European Mechanical Engineering's Experiences with the 6th Framework Programme for Research and Technological Development

Orgalime Position Paper
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1. Introduction

Orgalime is the liaison group representing the interests of the European mechanical, electrical, electronic and metalworking industries at the level of the EU. Orgalime's members include, at the present time, 32 national trade federations representing some 130,000 companies in 21 European countries. These industries, which include mainly small and medium sized companies, employ some 7.3 million people and account for around 1,200 billion Euro in the GNP and one third of the industrial exports of the EU. The present position paper is issued by the mechanical engineering branch of Orgalime.

2. The Mechanical Engineering Industry Sector

A snapshot of the industry- a world leader
Mechanical Engineering accounts for approximately one third of the engineering industry which Orgalime represents. The European Mechanical Engineering industry had an annual production value of € 412 billion in 2002. It is dominated by SMEs, with 140,000 companies employing 2.5 million people. Only 21,600 (15%) of these employ 20 persons or more. Only 4,500 (3%) of these companies employ 100 or more people.

EU Mechanical Engineering is a very export oriented Industry: € 129 Bn of equipment was exported outside the EU in 2001, a notable export share. Among all NACE 2-digit level sectors Mechanical Engineering is the one that contributes the largest trade surplus to the EU economy: over € 67 billion. The EU controls a 36 % share in world machinery trade. It is the largest producer of mechanical engineering equipment in the world, clearly surpassing USA (€ 330 Bn in 2001) and far ahead of Japan (€ 196 Bn). Its dominance is even more marked in terms of export: the EU's export prowess contrasts advantageously with USA's € 77 Bn and more than doubles Japan's € 60 Bn. Output of mechanical engineering equipment is growing much faster in China than in the Triad. China is thus becoming a serious competitor for the EU.

If the EU has achieved a predominant role at world level, this is due to the technological excellence of the products produced by EU mechanical engineering companies. It is therefore in the context of maintaining this position of excellence that this position paper must be viewed.

The enabling industry
Mechanical Engineering supplies enabling technology for all parts of the economy and thus is one of the most important and largest industrial sectors of the European Union. This sector plays a key role in the competitiveness of European industry. Its prime customer is manufacturing industry to which it essentially supplies capital goods. It thereby enables all other sectors to advance technologically. Some concrete examples are:

- As the major supplier of manufacturing equipment and of mechanical parts for the automotive and the aeronautic sectors, innovation from mechanical engineering companies enables these two strategic industries to constantly reduce costs, increase quality and thus remain competitive.

- Plastic injection moulding enabled the domestic appliances industry to manufacture high volumes of competitively priced products.
- Laser cutting and welding enabled the spread of titanium products.
- Ultra precision machining enabled the cheap production of optical lenses for use in CD equipment.

Mechanical Engineering is a very wide and diverse sector. Among the main sub-sectors are lifting and handling equipment, machine tools, textile machines, agricultural machines, construction equipment, transmission technology, compressors, pumps, air conditioning equipment, combustion engines, windmills, special machines and other manufacturing machinery. Table 1 gives an approximate of the main sectors, measured by production.

Complex technologies are used to develop these products e.g. forging, machining, sheet-metal technologies, laser technologies (laser cutting etc), material technologies, joining (welding etc.), mechatronics / embedded systems, industrial engineering, surfacing, maintenance and service etc. These technologies need constant upgrading, which in turn can only be achieved by maintaining a high degree of research and development activities within this sector.

The technological advance in Mechanical Engineering has a huge impact across the entire society and is comparable to that of Information and Communication Technologies (ICT). Mechanical Engineering technologies and products are essential factors for boosting the competitiveness of all other sectors of society (chemical, automotive, process, food, textile). It is therefore essential that the European Commission, when defining research priorities in its research programmes, pay considerable attention to the development of these enabling technologies, to ensure that it can maintain the competitive edge, that this sector and other production sectors using machinery would otherwise risk to lose.

