautics industry,
- manufacturers of railway vehicles,
- manufacturers of power generation and distribution equipment (including conventional fossil fuel, nuclear power and renewable energies such as wind, solar, hydro and geothermal),
- die and mould industry,
- med-tech industry, domestic appliances, ship-building, metal goods, defence sector, jewellery, watch-making, optical industry and others.

These customers may be direct end-users of machine tools or machine tools may be sold to the supply chain of these sectors which produce parts and components that are later assembled into final products. Machine tools are used in the production of crucial mechanical parts and components such as bodies, engines, gear boxes and power trains for the automotive industry; the production of high precision complex 3D parts for the aerospace sector; or for manufacturing high precision implants, surgical instruments and precision components medical device applications for the medical engineering industry. Besides these high precision machining needs, machine tools meet also the needs for basic operations in industries such as metal articles.



End-users are often involved in the development of new production solutions by machine tool builders, from product development to the design of after-sales services. Moreover, customer needs may also determine which activities machine tools will perform in the buyer's value chain. For example, if the customer lacks the capacity to operate or monitor its machine tools and further improve its production technologies, this opens up new space for machine tool builders to develop new services and products.

The most important customer of machine tool builders is the automotive industry, which covers approximately one third of the market, and mechanical engineering industries. Customers spread over a wide geographical area as the supply chains are increasingly globalised. Machine tool builders either establish their own distribution channels to reach customers in remote markets, or they enter into partnerships and sign dealership agreements with local partners in their export markets.

e) Trade and Investments

TRADE

European Machine Tool industry is highly export-oriented with the external sales of CECIMO countries accounting for almost three quarters of the total sales. Europe is the most important production base for machine tools as well as for engineering industries which are the major buyer of machine tools. In recent years Europe has lost its significance in the sector to Asia. Countries of East Asia, especially China, have become the engine of the world's economic growth. China has been massively developing virtually all aspects of its economy. It has not been affected by the economic crisis triggered in 2008 in the way the western economies have.

In recent years, Europe has lost its significance in the machine tool industry to Asia.



TABLE 2: CECIMO TOP EXPORTS DESTINATIONS

| Country / region | Share in total |
|------------------|----------------|
| China & HK | 31% |
| USA | 10% |
| Russia | 8% |
| India | 6% |
| Brazil | 5% |
| S. Korea | 5% |

SOURCE: CECIMO; STRUCTURE STABLE OVER TIME

TABLE 3: CECIMO EXPORTS AND IMPORTS PER ZONES IN 2010

| EXPORTS | | | | | | |
|----------------------|-------------------|-------------------|-----------|-------|-------|--|
| Zone | | | | Share | Share | |
| | 2010 | 2009 | %10/09 | 2010 | 2009 | |
| I. ASIA | 3.860.562 | 3.200.383 | 21% | 31% | 26% | |
| II. AMERICAS | 1.609.591 | 1.461.006 | 10% | 13% | 12% | |
| III. EUROPE | 5.408.131 | 5.936.774 | | 43% | 48% | |
| CECIMO | 4.475.869 | 4.873.011 | | | | |
| non CECIMO | 932.262 | 1.063.764 | | | | |
| IV. RUSSIA+CIS | 905.323 | 845.502 | 7% | 7% | 7% | |
| V. OTHERS | 743.407 | 680.329 | 9% | 6% | 6% | |
| VI. ROW | 129.785 | 228.392 | | 1% | 2% | |
| TOTAL EXPORTS | 12.656.799 | 12.352.386 | 2% | | | |

| IMPORTS | | | | | | |
|----------------------|------------------|------------------|--------|-------|-------|--|
| Zone | | | | Share | Share | |
| | 2010 | 2009 | %10/09 | 2010 | 2009 | |
| I. ASIA | 1.445.267 | 1.299.272 | 11% | 25% | 22% | |
| II. AMERICAS | 296.395 | 288.522 | 3% | 5% | 5% | |
| III. EUROPE | 3.802.303 | 4.069.331 | | 67% | 69% | |
| CECIMO | 3.651.360 | 3.818.532 | | | | |
| non CECIMO | 150.943 | 250.800 | | | | |
| IV. RUSSIA+CIS | 18.020 | 15.052 | 20% | 0% | 0% | |
| V. OTHERS | 20.440 | 21.100 | | 0% | 0% | |
| VI. ROW | 86.762 | 176.101 | | 2% | 3% | |
| TOTAL IMPORTS | 5.669.186 | 5.869.379 | | | | |

SOURCE: CECIMO; SHARES MIGHT NOT SUM UP TO 100% BECAUSE OF ROUNDING

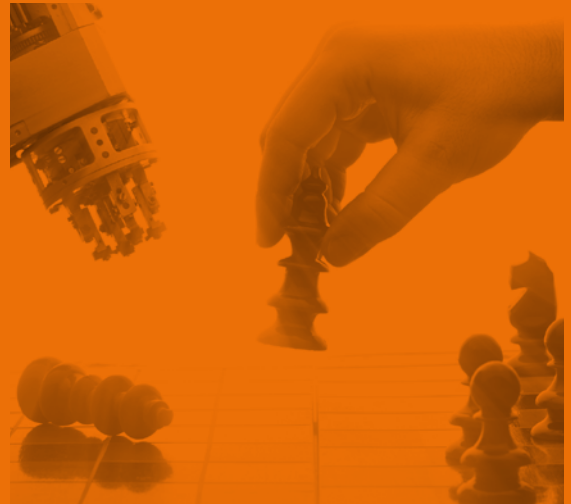
Following the rapid expansion of the Chinese economy, European machine tool builders are increasingly engaged in selling to customers based in China. They also produce in China. The country accounts for roughly one third of the total external shipments of CECIMO members (See Table 2). The geographical expansion is the only guarantee for European companies to ensure a sustainable growth. European machine tools are mainly shipped to China, US, India, Russia, Korea and Brazil, but also intra-EU trade is still significant (See Table 2 and 3).

FOREIGN INVESTMENTS

Europe remains the biggest economic block in the world and continues to attract foreign investments. Foreign companies investing in Europe can provide a source of new technologies, capital, processes, products, organizational technologies and management skills, and as such can provide a strong impetus to economic development. There are several machine tool production facilities of foreign origin in Europe, although it is not very significant. The benefit of these investments to the European machine tool industry is that new investments contribute to consolidating the European manufacturing base and make it attractive for R&D investments. The shortcoming which is highlighted by European machine tool builders is that this situation increases risks for the leakage of European know-how and technology to competitors.

European investments in third countries are motivated by the need to reduce costs, to exploit benefits of the local supply chains and to be close to the customer base which enables them to better understand user needs and better serve their customers. European machine tool builders' investment strategies abroad vary from strategic alliances to joint ventures, from the acquisition of foreign companies to opening production facilities in third countries. Increasing investments of global car manufacturers in emerging countries such as India, China or Brazil, but also large publicly-funded energy and infrastructure projects in these countries, make them attractive to European machine tool builders for investment.

III. Competitive position of the sector



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Two types of competitive advantages can be distinguished: cost advantage and differentiation advantage. Competitive advantage is created by using resources and capabilities to achieve either a lower cost structure or a superior quality and performance. It is the superiority gained by a firm when it can provide the same value as its competitors but at a lower price, or can charge higher prices by providing greater value through better quality or performance.

Product features such as precision and accuracy are far more important than unit labour costs in a technology-intensive sector such as machine tools, as a source of competitive advantage. Machine tool builders seek for differentiation and sources of uniqueness by creating value for their customers through the development of new processes and new services which help achieve high productivity levels, meet the precision needs of their customers and help lower their costs. Machine tool companies rely to a large extent on the quality and the availability of parts and services supplied by upstream actors to be able to respond to customer demands. Although European machine tool builders do not compete on the basis of costs, they need to watch over their costs to maintain a sustainable competitive advantage especially against technologically strong competitors.

Product features such as precision and accuracy are the major determinants of competitive advantage in the sector.

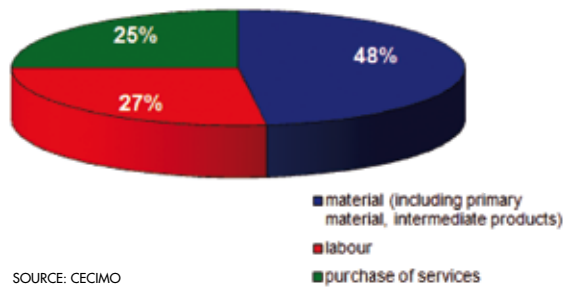
Horizontal framework conditions and the regulatory environment also have an important impact on the competitiveness of the sector. For example, the accessibility to bank credits determines the availability and the cost of financing customers' investment in new machinery. Health and safety regulations at home may impact on cost structures and the regulatory framework in the third country may raise barriers to market access. Furthermore, an effective education system and the availability of vocational training centers are fundamental to raising the skilled workforce for industry.

a) Cost structure

On average, the cost factors in machine tool manufacturing business with their respective share are as follows:

- material (including primary material, intermediate products): ~ 48%
- labour: 27%
- purchase of services: 25%

FIGURE 3: AVERAGE COST STRUCTURE OF MACHINE TOOL BUILDERS



SOURCE: CECIMO

The value created by European manufacturers help them get a premium price which pays off high costs. Costs are not a driver of differentiation for European machine tool builders. Their sources of uniqueness lie mainly in product features and unique technology.

The value created by European manufacturers help them get a premium price which pays off high costs.

Even though European machine tool builders pursue a strategy of differentiation to gain competitive advantage, this differentiation must be sustainable. Machine tool builders outsource many critical components such as controls and drives. Moreover activities which are costly to provide in-house such as R&D and maintenance are also outsourced. Too much outsourcing may become risky as it includes some hidden costs such as logistics, energy and labour costs, which are determined outside the control of machine tool builders.

b) Differentiation factors

European machine tool builders' strengths in global markets are quality, performance, precision, productivity, reliability, brand, superior cost of ownership and the ability solve customer problems.

Compared to their competitors, European machine tools enjoy a competitive edge in performance on work-piece which refers to precision, output and productivity. The long-standing experience and know-how developed with demanding customers and thanks to the experience of engineers are the main sources of the high quality solutions they provide. European machine tool builders have a high level of technological readiness, which means that they have the agility to adopt new technologies such as ICT to enhance the productivity of their own production process.

Main strengths of European machine tool builders are quality, performance, precision, productivity and the ability solve customer problems.

The service ability of European manufacturers is not provided by Japanese, Taiwanese or other important competitors. European manufacturers supply application solutions rather than standard machines. High level service orientation can be measured by the service content, which can go as high as 40% in some companies. European machine tool builders enjoy a strong capacity of responsiveness to customer demands and the flexibility to provide a wide array of production solutions for changing needs. The ability to deliver high precision parts in low volume just in time determines to a large extent the level of differentiation from competitors.

c) Industry structure and competitive forces

Product quality alone cannot create a competitive advantage for European machine tool builders. Manufacturers create buyer value through diverse activities in their value chain. Companies need to concentrate on activities which create the greatest value for their customers whilst they try to respond to forces which shape competition. These forces which are examined in detail below include the power of suppliers or buyers, barriers to entry, the power of competitors and the threat of substitution.



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BARGAINING POWER OF SUPPLIERS

Powerful suppliers may constrain machine tool builders' profits if they charge too high prices. Recently, serious availability and cost problems in the supply of raw material and components negatively affected the European machine tool industry.

The main problems which disturb the supply chain are as follows:

- Suppliers were unable to meet the sharply rising demand in orders with the economic up-turn which followed a period of stagnation during the global economic crisis. Especially Asian suppliers had difficulties in ramping up production. This has created serious bottlenecks in the supply of some key components and delays in delivery.
- It has been proven that large suppliers of components which dominate the markets prioritize big companies to SMEs at the times of recovery and when they lack capacity to respond to all orders.
- The recent disruptions in the supply chain has revealed the over-reliance of machine tool builders on suppliers of key components and their weak negotiation power vis-à-vis suppliers of CNC, electronic components, casting, high precision components and others.
- Machine tool builders had difficulties in purchasing imported raw material due to volatile prices in global markets.
- Export restrictions have recently constrained the machine tool builders' ability to meet rising orders of machinery due to their over-reliance on imports from developing countries.
- Problems in the supply of material have affected some key suppliers of machine tool builders such as linear guide suppliers. Heavy pressure was put on Italian and German suppliers of linear guides as Asian machine tool builders turned their face to European suppliers due to supply shortages.

- Weak position of SMEs to check quality of their purchases and managing currency fluctuations reduce their bargaining power vis-à-vis suppliers.

Bottlenecks in the supply of raw material and components have negatively affected the sector recently.

European machine tool manufacturers report that their portfolio of suppliers is not diversified enough. This is mainly due to a low procurement volume and their lack of capacity in procurement planning, which is requested by most suppliers. Machine tool builders require high quality, high complexity, low cost parts which they buy in low volumes. These are difficult requirements for suppliers to meet. If machine tool manufacturers could do everything in-house they would prefer to do it that way. However, they have to outsource certain activities. Some value chain activities such as R&D and maintenance are too costly to keep in-house. It is becoming harder to find suppliers which can do and are willing to do the complex jobs demanded by machine tool builders. Against this background, too much outsourcing risks rising transactional and availability costs.

Concentration of suppliers is a new phenomenon observed in the value chain. Suppliers are getting bigger and as they grow bigger, their interest in serving small companies is diminishing. A single source of supply or oligopolies in some key areas threaten the profitability of the machine tool industry by keeping input costs high. For example, in the electronic controllers, only a few big players dominate the market. Big suppliers have a very strong bargaining hand which diminishes the negotiation power of small and medium size machine tool companies. Components suppliers prefer, moreover, Asian markets where customers purchase components in bigger volumes compared to machine tool producers in Europe. Moreover, European machine tool builders have raised some doubts about possible discrimination in pricing on the basis of nationality, stating that non-European suppliers possibly make more favorable quotations to their nationals.

Suppliers are getting bigger and as they grow bigger, their interest in serving small companies is diminishing.

Machine tool builders, especially SMEs, are deprived from strategies to offset high costs created by the strong bargaining power of suppliers and the increase in raw material prices. They report that these increases in input prices cannot be easily reflected on final prices as the competition is very high and profit margins are low in the end market. In other cases, small and medium-sized downstream suppliers of machine tools may find themselves exposed to pressure from big companies. Should big customers force them to lower their prices, their small size would give them no other option than to sacrifice their profitability for the sake of keeping their customers.

ACTION

How to enhance the position of SMEs towards big suppliers?

Machine tool companies should be supported in producing their own electronic parts/controllers. Most manufacturers outsource to a few big companies. More competition and a larger number of options are needed in Europe in electronic components.

BARGAINING POWER OF BUYERS

Some major customers such as automotive companies are facing increasing competitive pressures in the global market which leads to a growing concentration of companies in the sector. Consequently, their demands for machine tools are determined by their needs for ever more efficient, reliable, accurate and flexible equipment provided at low prices and with a valid technical assistance organisation located close to their facilities all over the world. The automotive industry has an interest in entering in long-term partnership agreements with machine tool builders to ensure the timely supply of high quality parts which meet common technical standards set by car makers.

In long-term partnerships machine tool builders need to be prepared to respond to orders in high volumes whilst respecting stringent technical standards. Long-term contracts would also require machine tool builders to accept long-term payments and low profit margins; to respect short delivery times; and to ensure wide sales and after sales organization in all the countries where customers are based. Large suppliers of machine tools which can meet these requirements and which can serve car makers worldwide may squeeze SMEs' profit margins and/or push them out of the market.

ACTION

How to react to the concentration trend in customer sectors?

Changes in customer sectors such as the concentration of automotive companies may bring SMEs to the strategic decision of planning/evaluating possible forms of aggregation to share opportunities and costs. A proposed solution to enable SMEs to cope with big customers in the car industry is to provide complementary machines in the same production line in cooperation with other SMEs. Another challenge is providing a worldwide services organization. SMEs can consider creating common structures for sales and exports for complementary machines.

BARRIERS TO ENTRY

New entrants who are technologically well-equipped and hungry for market share may eat up European machine tool companies' market share. Machine tools are capital-intensive investment goods with the high value added and know-how content. As a consequence, the market entry is by nature limited to the new players.

Nevertheless, the rapid industrialization process in emerging countries of Asia has been accompanied by the emergence of new manufacturers of machine tools which are backed up by public finances. These companies have quickly grown into important global market players in the recent years. Governments in developing countries lower the costs of entry for their national entrepreneurs by providing subsidies and grants. Moreover, governments try to increase the costs of entry of European imports into their domestic market by using trade barriers, which provides more room for their national companies to grow.

Highly stringent health and safety standards set by the EU regulatory framework raise the cost of entry for these new entrants in the European market. However these barriers are being diminished in the absence of effective market surveillance. The European market has largely lost its significance given the impressive growth of Asian markets.

The new competitors offer a very competitive price cost/ratio. They have built their technological power mainly on copying, but governments, especially the Chinese government, provide strong financial support for research and development in the machine tool industry. New competitors are trying to establish themselves as new quality producers and if they catch with European manufacturers in technology, they will threaten the European market share as well.

ACTION

How to react to the emergence of new competitors in Asia?

- European companies should look into investment options in third countries to take advantage of the local supply chain and cheap labour. This can help them create new local brands which can compete with new entrants. This should ensure that high added value activities are kept in Europe at any price.
- European machine tool builders should increase their efforts in technology development to raise the costs of competing. European policy-makers and national governments should facilitate access to credit and public funds to help manufacturers finance their R&D activities.

THREATS FROM EXISTING COMPETITORS

Rivalry among existing competitors may take different forms such as competition on price, introduction of new products and new services, advertising campaign and so on. Price competition transfers the profits of the industry to customers.

The European machine tool business landscape is dominated by SMEs whereas non-European companies are bigger and have more possibilities to shape competition, for example by dumping prices or buying market share. Suppliers' and buyers' bargaining power coupled with low margin profits deprive European SMEs from the possibility to make big discounts. In an increasingly fierce market competition, established competitors of European manufacturers are trying to heat up price competition. Some competitors have recently been taking advantage of currency fluctuations or government support to slash prices.

Furthermore, state-backed competitors from non-EU countries have strong ambitions to obtain market leadership, a target which is strongly linked to economic policies of their governments. This strong determination of emerging countries for developing a competitive domestic machine tool industry may exacerbate rivalry and diminish the profitability of the business.

The share of the European machine tool industry has dropped from to 33% in 2010 compared to 44% in 2008.

The share of the European machine tool industry in global output has dropped from to 33% in 2010 compared to 44% before the global economic crisis

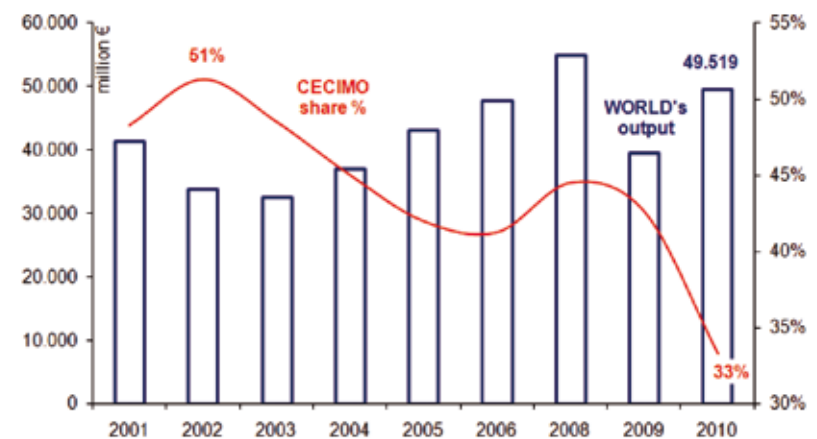
in 2008 (See Figure 4). This share has been lost to Asian competitors including China, Korea and Taiwan which emerged from the crisis quicker and stronger. China has emerged as a strong competitor in the recent years and has overtaken Japan in 2009 to be the second largest producer of machine tools in the world after CECIMO countries (See Table 4). However, Chinese companies largely satisfy their domestic market by supplying low value machines which can perform basic operations and they need to overcome a large technological gap to reach the level of technology leaders such as Europe and Japan.