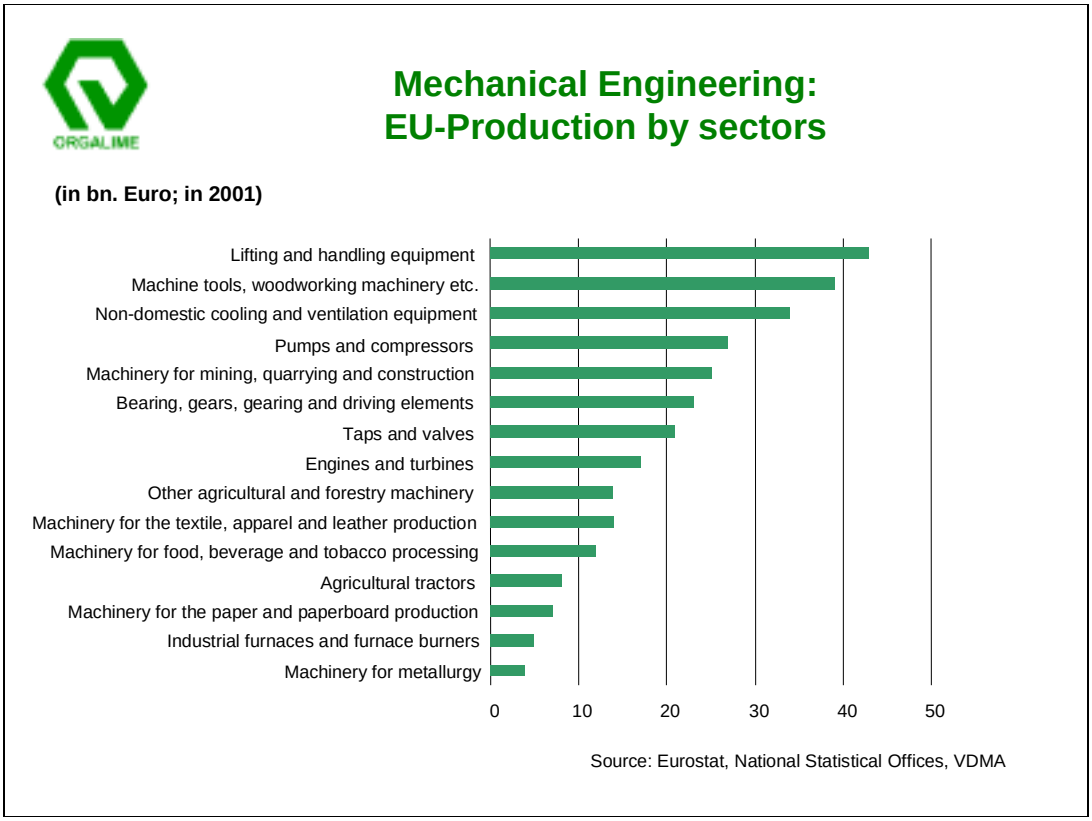

Table 1: Turnover of several sub-sectors of Mechanical Engineering

3. Mechanical Engineering is not adequately addressed in 6th FP

The Mechanical Engineering industry is only barely addressed in the priorities of the 6th RTD Framework Programme (6th FP). This leads to a very **scattered and dispersed approach** for the industry as a whole. Of the seven thematic priorities in 6th FP some are more relevant than others for the Mechanical Engineering industry. At present, the priorities of relevance for the Mechanical Engineering industries can mainly be found under priority 2 (IST), priority 3 (NMP) and priority 6 (Energy).

However, with this dispersion of the core activities of the mechanical engineering sector, companies are required to thoroughly study the 6th FP to identify possible areas of relevance to their activities. With the current set up, it is very difficult for mechanical engineering companies to recognise their core activities in the priorities of the 6th FP. Table 2 below indicates the degree to which the thematic priorities of 6th FP address key enabling technologies that play an essential role in the mechanical engineering sector.