TABLE 4: WORLD MACHINE TOOL PRODUCTION IN 2010

| Country | 2010 Output | 10/09 change | % Share |
|---------------|---------------|--------------|------------|
| CECIMO | 16.476 | -2% | 33% |
| China | 15.778 | 43% | 32% |
| Japan | 7.170 | 42% | 14% |
| Rep. of Korea | 3.394 | 71% | 7% |
| Taiwan | 2.926 | 79% | 6% |
| United States | 1.820 | 14% | 4% |
| Brazil | 632 | 23% | 1% |
| Canada* | 347 | 11% | 1% |
| India | 346 | 73% | 1% |
| Poland* | 223 | -5% | 0% |
| Russia | 165 | 0% | 0% |
| Mexico* | 100 | 5% | 0% |
| Australia | 84 | 267% | 0% |
| Argentina | 30 | 57% | 0% |
| Romania | 26 | 1% | 0% |
| TOTALS | 49.519 | 25% | |

SOURCE: CECIMO, VALUES IN MILLIONS OF EUROS - * DATA ESTIMATED

FIGURE 4: WORLD'S MACHINE TOOL PRODUCTION AND CECIMO SHARE



SOURCE: CECIMO

According to European machine tool builders, the main competitors are the Japanese companies because of the reliability of their machines and Taiwanese companies because of their low cost. Japanese competitors are technologically on eye level with Europeans. Japanese, Taiwanese and Korean competitors have the advantage of being geographically and culturally close to high growth markets in Asia. China's cost

competitiveness seems likely to be complemented soon with ever greater technological capabilities. Chinese companies are able to provide big sales and after-service force in their domestic market which is hard for small and medium-sized European companies to match.

ACTION

What should be Europe's strategy towards an ever increasing competition?

- European machine tool builders should try to temper price wars initiated by established competitors. They should heavily invest in new products and technology to help their equipment and services to radically differentiate from their rivals.
- European manufacturers should strive to shift competition further into other dimensions than price, such as product features, delivery time, support services and brand image. This could help prevent competition from driving down profitability. Competition on other dimensions can also help improve value created for buyer and support higher prices.

THREAT OF SUBSTITUTION

The threat of substitution may come from products which offer the same or similar functions to machine tool builders' products. Sometimes, the threat of substitution may derive from the downstream market and in an indirect way.

The increasingly use of composites in the automotive and other transport vehicles may diminish the number of operations performed by machine tools. The new environmental consciousness and regulatory framework is leading to the downsizing of car engines. Furthermore, the shift to battery cars may decrease the number of mechanical parts to be machined in cars. Additive manufacturing offers new methods of processing metal as a substitute to machining.

ACTION

How to tackle the threat of substitution?

- Machine tool builders should respond to the threat of substitution by investing in new technologies to meet customer demand for machining more accurate parts and processing new materials.
- Machine tool companies should consider enlarging the breadth of product range to avoid over-reliance on one product group when customers switch to substitutes.

However, these changes in technology and market trends are also promising to open up new opportunities for machine tool builders. An increase in the share of composites in transport vehicles may require more moulds which need to be machined by machine tools. Aluminum is an important competitor of composites and there is much room to improve the machining of aluminum. Downsizing of engines will require smaller parts with higher precision and tolerance which will offer new business opportunities to some manufacturers. The shift to electric cars is not a significant perspective in the next twenty years, but when it will happen, the replacement of the existing car fleet with battery cars will mean more business for machine tool builders.

Finally, whilst some markets may shrink or disappear for machine tool builders, other markets will emerge such as the med-tech industry or electronics and optics industries which will increase demand for micro and nano machining capabilities. Overall, the threat of substitution exists in some areas; however this is going to be accompanied by new market opportunities.

d) The position of SMEs

SMEs enjoy some advantages, which also explain why the SME-dominated European machine tool industry holds the world technology and market leadership:

FLEXIBILITY AND ADAPTABILITY

- SMEs have a flexibility and ability to produce customer solutions. They are good at solving customer problems.

AGILITY

- SMEs can generally respond quicker to customers' needs compared to big companies
- They can generate quicker and more efficient response to challenges since information and decision making are more concentrated in one or a few persons.

NICHE PLAYERS

- SMEs have a strong ability to serve niche markets whilst bigger manufacturers may have difficulties in adjusting their high volume production to specific customer demands.

VISION

- SMEs generally focus on the long-term industrial success of the company and they are rela-

tively indifferent to short-term financial results. This typically shows as lower average return and economic success on difficult markets or in managing complex innovations.

Compared to large corporations, small and medium machine tool builders are faced with several disadvantages which are:

LACK OF HUMAN RESOURCES

- SMEs generally lack management competences and skills.
- The decision-making power is concentrated in one person, who is usually the owner of the company, and who has a too limited background to cover all important competences ranging from engineering, human resource management, international financing, etc.
- Lack of human resources triggers problems in internal development projects and publicly funded projects. They do not have the staff that can develop knowledge on the existence and content of research programs. Even if they can participate in projects, they lack staff to prepare the necessary paperwork.
- Best engineers and workers prefer to work for big firms. SMEs have limited financial resources to hire them.
- They lack human resources to manage a globally successful marketing activity.

FINANCIAL CHALLENGES

- Low capitalization deprives SMEs from having enough "horsepower" to tackle all the upcoming BRIC market challenges.
- SMEs have difficulties entering new markets due to high entrance costs especially on the new geographically and culturally distant emerging markets. They do not have the capacity and resources to afford the internationalization of their operations and services network.
- They do not have sufficient budget for R&D to develop new and innovative products.
- SMEs have difficulties raising funds from banks, which see cyclical businesses such as machine tools, as too risky customers.
- SMEs have no possibility to protect market share by giving huge discounts as some big companies do.
- SMEs have a high level of vulnerability especially to deep down-cycles in economy and financial shocks
- They cannot take big risks as one big project can destroy the company.
- SMEs need to bear higher purchasing costs from suppliers due to lower volume of procurement.

CAPACITY – RESOURCE – COMPETENCE PROBLEMS

- SMEs have a low management bench strength. Strategic management of resources is a challenge.
- They have difficulties responding to big volume orders. The breadth of product range is limited.
- Customers have better reasons to work with big suppliers instead of SMEs. SMEs cannot follow big companies and respond to their needs.
- A lack of resources and competences make organic and non-organic growth of SMEs difficult.
- SMEs do not have sufficient resources for marketing and advertising activities.
- They lack resources to establish global customer services systems.
- IPR management is a challenge. SMEs' resources are too weak to cope with high costs of protecting IP rights in important markets such as China.
- "Eurocentrism" prevents some SMEs from adapting to the business culture in remote but important markets such as the ones in Asia. They need to make more efforts to adopt the approach and cultural orientation required by their customers in Asia.



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- SMEs are overly focused on technical and trade aspects and they pay less attention on other important value chain activities which can help them differentiate and create value for their customers, such as marketing and finance.

GROWTH – EXPANSION

- Small and medium-sized machine tool companies need to reach a critical mass. As customer companies get bigger, this is a pre-requisite to be able to catch up and scale up capacity (production, human, management, etc).
- It is almost impossible to set up R&D services and production in China for an SME which employs a hundred people.
- Size is a problem for finding funding and affording strategic partnerships, mergers and acquisitions.
- It is hard for SMEs to get premium price due to low level of brand recognition.

ACTION

How can SMEs prepare for the challenges of global markets?

- SMEs should consider setting up common and joint activities outside Europe, such as using common platforms and services.
- The EU should provide support for market access in the same way it supports research and technology development. SMEs need facilitated access to consultants for advice on strategic management and international markets.
- Knowledge transfer may erode Europe's competitiveness in all manufacturing activities which rely on machine tools. Machine tool companies should have facilitated access to training and consultancy services to be able to effectively protect their IPR abroad. This is crucial to maintain the industrial base.

e) Role of technology and innovation

The machine tool industry is a technical and technology-intensive sector in which precision and product features determine differentiation and fuel competitiveness. High competitive pressures coming from competitors at the medium technology level from developing countries are likely to force European machine tool builders to increase technology development activities. Innovation and capitalizing on knowledge-intensive, high value activities are the only way to remain competitive in global markets.

Technological development can help machine tool builders live up to the current and future challenges they are faced with. For example, in order to respond to bottlenecks in the supply chain, such as the case of control supply, they can invest to develop their in-house capabilities for producing electronic controls, which will help them reduce dependence on big suppliers. To be able to confront high energy and raw material prices, they are already investing in resource and energy-efficiency technologies. Technological achievements in downstream supply chain of machine tool builders have an important potential to help improve the position of the sector position vis-à-vis material shortages. An example of this is the replacement of traditional materials used in machine construction by composites.

Companies which have the agility to respond to changing technological needs of customer sectors and have the technological advantage to confront cost pressures deriving from upstream suppliers will be one step ahead in competition.

TABLE 5: ADVANTAGES AND DISADVANTAGES OF BEING A SME

| ADVANTAGES | DISADVANTAGES |
|--|--|
| Flexibility and Adaptability | Low capitalization and not enough horsepower to tackle BRIC markets' challenges |
| Agility to respond to customer needs | Low capacity to internationalize operations and develop a global services network |
| Being a niche player | Lack of management competences and skills |
| Long-term vision focused on the success of company | Lack of human resources for R&D activities, global marketing; limited resources to hire the best engineers |
| | Limited capability to grow and expand |
| | Difficulties accessing finance; considered as cyclical and risky business |
| | SMEs have to bear high purchasing costs from suppliers due to low volume of procurement |
| | No possibility to give big price discounts as some big companies do |
| | Limited capacity to respond to large volume orders of customers; limited breadth of product range |
| | Insufficient budget to allocate to R&D activities and to the development of new products |

RELATIONS WITH CUSTOMERS

Customer demand is the driving force of innovation in the machine tool industry. Many new processes can be developed only in cooperation with big end users and in cooperation with their RTD structures. In energy, medical and automotive sectors, expectations change rapidly and they become the driving force of innovations. The central driver is superior technology and process capability which are demanded by high volume industries such as automotive, or high precision industries such as aeronautics.

Customer demand is the driving force of innovation in the machine tool industry.

Customers depend on machine tools for the development of new processes to produce their products and increase productivity. Machine tool manufacturers will be able to create value for their customers as long as they manage to integrate in the value chain of their customers and present them as strategic partners. This will require investment in new high value processing technologies and services.

COMPETITORS' PERFORMANCE

Japanese, Korean and Taiwanese competitors are well established on the market and have experienced and high level RTD structures. Chinese competitors are increasing the quality and performance of their RTD structures mainly through the acquisition of European companies or joint ventures. A strong government-backed financial support coupled with a high level of cooperation with local universities whose quality and RTD capabilities are now comparable with Europeans, are helping Chinese companies climb up the value chain.

Copying helps to reduce the technological gap in the short-term. Competitors in developing Asian countries are investing in technological capacity building to sustain their growth. They enjoy the advantage of being close to customer which eases their access to new partnerships for technology development. Strong governmental support to non-EU machine tool manufacturers, especially in Asia, seems likely to continue in the future and to reduce the fixed costs of competing.

BARRIERS TO TECHNOLOGY TRANSFER

The interface between machine tool builders and customers is of critical importance for technology development in the sector. Several problems in and outside Europe hamper these interrelations and linkages in the value chain. In the automotive industry for example, there are two different groups of customers. The first group sees machine tool suppliers as key to manufacturing process development whereas the second group prefers developing their manufacturing processes in-house. Therefore, this stops SMEs from accessing OEMs in process development and is an important barrier to technology transfer throughout the value chain.

European machine tool builders state that most of the European SMEs are unable to propose themselves as strategic partners to big end-users. This is mainly due to the small company size and low R&D capacity.

However, they also observe a low propensity of small-sized machine tool builders to cooperate and build partnerships. IPR concerns are a major problem. Small company size limits, moreover, the capacity to use and exploit the results of technology transfer.

The interface between machine tool builders and customers is of critical importance for technology development in the sector.

ACTION

How to facilitate technology transfer?

- European machine tool builders think that developing common/shared platforms for R&D development could help join forces and pool strategic resources. Examples of this type of cooperation exist in the car industry, for example in the development of battery cars.
- SMEs should get out of their traditional mindset and develop more strategic approaches to technology transfer in a global market context.



IV. Horizontal framework conditions



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The domestic and international framework in which firms operate have a significant impact on the competitiveness and export performance of the European machine tool industry.

a. Regulatory framework in Europe

The European Single Market has been designed to provide businesses with a large market by removing technical barriers to trade. European economic integration has boosted intra-EU trade, stimulated competition and it has led to significant productivity and efficiency gains in industry. The harmonization of diverse national regulations in the machinery industry has been beneficial to machine tool companies engaged in exports. The Internal Market, however, is not a completed project as there are remaining barriers to cross-border business and to the provision of services in the EU.

European regulations in the areas of health, safety or environment are strict and they aim at guaranteeing a safe working environment for machine operators and other workers on the factory floor. European machine tool manufacturers have, in general, a good track-record in complying with health and safety regulations. They often overshoot the existing standards. The main threat to machine tool builders come from imported machinery in the absence of effective market surveillance. Non-compliant products, which enjoy an

unfair cost advantage, threaten the competitiveness of European manufacturers in the Internal Market. Moreover, these machines pose a serious threat to the health and safety of workers.

The main threat to machine tool builders come from non-compliant imported machinery in the absence of effective market surveillance.

In the case of energy-efficiency, regulation is designed to be used as a leverage to help industry upgrade itself to more sustainable production patterns and to create a market for energy-efficient products. Today, machine tools are much more efficient than 10 years ago; some manufacturers confirm that they have recorded 70% improvement in productivity and 10% improvement in energy efficiency over the past decade. There is more room for improvement in the environmental performance of machine tools; however, this needs to be done without compromising the productivity of machines in order to remain competitive.

Industry is concerned mostly about the uncertainty of the way the energy-efficiency regulation will impact on their competitiveness.

Overly strict regulations which do not take into account the industrial and market reality may create too heavy burden on industry by raising compliance and production costs. Industry is concerned mostly about the uncertainty of the way the regulation will impact on their competitiveness. Methodologies which are currently applied by regulatory bodies for analyzing the energy efficiency of the industry are based on the comparison of different machine tool technologies and they exclude the productivity factor.

Technical regulations can lead to innovation as they aim at setting the highest level of standards. However, in the face of a radical shift of consumption of machine tools outside Europe, regulations risk becoming a barrier to European exports. European manufacturers which comply with very stringent regulations in Europe suffer from cost disadvantages in third countries with less stringent rules. Moreover, they also sometimes suffer from uneven conditions in the Internal Market due to different interpretations of regulations and divergences in implementation of European legislation in different EU Member States.

b. Access to finance

Investment in capital goods requires large sums of money. Machine tool builders depend on bank credits to upgrade their new machinery or to finance their exports. In the face of the meltdown in financial markets, machine tool buyers are left with fewer options to finance their equipment purchase.

Manufacturers worry about the lack of funding/financing schemes to support investments of customer sectors in production machinery in Europe.

The difficulties in financing have been multiplied due to a deterioration of industry results during the global economic crisis. Banks are more reluctant to give credits and loans to SMEs as machine tool industry is seen as a cyclical industry and a risky business. Asian competition is considered as a risk by the banks. Manufacturers worry about the lack of funding/financing schemes to support investments of customer sectors in production machinery in Europe.

Private financing options such as venture capital are not developed in Europe. Machine tools are seen by risk capital investors as risky because customized production solutions cannot be replicated for the use of a broad base of customers at once, thus the return on investment is not as high as with mass production industries.

c. Access to international markets

The strong shift of machine tool consumption to non-European markets means that machine tool companies need to go to look for new customers in third countries. Moreover, the advantages of being close to the customer base and in some cases the need to deal with unfavorable exchange rates force machine tool builders to invest abroad.

Emerging countries which go through a rapid industrialization process and which pursue 'new industrial policies' to support the development of their national industry have increased protectionism in recent years. Customs duties and non-tariff barriers are used to shield domestic manufacturers from foreign competition. Important barriers to market access recently identified by European machine tool builders in different countries include complicated and discriminatory health and safety regulations, certification requirements,

The Energy-related Products Directive

The Energy-related Products (ErP) Directive (2009/125/EC) of the EU covers machine tools and the European Commission is currently analyzing options for setting possible mandatory measures to implement the directive.

Meanwhile, CECIMO has proposed a self-regulatory initiative, a method which is prioritized by the European legislation as long as it can help achieve the energy efficiency targets laid down in the ErP directive.

The CECIMO self-regulatory initiative is currently under development.

ACTION

Streamlining the regulatory framework in Europe

- Energy efficiency regulation should not penalize productivity. A practical and industry-friendly approach is needed in regulation making to enable its role in boosting the energy efficiency of the industry without compromising the industrial performance. Proper impact assessment on industrial productivity and performance is a must.
- Regulations should be made in a transparent and inclusive manner by involving industry experts drafting regulation.
- Regulations should be easy to understand and to implement; they should be supported by harmonized standards drafted by industry.
- Self-regulation should be prioritized in energy-efficiency related legislation.



Barriers to machine tool imports in third countries

Brasil and China have recently been playing with tariff barriers waving by restricting the access of imports whilst the local industry is increasing its market share in a growing domestic market and upgrading their technological capabilities.

Tariff barriers are imposed on machine tools which can be domestically produced in many developing countries. IPR protection is an important concern in China and India.

Import licenses in Brasil and Argentina, as well as lengthy customs procedures in Russia clearly hamper European exports.

Manufacturers fear that Japan is using some key performance criteria to restrict imports.

Manufacturers are not happy about visa regimes in third countries such as India and USA which constrain the access of their services personel to customer sites.

lengthy customs and administrative procedures at the borders, frequent changes in government policies, a lack of IPR rights protection, explicit and implicit government support to local companies and subsidies, unrealistic exchange rates, the opacity of some procurement channels in overseas countries and minimum content requirements imposed on OEMs operating in developing countries.

Some developing countries are clearly circumventing global trade rules or just ignore them to subsidize and promote their industries and to copy technologies. The global playing field is severely tilted by political practices.

Investing abroad is a risky decision due to the unreliable legislative environment and mistrust in government policies. A major concern stems from government policies in developing countries which force European companies to build partnerships with local companies if they want to invest in their country. This creates serious knowledge-transfer risks. The transfer of profits from abroad to home country is another issue of concern. Furthermore, the overly mobility of employees jumping from one company to another increases the risks of know-how transfer.

Small European firms have generally limited resources to learn about overseas market opportunities and they have limited access to information about the business environment in third countries, including regulations and legislations. Moreover, they have difficulties dealing with cultural differences, building trust and establishing business relationships with new customers.

ACTION

Standards can help facilitate market access

- Standards will play an important role in enabling cost-effective access of SMEs to foreign markets. The EU should continue to promote EU/ISO standards in developing countries.
- National institutes can help SMEs adapt to Chinese (or other) standards by offering assistance and special services.
- There are market access support structures which exist at national level (such as experts appointed by trade associations hosted in representation offices in third countries), however small countries do not have sufficient resources to afford this. They plead for collective support structures at European level to support finding strategic partners in third countries.

d. Research Infrastructure

The access to skilled engineers and scientists, the availability and quality of research institutes along with the extent of university-business cooperation and barriers to technology transfer are important factors which determine the innovative capacity of machine tool manufacturers.

UNIVERSITY – BUSINESS COOPERATION

The cooperation is effective where an 'intermediate' infrastructure focused on industrial innovation is present, such as in Germany or Spain. In other countries, the main obstacles are connected to the tendency of universities to focus on more theoretical and basic research activities and to the difficulties ensuring the interface between the scientific research and companies.



SME - research institute cooperation is not at ideal level in many countries. In some cases, SMEs cannot access research institutes and in some cases they do not want to share their in-house know-how and expertise. The ownership of results creates a major problem; the ground is not ripe yet for an effective cooperation. This is partly linked to deficiencies in the system as regards to IPR protection. Moreover, SMEs do not have sufficient resources to manage their IPR effectively. Sector-specific cultural barriers may also become an obstacle to cooperation.

University - business cooperation is effective in countries where there are intermediary structures focused on innovation.

Most SMEs have little knowledge about the existence and/or competences of machine tools research centers in other EU countries. They mention that they almost never receive offers for technology transfer from institutes outside their home country. Companies need to exploit the opportunities of cross-border research cooperation in the European Union and look for new partners for research and development activities.

ACTION

Boosting university - business cooperation in the EU

- Both companies and research actors need to make more efforts to tap the potential of technology transfer in the EU for the benefit of industrial competitiveness.
- Public actors should make sure that publicly funded research activities are industry-driven and that they have a clear market-focus.
- Public bodies should support SMEs to access information about opportunities for technology transfer in other EU countries. Cross-border cooperation should be facilitated.

RESEARCH FUNDING

Many national and European research programmes (such as FP7, Factories of the Future, Eureka) fund research in manufacturing technologies. The cost/quality ratio for R&D is very high in the machine tool industry. It could be made even more favourable by increasing available public resources and pooling resources available in industry and RTD funding structures. Europe cannot fully leverage on the available public funding. Too small companies, thousands of players operating in an uncoordinated manner in a fragmented research area, non-optimal allocation of resources and overlaps in research activity are the main weaknesses.