	Key enabling technologies of Mechanical Engineering						
Thematic priorities of 6th FP	**ICT**	**Mgmnt Information Systems**	**Integrated Design Tools**	**Materials**	**Mecha-tronics**	**Energy**	**Manu-facturing**
Priority 1: Life sciences, genomics and biotechnology for health							
Priority 2: Information society technologies	**X**	**X**	**X**	**O**	**O**		**O**
Priority 3: NMP							
3.1 Nanotechnologies and nanosciences				**X**			**X**
3.2 Knowledge-based multifunctional materials				**X**			**X**
3.3 New production processes and devices					**O**		**X**
Priority 4: Aeronautics and space			**X**	**X**	**O**		**X**
Priority 5: Food quality and safety							
Priority 6: Sustainable development, global change and ecosystems							
6.1 Sustainable energy systems				**O**	**O**	**X**	
6.2 Sustainable surface transport			**X**	**X**	**O**		**X**
6.3 Global change and ecosystems							
Priority 7: Citizens and governance in a knowledge-based society							

Table 2: Thematic priorities and Mechanical Engineering

O: indirect reference to the enabling technology
X: clearly targeting the enabling technology

The mechanical engineering industry is the main supplier of the means of production for a range of other application domains. It would therefore be highly desirable to concentrate such key enabling technologies under one distinctive topic under the 6th FP and to adapt future programmes. If these enabling technologies as listed below were made more visible, recognisable and addressable, innovative mechanical engineering companies would be more inclined to participate in the 6th FP. Examples of such key enabling technologies that the Mechanical Engineering sector relies upon, and where new developments can lead to breakthroughs also in other sectors are the following:

- **Data communication and data processing technologies**
  referred to as Information and Communication Technologies or "ICT"

- **Management Information Systems (MIS)**
  providing the supporting framework of the enterprise organizational aspects (Enterprise Resource Management, Supply Chain Management, Product Life Cycle Management…)

- **Integrated design capabilities**
  in support of product development and including eco design/ end of life concepts

- **Material technologies**

- **Mechatronics**,
  being a key discipline for the optimal application of different technologies such as material technology, control engineering, mechanics and dynamics, microtechnology, ICT, etc

- **Energy technologies**

- **Manufacturing technologies**

4. Mechanical Engineering industry – a key sector for the competitiveness of Europe

Innovation in the mechanical engineering sector is typically the product of the mechatronical design approach: the integrated application and development of different enabling technologies results in new products and functionalities. Although the 6th FP thematic priorities make reference to some of the enabling technologies that are important for the mechanical engineering sector, **the mechatronical design philosophy does not seem to be well recognised**. Furthermore, the thematic priorities provide few opportunities for innovating in the enormous range of products that are developed by the mechanical engineering sector, in particular those that are produced by small and medium sized enterprises.

The Mechanical Engineering industry is as technology driven as the aeronautics and space industry and the transportation industry. Its impact on society must not be underestimated. If a prosperous European manufacturing industry is desirable, the Mechanical Engineering companies should have a recognisable way to the RTD priorities and should find their RTD topics addressed. A concentrated approach will also increase the likelihood of spin-off effects to different application fields.

5. Funds distribution disadvantages European Mechanical Engineering

We are concerned by the fact that priority 3 has received very limited funding compared to several of the other priorities. Moreover, a somewhat disproportionate attention is being directed towards technologies whose final areas of application still remain very uncertain. Moreover, within priority 3, the allocated funding for the traditional mechanical engineering areas like processes and products is now extremely limited and has been considerably downsized. Furthermore, the impression is that the priorities in 6th FP are less suited for the mechanical engineering industry than the RTD topics of previous framework programmes.

The principle of allocating the bulk of funding in the 6th FP (around 80%) for the two new instruments, Integrated Projects and Networks of Excellence, must be questioned. These two instruments are untested in practice, and although most of the traditional instruments for funding can also be used for all the seven priorities mentioned above, the balance between new and old instruments appears to be far from optimal.