The cost/quality ratio for R&D could be made more favourable by increasing public resources dedicated to supporting research.

Some manufacturers think that it is not easy to understand how to get financial help from governments and EU schemes. They think administrative burden is high when it comes to evaluation procedures for providing funds. Generally, EU funding is considered to be sufficient, however there is room for improvement as regards to the reduction of paperwork. Manufacturers want to see focused calls about machine tools and manufacturing topics, short and clearer procedures and a strong focus on industrialization of results from RTD activities. SMEs plead for more support structures to access funding.

The biggest problem of small/medium-sized machine tool companies is accessing their customers for joint technology development. They need to be given the possibility to provide new production solutions to their current customers. Public actors could facilitate this by providing funding or incentives for 'production chain' projects.

The biggest problem of SMEs is accessing their customers to jointly develop new technologies.

e. Skills base

There is a shortage of workforce and a gap between industry's skill needs and skill availability on the market. A lack of workforce may put pressure on industry performance and wages in the long-term.

There is a gap between industry's skill needs and skill availability on the market.

SKILLS IN SHORTAGE

Skill shortages are observed in the following positions: skilled craftsmanship, mechanical and controls designers and process engineers, CNC operation, precision welding. It is also hard to find engineers who are ready to accept to travel to customers facilities. Labour costs of design engineers are much higher compared to the rest of the world mainly due to the scarcity of qualified workforce.

VOCATIONAL TRAINING

There is a sufficient number of training centers in most European countries, but companies need to invest from their own resources more than they currently do. Preparing 'new' people for a challenging job is a hard task and a big challenge for both small and big companies. More public support for training activities is needed. Support is required also for training trainers. Manufacturers emphasize the importance of systematic prospective management of workforce and strong innovation programs.

More public and private investment in vocational training is needed.



WORKFORCE FOR RESEARCH AND DEVELOPMENT

Big companies have faced fewer problems in accessing skilled labour, especially engineers. SMEs hardly find staff and engineers to conduct R&D activities, because it is far more expensive for them to hire this workforce. Big companies offer more promising career opportunities including

many advantages, notably economic ones. Most companies must appoint 'research people' who can be dedicated full-time to establish links and partnerships with research institutes and other companies in the supply chain. However, SMEs cannot afford this.

There is a divergence across Member States when the availability of labour for R&D is concerned. Manufacturers do not have equal access to skilled labour. Increasing mobility of labour, especially R&D labour, in the EU is positive, however, companies state that cultural and language barriers are still a big obstacle to mobility.

IMPORT OF WORKFORCE

Import of workforce is a way to address the problem of skill shortage. For example, controls engineers come mostly from India and mechanical engineers from North Africa. This practice could be extended. However, there are political risks involved which raise barriers to imported labour. Negative attitude of local populations towards foreigners tend to become stronger especially during economic depressions.

EDUCATION

There is a lack of interest in engineering/mechanical engineering among young students. Mega trends steer people to emerging new generation technologies. The infrastructure for engineering education exists in Europe; the problem is to not being able to fill the existing places in technical universities. Young students are not interested in a career in engineering.

The problem is to not being able to fill the existing places in technical universities.

Machine tool industry is a cyclical industry and wages of engineers may be subject to fluctuations during times of downturn. This may deter students from choosing a career in engineering. However, there are many advantages of working in the machine tool industry. Engineering is a stimulating job and it gives young people the possibility to create real value for society and the economy. Engineering and sciences studies should be effectively promoted to students, by both public and private actors.

FUTURE SKILL NEEDS

Qualification and skills of the labour force are vital for maintaining the global competitiveness of the European machine tool industry. Skills are fundamental to the design of advanced manufacturing technologies and equipment. Also, the production process of sophisticated products requires well-trained and experienced technicians and workers. Mechanical engineering is the core engineering science for the machine tool industry. However, nowadays customers' demand for increased efficiency, precision, digitalization (intelligence), safety and environmental performance requires to combine knowledge from various disciplines in order to design and build machines which respond to new challenges and market needs.

Engineers should be able to cope with the 'integration of multi-technologies'.

Engineers need a multi-disciplinary skill mix (pneumatic, software, hydraulics, control, etc) in the machine tool sector. It is important for engineers and the technical staff to be proficient in basic design tools. However, machine tools design and production require them to be endowed with further sophisticated skills. Innovation in the machine tool industry occurs mainly in the software nowadays. Therefore engineers need to have a strong knowledge of software and they need to master expert systems. They need to be able to analyze complex systems and understand all processes such as milling, assembly, installation and others to be able to transfer the expertise of a machine tool into a software programme. Finally, there will be a need for people to handle vision systems as intelligent and smart machines (e.g. repairing themselves) become more common in the future.

f) Protection of intellectual property rights

Technological development is a very strong differentiation point for European SMEs and an effective legislative framework which protects their knowledge has an important role to play in helping the industry maintain its competitiveness.

Manufacturers from emerging countries are rapidly climbing up the value chain by acquiring new technological capabilities. The knowledge is acquired from European manufacturers either by the acquisition of European companies or by copying.

Nevertheless, governments show strong support to indigenous technology development by financing R&D centers and by investing in the education of skilled engineers. There is growing global competition for the acquisition of knowledge.

Emerging market actors acquire knowledge from European manufacturers either by the acquisition of companies or by copying.

Important risks of knowledge leakage are identified in the supply chain of the European machine tool industry. This may occur during the transfer of components and parts throughout the supply chain. Sometimes knowledge may leak through the value channels of machine tool builders. SMEs transfer knowledge to big companies which perform operations such as tuning and optimization operations on machines. These big companies learn a lot from European SMEs and this European knowledge is transferred to producers in Asia through the global service channels of these big players.

The framework for IPR protection is on the way of improvement in Europe. The launch of a single European patent and litigation system can reduce costs for IPR protection. However, the capacity of Europe to stop knowledge leakage through global suppliers to competing nations depend largely on the IPR management capacity of companies. As far as third countries are concerned, the effectiveness of EU trade policy will have a determinant role for the improvement of enforcement and litigation mechanisms which are far too complicated and costly for SMEs.

ACTION

How to protect the European knowledge?

- European machine tool builders need to have a strong and clear strategy for IPR management. All actors in the supply chain need to have a common understanding of IPR risks and they should pay particular attention to sensitive issues of common interest.
- Companies should have easy access to consultancy services to get informed about risks and the legal framework in third countries.
- The EU should cooperate with third countries of critical importance to improve the IPR related legislation, for example by offering technical assistance.

V. Latest trends in global markets



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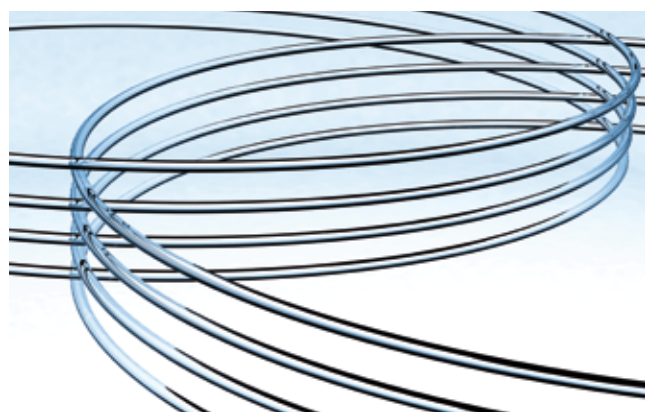
a) Global economic crisis and the machine tool industry

In 2008, the European machine tool industry saw a peak in output of 24.4 billion Euros, which dropped to 16.5 billion Euros by 2010 after two years of contraction during the global downturn. This equals to a drop from 44% to 33% in Europe's share in global output in machine tool production. The share of European exports in total global exports which amounted to 62% in 2008, dropped to 50% in two years' time. The prospects for 2011 are positive; 20% growth in output is forecasted and this would help the European production to reach 20 billion Euros.

Impact of the global economic crisis on European machine tool manufacturers has been as follows:

- Shift of market to emerging countries; market shares have been reshuffled during the crisis
- Small companies became even smaller and big companies got even bigger
- Trouble in the demand from traditional domestic markets after the crisis; local market has lost significant weight
- The weakening of the European market has a negative impact on R&D and innovation and end-users at proximity drive the demand for new solutions
- A certain number of companies did go through hard times and were acquired by other builders, both European and non-European
- Crisis forced to slow down R&D efforts for two years

- Overall, a low rate of company failure was observed in Europe
- Enormous cost pressures and inflation after the crisis was observed; inflation in raw materials, intermediary components and energy prices
- European customers are still very cautious in their capital expenditure programs.
- The difficulties in accessing finance are multiplied due to a deterioration of industry results
- Banks are more cautious about giving credit to SMEs; the machine tool industry is considered as a cyclical industry and a risky business. The financial system is also short of liquidity amid the government debt problem and subsequent deterioration of confidence
- Most companies were able to keep their skilled workforce; support schemes were helpful to maintain workers on the jobs
- In some companies the rate of workforce loss went up to 20%. Loss of workforce means loss of know-how and experience, which are both difficult to recover



Machine tool builders responded to the crisis in the following way:

- Cost cutting to cope with vanishing income (competitors from developed and developing Asia benefited from broad government support)
- Adjustments in production capacity
- Flexible working hours
- Adoption of solutions to increase productivity
- Increasing focus on emerging markets
- Concentrating on more customer-oriented business strategies
- Increasing automation and taking new tools in use to tackle the labour shortage threat in the long-term

The global economic crisis has brought about dramatic changes in the global machine tool markets. Besides a strong shift in machine tool consumption to developing countries mainly in Asia, an important change in the post-crisis era is an ever increasing competition in international markets due to the emergence of ever stronger competitors in Asia. Today, European machine tool companies are faced with a dramatically new business environment.

The global economic crisis

Europe has borne witness to a radical shift of machine tool consumption to developing countries over the last decade.

The global economic crisis has further accelerated this trend. Europe represented three quarters of the world consumption of machine tools at the turn of the century, whereas today Asia has taken over this share and Europe's share dropped to one quarter of world consumption.

Asia is forecasted to maintain this share whilst consumption will grow even further.

Today, 79% of European machine tool production is exported and 62% of these exports go to non-CECIMO countries.

All important business opportunities for European manufacturers are and will be outside Europe.

b) Global competition

European machine tool builders together with the Japanese, American and Taiwanese manufacturers have dominated the high-end machine tool markets for a long time. However, manufacturers from other developed Asian countries such as Korea and recently from emerging countries such as China have come to challenge the traditional big players. Manufacturers from developing Asian countries have already taken their places among the top machine tool suppliers of the world in terms of production volume, next to European firms. The rapid technological development in Asia, coupled with low labour costs, risks eroding the competitiveness of the European machine tool industry in global markets.

Main competitors of Europe have recovered relatively faster from the crisis. Over the last two years, Europe has lost its market share to competitors from Japan, Korea, China and Taiwan, which have experienced a much greater surge in their orders mainly thanks to their dynamic local markets. Following the significant shift of consumption towards Asian markets, European machine tool builders need to compete with their major Asian competitors in their home markets or neighboring countries. Protectionist policies and barriers to trade hinder the access of European machine tool builders to high growth third country markets. The playing field is not even, as global rules of trade lack teeth.

Main competitors of Europe have recovered relatively faster from the economic crisis.

The machine tool industry, the key driver of the industrialization process in emerging countries, will continue to receive government support in the form of grants, subsidies and investment capital. Moreover, investments in manufacturing infrastructure, including education and research, will help Asian manufacturers develop their indigenous innovation capacity. The competition will get only fiercer in the coming years.

c) Buyers' markets

Customer requirements are changing rapidly due to their constant search for new technological requirements to enhance their competitive advantage in the face of an increasing competition. Grand challenges such as climate change and environmental degradation are other important factors which drive changes in buyers' markets. The diversification of the customer base means that machine tool builders need to respond to specific technical needs of customers in different regions and locations.

Increased global competition and grand societal challenges are driving the changes in customer requirements.

European machine tool builders cannot sell the same machine in Europe and China. Chinese customers do not want sophisticated, complex and expensive machines. Even though European machines are aligned to Chinese needs, they turn out to be too expensive for Chinese customers mostly because of the stringent standards manufacturers have to meet in Europe. Basic machines with



fewer functionalities which are precise and productive satisfy the customer base in emerging markets. European manufacturers need to change their product configurations and specifications accordingly, which are currently adapted to European regulations.

Nevertheless, precise and reliable parts and production are still pre-requisites for most important machine tool end-user industries, such as automotive and aerospace. Furthermore, total cost of ownership (TCO) and life-time cost thinking are becoming more important in customers' purchasing decisions. Especially big end-users, but also SMEs, pay attention to TCO which covers environmental aspects (e.g. energy use, recycling) and health and safety. Machine tool companies need to supply machines with smaller volume and reduced environmental footprint to reduce total cost of ownership. Risk is passing more onto manufacturers in terms of availability and machine tool output.

Total cost of ownership and life-time cost thinking increasingly affect customers' purchasing decisions.

In the automotive industry, the downsizing of engines will increase needs for machining smaller parts. Machine tool industry will need to adapt to this also by reducing the footprint of machine tools by shifting to more environmentally-friendly processes and reducing the size of machines. As carbon-intensive emerging countries shift to greener production practices and products, new opportunities will arise for machine tool builders from Europe.

d) New business and technological trends in the machine tool industry

TRENDS IN BUSINESS MODELS

Supplying a complex production technology to the customer requires large after sales services, such as training, consultation, maintenance and repairs. Machines and related services are increasingly getting integrated and being traded by

machine tool suppliers in one package. Technical services such as after-sales service and life-cycle support have gained increased importance.

Machine tool builders are trying to figure out ways to turn technical services into a profitable business. They need to think about solutions to create more value through new services. For example, there is a strong demand in application engineering in developing Asian countries, but European companies do not charge their customers for these services. Europe is good at providing application and integrated solutions, but customers in developing countries do not want to pay for that. On the other hand, customers no longer have sufficient resources to operate/monitor their machine tools or to further develop production technologies. This opens up space for machine tool manufacturers to get closer customer intimacy.

INTERNATIONALISATION

The increasing international competition and new trends in the markets require a transformation of the machine tool industry where companies are often focused on products and technology. The new globalized business environment calls for a managerial and organizational mutation in companies. A holistic approach is needed in order to cope with market challenges which show higher complexity compared to a few years ago.

The new globalized business environment calls for a managerial and organizational transformation in companies.

Knowledge has a very important role in modern economy. Machine tool builders need to learn to use knowledge as a competitive and economic asset. This requires an efficient use of ICT, mastering legal and contractual issues to protect investments in third markets and IPR issues.

PRODUCTION STRATEGY

The openness of the international markets encourages European Machine tool builders to outsource low added value production to the countries with lower production costs. Outsourcing is increasing and creating more complex added value chains. Understanding customer needs is the key factor for successful outsourcing; the problem is to find a way to create this understanding between supplier and manufacturer.

At the same time, outsourcing to 'low cost' countries is a double-edged sword. It is hard to estimate for how long one country will remain low cost. Manufacturers need to question if the need for significantly increased quality control and higher inventory volume and cost can mitigate the lower purchase price. Technology protection, costs and resources affect the outsourcing strategy.

Outsourcing to 'low cost' countries is a double-edged sword.

As major customers in automotive and other end-user industries continue to relocate their production and consumption in emerging countries continue to grow, European machine tool manufacturers will be forced to follow them. They need to adjust their operations to be able to provide their customers in overseas markets with customized products at low costs and just-in-time. Another major force which pushes machine tool builders to expand their presence in emerging markets is the increasing demand for low/mid-value machines in these countries. It is impossible for European machine tool builders to cope with low labour costs in Asian countries in the production of machines in this range, which are standard machines that can be mass produced. Nevertheless, the big market volume in this range presents important business opportunities for European manufacturers to boost their sales.

European machine tool builders are increasingly forced to follow customers which relocate and expand to international markets.

Machine tool builders consider the option of producing low/mid-range machines in Asia at low costs but with high quality enabled by European expertise. Some European companies have been running their production plants in developing countries for some time. This strategy can help European manufacturers to tap the growth potential of the market for mid-range machine tools in emerging countries. The generated profits can be a valuable source of finance to invest in innovations and high-value products which they would continue to develop and produce in Europe. In this option, special attention needs to be paid to preventing know-how transfer. Smart strategies for IPR protection and reinvesting in Europe will help Europe remain a sound competitive manufacturing base.

NEW TECHNOLOGIES

The massive increase in consumption of capital goods in China unveiled the huge market potential for middle-class, low-price machines with relatively low input of innovation. Nevertheless, European machine tool builders are specialized in advanced, highly precise, multi-purpose machines. In the high-end markets, productivity, quality, accuracy, service and price of machines will continue to determine the customer's choice.

The machine tool market is largely split in two segments: low-cost & high-volume machine tools and high-end & customized machine tools.

The machine tool market is largely split in two or three segments: low-cost, high-volume machine tools and high-end, customized machine tools. Major technological trends in the high-end segment include advances in machining technologies to achieve faster processes with fewer resources (e.g.net and near-net technologies); processing technologies for new materials (glass, composites, titanium); advances in precision, reliability and productivity; increasing automation to eliminate monotonous work and ensure a more extensive scope of delivery; improvements in machine-user interface to improve safety and ergonomic aspects.

New approaches to design aim at ensuring modularity, flexibility, adaptability and easy integration of machines within manufacturing systems. Manufacturers need to provide more flexible solutions to meet volatility and rapid changes in demand. Machines need to have a reduced environmental footprint to meet total cost of ownership requirements. In the future, machines will have more functions and features than today's machine tools.

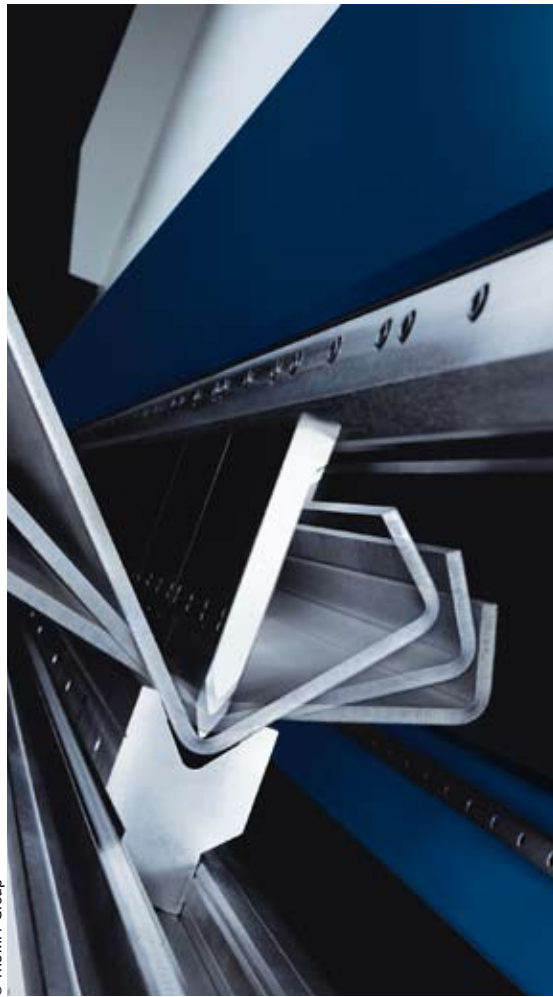
Machine tools are seen more and more as part of the manufacturing process, not as an independent resource with no connection to other processes. Machine tool builders strive to ensure their integration to the value chain of their customers. Lean production, co-design and cooperation with suppliers are becoming more and more important.

VI. Strategic outlook



a) SWOT analysis Strengths

| Strengths | Weaknesses |
|--|---|
| <ul style="list-style-type: none"> • High-end technology • High skilled labour • Accumulated engineering experience • Innovation capacity • The existence of excellent downstream suppliers in Europe • Vocational training • Multilingualism • Public R&D resources • Customer intimacy | <ul style="list-style-type: none"> • Small enterprise dimension to attack global market • Administrative burdens, restrictions, tight regulations • Difficult access to Asian markets • Limited access to finance (total risk on owner in SMEs) • Not sufficient supply of labour • Average small size of suppliers • Unfavourable cost structure • Image/priority amongst young people • Adapting products to Chinese markets • Marketing (especially in third countries markets) |
| Opportunities | Threats |
| <ul style="list-style-type: none"> • Strong European image/brand • Customer intimacy (develop customer services and turn it into value. Customers do not have their own people to develop production solutions) • Shift towards green economy • Rising demand in China • Further EU enlargement • Global economy growth - rising technical requirements • Automation • Free trade agreements | <ul style="list-style-type: none"> • Chinese competition • Shrinking of manufacturing industry in China • Moving of the European manufacturing to Asia • Access to materials • New low cost competitors from Taiwan first and then from China • Limited interest of students in engineering • Subcontracting network loses competitiveness • IPR infringements • Subsidizing non-EU competitor investors with EU public money • Ageing population, early retirement • Financial system risks |



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STRENGTHS

Machine tools are highly sophisticated products with high knowledge content. Once the mechanical and electronic parts are put together, it is the engineering knowledge that brings the machines into movement. Building up a competitive machine tool manufacturing base is a hard job. It may take competitor nations many years to establish a competitive supplier chain, develop indigenous innovation capacity and raise the skilled workforce which can apply knowledge in process and product development. Europe enjoys a very strong advantage thanks to a top level engineering knowledge which helps it to maintain its position as the pioneer of technological progress and innovation. Europe's strength in developing customized solutions help manufacturers differentiate from international competitors which provide standard mass-produced machines.

WEAKNESSES

More than 80% of European machine tool manufacturers are SMEs which have enjoyed a strong growth driven by a strong demand from the European market. Their specialization in customized solutions and proximity to major industrial sectors helped them reach a level of production expertise

that most competitors cannot match. However, today's business opportunities are in developing Asian markets and SMEs lack the capacity to expand to international markets. Strict regulations in Europe prevent European manufacturers from matching the cost-effectiveness of manufacturers in developing countries.

Moreover, trade barriers and protectionism further hinder market access in Asia. It is a challenge for European manufacturers to adapt their products to the Chinese market as strict European regulations prevent them from matching costs and price levels offered by other competitors. In the face of the debt crisis and an environment of mistrust in financial markets, the machine tool industry, as a cyclical business, is treated as a high risk customer by banks which refuse to release credits. SMEs are mainly family owned enterprises and the entire risk falls on one person: the owner of the company.

OPPORTUNITIES

European machine tool builders have traditionally a strong position in global markets and a good reputation for the precision, reliability and the quality of their machines. They have been on the market for decades whereas many competitors from emerging countries are very new to this sector. European companies are able to create very high value for their customers by providing manufacturing solutions with customer intimacy. European companies strengthen their positioning vis-à-vis customers by signaling this value through increasing marketing activities. They can build up their marketing strategy on the European brand which has a well-established recognition.

The second step would be to turn the value they create through customized services into a premium price. Customers do not have their own people to develop production solutions, which is an opportunity for machine tool builders. They can integrate themselves in the value chain of customers from competitors by offering integrated production solutions. With the shift to a low-carbon economy, they can tap the market for machines with reduced footprint, and they can also create value by offering solutions which help customers to have a control on life cycle costs. As long as the global competition continues to push industries to constantly improve their products, the growing market for high-precision parts and components will drive demand for new processes.

THREATS

Chinese companies aim at increasing their competitiveness at medium-level technology to compete at international level. This is a threat to standard machine tool manufacturers in Europe. They cannot cope with the labour and other input costs in Asia, thus they are unlikely to be able to compete with these manufacturers in their domestic markets where the customer base is. Furthermore, the rise of the Chinese competitiveness in mid-range machine tools would mean that Europe will be squashed into a very narrow niche market for high-end machines. Europe cannot live on these niche markets which correspond only to 20% of the market. Meanwhile, the new competitors may threaten the position of Europe in high-end markets as they continue to improve their R&D base.

European machine tool builders fear that the extraordinary growth of consumption in China will come to an end one day. This would represent a drastic drop in world consumption as China is the largest consumer of machine tools in the world and absorbs 30% of European exports. The European market has lost its significance and manufacturers rely on exports to emerging countries to sustain their business. The shift of the entire machine tool manufacturing base from Europe to Asia is a concern in the long run. Machine tool builders are already forced to relocate low-value operations to Asian countries and to follow their customers which shift their investments to emerging countries. Machine tool manufacturers state that the forces pushing the manufacturing base to relocate are as follows: the need to maintain customer intimacy, costs and Asian governments' policies which try to affect the location of manufacturing through tax incentives, subsidies, minimum local content requirements and trade barriers.

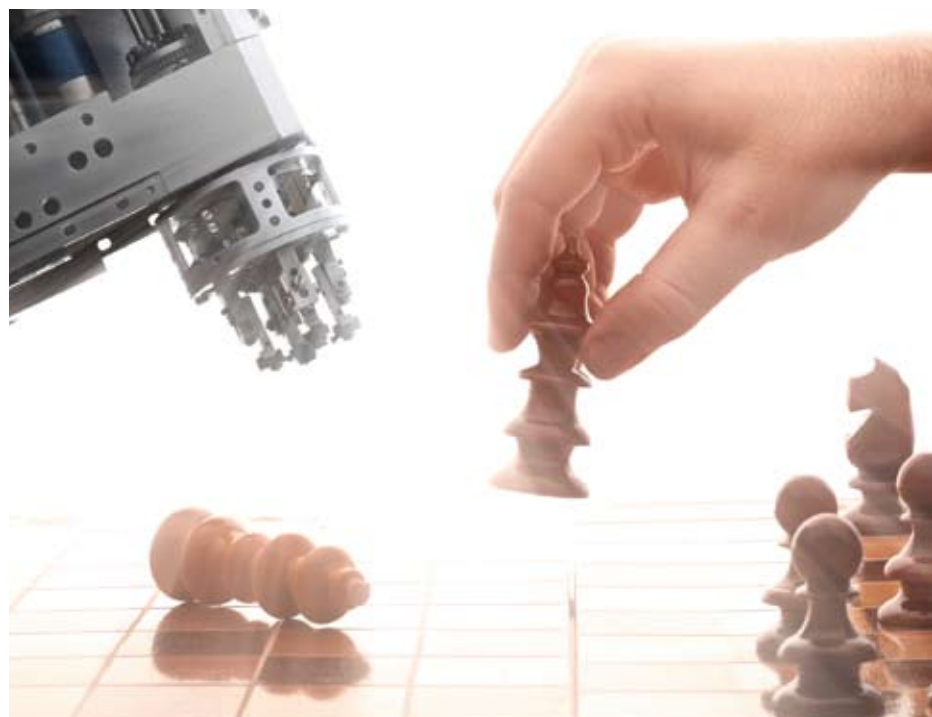
Bottlenecks in the supply chain have recently disrupted the machine tool industry. This was partly due to the inability of suppliers to ramp up production during the economic upturn and partly due to soaring energy and material costs. As China and other emerging countries develop their manufacturing base, the competition over material resources are increasing and the export restrictions on raw material are a concern for the European machine tool industry. Disruption in any part of the supply chain affects lead-times and prices.

b) Strategic options

When European machine tool builders were asked about future scenarios, they described both optimistic and pessimistic options for the future of the sector.

In one of the scenarios, Asia keeps growing its technology and Asian companies gradually push European manufacturers out of Asian markets. Europeans are squashed into the EU market which continues to stagnate. Asian manufacturers, thanks to their rapid growth and high capitalization, continue buying European machine tool companies for know-how transfer. European exports decline. Chinese share in global consumption grows above 60%, top Chinese manufacturers which are strongly backed up by governments appear and they challenge European machine tool builders.

In another scenario, a slight increase in markets is observed, however this comes along significant changes in market segments. Due to productivity improvements, the number of machines sold in the main historical markets does not grow anymore, and maybe it declines. Market growth is driven from new markets such as machining of new materials (e.g. titanium - composites) and from new applications such as medical parts. Innovative machine tool firms survive high competition, but small firms with limited resources for R&D lag behind due to lack of competitiveness and they end up being pushed out of business or being bought up by bigger firms. The market in the future is dominated by medium and large sized firms.



In an ideal future scenario depicted by some European machine tool manufacturers, European companies become bigger and more international.

Machine tool builders describe the desired scenario as follows:

European companies become bigger and more international, which provides them with the required horsepower to cope with emerging Asian competitors. Competitiveness is based on high performance solutions including automation and innovation in products such as energy-efficiency and sustainability. European machine tool builders increase the service content of their value proposal and reach high profitability levels. Europe lives up to the internationalisation challenge and resists against the Chinese expansion. European manufacturers win in global markets by:

- maintaining their position as leaders in technology, innovation, quality and the ability to satisfy the specific needs of each customer;
- developing strong commercial and service networks in China and Asia, serving these markets in the best way possible and with comfortable returns.

VII. Recommendations for enhancing the competitiveness of the European machine tool industry



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a) Recommendations to the industry

PROTECT YOUR KNOWLEDGE.

Knowledge is a strategic asset for a machine tool company. Companies should pay more attention to the protection of their know-how as they increase their interaction with global markets. Neither universities, nor small and medium machine tool builders have sufficient expertise on how to effectively protect their intellectual property. Maintaining manufacturing in Europe is a priority for European machine tool builders. Knowledge protection is key to helping them to continue creating value in Europe and ensure a competitive edge.

CONTINUE DEVELOPING NEW TECHNOLOGIES.

In the face of increased global competition, innovation will be the only way to help European manufacturers to differentiate. Big and small manufacturers should focus on the development of new processes to machine new materials and address niche market needs such as the rapidly growing med-tech industry.

FORM ALLIANCES AND GO ON THE INTERNATIONAL MARKET TOGETHER.

SMEs cannot respond alone to new business challenges in global markets; they lack skills, expertise and resources to cope with government-supported large players from emerging markets. European machine tool businesses should base their strategy on the creation of 'coalitions' and 'alliances'. They should consider developing common/shared platforms for research and development by joining forces and strategic resources. SMEs should consider setting up common and joint activities outside Europe, such as using common platforms and services. Increased cooperation, or in other words 'co-opetition' can lead to more integrated forms of partnerships, which is in line with the desired scenario in which SMEs grow bigger and more international.

RETHINK YOUR BUSINESS ORGANIZATION AND BUSINESS MODEL. THINK INTERNATIONAL!

Especially small and medium-sized companies need to go through a managerial and organisational transformation to adapt their operations to international markets. They need to develop their capacities for strategic resource management and enhance their ability to tap the opportunities existing in the overseas markets.

INVEST IN MARKETING.

European machine tool builders need to intensify their marketing efforts especially in third countries markets where they enter for the first time. In these markets, they are facing competition from local manufacturers with strong distribution channels and low prices. Moreover, Japan and Korea enjoy many advantages in the Asian markets due to their cultural and geographical proximity. European manufacturers are good at creating value for customers through custom-made solutions; however, in the face of a strong price competition they need to make more efforts to signal to customers the value they create and convince them to pay a premium price for their products.

PROMOTE AND MAKE USE OF THE 'MADE IN EUROPE' BRAND.

European machine tool brands enjoy a long-standing reputation all over the world. It is recommended to machine tool companies to place a strong emphasis on the 'made in Europe' brand in their marketing activities. A collective made-in-Europe campaign has a high potential to help streamline efforts in this direction.

UNDERSTAND CHINA.

China is the biggest market for European exports and its significance is forecasted to grow in the near future. Machine tool builders are recommended to increase their acquaintance with China and the business culture in China.

This knowledge is important for the selection of the right marketing strategies; for supporting companies in their decisions to enter into partnership with Asian companies and finally, for the protection of their assets and IPR in third countries.

BE IN CHINA.

European manufacturers need to develop their ties with China in one way or another to support the growth of their companies. They need to tap the growth potential of this market to offset the impacts of stagnating consumption in Europe and increase their economic performance. They need to be in China partly or entirely. Big companies which have sufficient resources and management capacity are recommended to invest in China to tap the potential of local resources and cost advantages.

PRODUCE AFFORDABLE GOODS FOR GROWING MARKETS.

European manufacturers are specialized in the supply of sophisticated, high-end machines with high customer intimacy. The economic growth in China is driven by a rapid industrialization process and the customers of machine tools are mainly young companies at low-to-medium technology. They can supply standard machine tools which can make some basic operations from local manufacturers at very competitive prices. European companies are recommended to produce machines in this range, possibly under a different brand adapted to the local market in third countries. They can ensure cost-effectiveness by taking advantage of the local suppliers and cheap labour, and at the same time they can differentiate from local competitors by providing products and services in European standards.

INVEST IN VOCATIONAL TRAINING AND IN RAISING THE FUTURE WORKFORCE.

A lack of qualified workforce is a serious threat to the future of the machine tool industry. There is little skilled labour availability on the markets and it is a long process to prepare a young graduate for an engineering career in a technically demanding sector such as machine tools. Companies should invest in internship and training programmes for young engineers by establishing partnerships with technical schools and universities. Moreover, they should invest in vocational training to upgrade the skills of their existing staff and to prepare them for new technological and market challenges.



b) Recommendations to European policy makers and national governments

RECOGNIZE THE MACHINE TOOL INDUSTRY AS A STRATEGIC SECTOR.

Machine tools and instrumental goods sectors are one of the few engines of the competitiveness of the European economy. The EU Key Enabling Technologies initiative has recognized the enabling role of 'advanced manufacturing systems' which covers machine tools. Following up on this, all EU and national policies including education, research and innovation should pay particular attention to helping the European machine tool industry maintaining and developing its leadership position in the world.

CONCENTRATE ON INDUSTRY-DRIVEN INNOVATION AND SUPPORT IT.

All product and service innovations link to a manufacturing process. The EU innovation policy should aim at increasing the innovation capacity of the European manufacturing base. The policy measures should include support for industry-academia cooperation, training of skilled personnel and investments in manufacturing research and development. Policy measures and funding instruments should have a clear focus on manufacturing research which has an impact on the competitiveness of manufacturing technology suppliers. Support for advanced manufacturing will enable Europe to develop and produce products and services required to tackle grand societal challenges and to ensure the shift towards a resource-efficient low carbon economy.

MODERNIZE THE EUROPEAN INDUSTRIAL BASE. KEEP MANUFACTURING IN EUROPE.

The European industrial base needs to be continuously upgraded technologically to boost its competitive force vis-à-vis increasing rivalry from emerging countries. An overhaul of the industrial base and factories could help revitalize the overall industrial growth by impacting on all upstream industries. This needs a holistic policy response comprising measures such as tax or economic incentives to upgrade machinery which will encourage widely adoption of modern production solutions in factories in Europe.

A comprehensive modernization plan for the manufacturing industry is needed to trigger innovation in the upstream suppliers in the value chain to boost the competitiveness of the European economy. The machine tool industry and advanced manufacturing in Europe owes their strength to competitive manufacturers which produce in Europe.



SUPPORT INTER-LINKAGES AND COOPERATION IN THE VALUE CHAIN TO TRIGGER INNOVATION.

Policy-makers in Europe should help streamline the links between machine tool builders, their suppliers and end-users by facilitating the establishment of cooperative networks which will spur innovation throughout the value chain. End-users should be encouraged to upgrade their old production systems and whilst doing so, they should get SMEs on board in the development of new technologies. SMEs have difficulties accessing their customers; they lack knowledge about research actors in other EU countries. The EU can help SMEs connect with research institutes in other EU Member States and encourage cooperation in applied research activities.

ENSURE A FAVOURABLE BUSINESS ENVIRONMENT IN EUROPE AND ADEQUATE ACCESS TO FINANCE.

European policy-makers and regulators should make sure that there is a favourable climate for manufacturing investments in Europe which, first of all, requires reduced administrative burden and bureaucracy as well as easy access to finance. Access to finance is a major problem which hinders new investments in new equipment and machinery. Moreover, machine tool builders have difficulties finding finance for their exports. Banks make a performance assessment to release credit lines to companies.

Machine tool companies should not be evaluated only in 'financial' terms by financial actors. The special conditions stemming from the cyclical character of the industry should be taken into consideration. Governments should try to stimulate private financing and increase financing options for companies.

REMOVE BARRIERS TO TRADE IN THIRD COUNTRIES MARKETS AND ENSURE A GLOBAL LEVEL PLAYING FIELD.

The EU needs to give a strong response to the new industrial policies based on protectionism and indigenous innovation in emerging countries. The more these countries grow their manufacturing capabilities, the more they block the entry of machine tools which are supplied by the local industry, into their home market. Customs duties, import licenses and certification requirements are widely used as protectionist measures.

The EU should, moreover, help eliminate barriers to investment to facilitate investment in third countries markets for SMEs and their suppliers. European machine tool builders should be able to have fully-owned affiliates in third countries without having to share their knowledge with third parties. The EU should define shared rules for the protection of investments and IPR.

Another effective way to facilitate market access is to push for the removal of deep diversification in markets and ensure the adoption of unified practices. The EU should continue promoting European and ISO standards in third countries to enable the cost-effective access of European companies. At home, national institutes could help SMEs adapt to third-country standards by offering assistance and special services. Effective representation of SMEs in ISO and CEN/CENELEC groups should be ensured as a part of this strategy.

PROVIDE SUPPORT FOR INTERNATIONALISATION OF SMES AND MARKET ACCESS.

The EU should support for market access in the way they do in technology development support. SMEs need to have facilitated access to consultants and training to get advice and increase their knowledge on new markets, strategic management and IPR protection. Common support structures at EU level should assist SMEs in finding partners in third countries and by providing consultancy and advice.

HELP PROTECT THE EUROPEAN KNOWLEDGE.

A European single patent and litigation system has an important potential to reduce costs of protecting knowledge. In third countries, companies are exposed to know-how leakage risks in joint-ventures, acquisitions, etc. due to the weak legal framework. Costly and complicated litigation procedures make it impossible for SMEs to sue infringers. The EU should continue its efforts to convince third-country governments to streamline their legislation and litigation mechanisms. Support structures at European level should be better promoted to SMEs.

INCREASE R&D FUNDS FOR ADVANCED MANUFACTURING AND ENCOURAGE SME PARTICIPATION IN R&D PROGRAMMES.

Recent initiatives with a strong focus on manufacturing technologies such as the Factories of the Future public-private partnership, which helped simplify application procedures, increase the industrial participation rate and bring research results closer to the market. However, some small-sized companies still face difficulties in providing human and financial resources to participate in R&D projects. R&D funding should finance 'production chain projects' and procedural rules should ensure that end-users bring along small-sized suppliers with them into projects.



HELP RAISE THE FUTURE WORKFORCE FOR MANUFACTURING.

Europe has an excellent high education infrastructure and institutes to raise top-quality engineers. The main problem of Europe is to attract students to engineering studies. Students should be encouraged to consider the technical departments of universities through scholarships and other incentives. Moreover, governments should figure out solutions to help make the machine tool industry more attractive for entrepreneurs and employees. Vocational training centers should receive support from public bodies; access to SMEs should be facilitated.

ENSURE SMART REGULATION IN ENERGY-EFFICIENCY.

Regulations should be drafted taking into account the industrial reality and involving industrial experts. Possible regulation should not ignore the demand side and be complemented by support measures to help boost demand for energy-efficient equipment.

Energy efficiency regulation should take into account the performance needs of production machinery and it should not penalize productivity. The EU should support the development of standards drafted by industry. Eventual regulations should be supported by harmonized standards. Standards may help implement self-regulation as well depending on the methodology used.

STREAMLINE LAW ENFORCEMENT AND MARKET SURVEILLANCE IN THE INTERNAL MARKET.

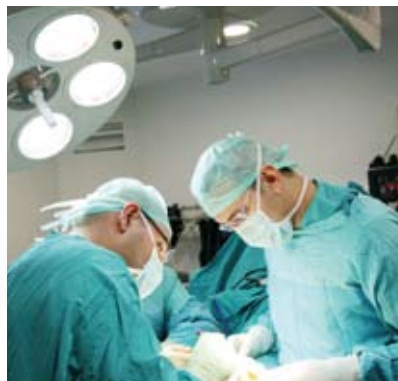
Effective enforcement of EU regulations guarantees the application of standards by all players and ensures a level-playing field in the Single Market. Currently, weak market surveillance and the absence of controls at the borders fail to stop non-compliant machinery into the Single Market, which exposes European manufacturers to unfair competition. This threatens the competitiveness of European industry and safety in the workplace. The EU and Member States should ensure that they have uniformed laws and controls in all Member States and that they enhance border controls.



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Machine tools: enabling the European manufacturing base







cecimo

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The Manufacturing Technologies Association

cecimo is the European Association representing the common interests of the Machine Tool Industries globally and at EU level. We bring together 15 national Associations of Machine Tool Builders, which represent approximately 1500 industrial enterprises in Europe*, over 80% of which are SMEs. CECIMO covers more than 97% of total Machine Tool production in Europe and more than one third worldwide. CECIMO assumes a key role in determining the strategic direction of the European machine tool industry and promotes the development of the sector in the fields of economy, technology and science.

* Europe = EU + EFTA + Turkey