Considering the economic importance of this sector, its social dimension and its innovative capacity, we are concerned that this means that far too little resources are being allocated for this sector as a whole. Viewing the diversity of this sector, it is clear that too narrow limitations are being set in the given topic areas in the relevant section of the work programme. These should be extended to a wider field of technological areas. It is important that the RTD topics of the workprogrammes reflect the image of the mechanical engineering sector more accurately.

Possibly, a better balance should be struck for funding going to the new and the "old" instruments. Orgalime believes that a greater portion of the available budget should be re-distributed, for the next call, to the "older" instruments, and with less going to NoEs (at least within the production technology area). A better fund distribution also within the NMP priority should be achieved. When seen in relation to its economic importance for Europe and for society, it can appear that the Mechanical Engineering sector is being marginalised.

6. Instruments for the Mechanical Engineering sector

A very important segment of the Mechanical Engineering industry includes those companies which constitute the "mid-range". With between 250 – 1000 employees, it is precisely these companies which make up the bulk of the innovative enterprises, and which are most likely to be able to contribute and play a major role in the 6th FP. They have an annual turnover of between € 40 -150 million, of which we estimate some 3.5% is allocated for RTD (i.e. € 1.4 - 5.25 million). It is notably these companies which are the real drivers of the innovative processes in Mechanical Engineering and the ones which are most likely possess R&D capacity. When one analyses the preliminary results following the first call for the NMP priority, less than 40% of the projects are industry-led, although it is in fact industry which is the real driver of innovation, and the one to first apply and implement innovations. We therefore believe that these mid-range companies need to be more explicitly addressed with more appropriate instruments and relevant topics.

In relation to the needs of mechanical engineering companies, we are concerned that a significant portion of funding is being allocated to Networks of Excellence (NoEs). NoEs are not currently seen as being the most relevant instrument in satisfying the RTD needs of the mechanical engineering industry. Moreover the NoE currently lack strong industrial participation or guidance, and will mainly be driven by resesarch institutes. We are anxious that with the current set-up of the 6th FP it will be top R&D organisations (including research departments of big industrial enterprises) which will participate in, or take the lead for in particular the NoEs. It is important that the NoEs are more industrially driven.

The mid-layer of research organisations and enterprises that have been able to take the lead in 5th FP initiatives, may currently be able to act as the driver in the "Specific Targeted Research Projects" (STREPs). However, severe "breakthrough" requirements are in many cases even more heavily imposed on STREPs than on Integrated Projects. The "stairway of excellence" that was promised by the EC when announcing the STREPs is not really available. In the fields relevant to the mechanical engineering sector, incremental improvements do not seem to be appreciated by the Commission. This we believe needs to be reconsidered.

Organisations that did not play a role in previous framework programmes will have even bigger difficulties in participating in the 6th FP. The SME specific measure "Collective research" was expected to answer some of these difficulties. According to the Commission, the Pilot Action demonstrated an "enormous interest " and the "active role of business associations". However, more emphasis on the SME Core Group role and on dissemination and training activities was requested by the Commission. This new instrument appeared to be particularly relevant for, and was also welcomed by, IAGs (Industrial Organisations groupings) which are dominated by SME's. Taking into consideration the success of this new initiative and its value for SMEs, we recommend increasing the importance and the budget for collective research in future calls for the 6th FP.

Finally, for SMEs, there will be two ways to participate to Integrated Projects:

- **Joining ongoing IPs:**
  In that case, a specific mechanism should be created that will act as interface in between large IP co-ordinators and SMEs willing to participate to R&D in view of solving their problems. In that respect, several IAGs of the Mechanical Engineering Industries are proposing, with the endorsement of Orgalime, a Specific Support Action under the Call "Stepping up Economic and Technological Intelligence" (FP6-2003-INNOV-1) in order to efficiently organise this interface and to help SMEs in joining IPs.

- **To Propose their own IP through dedicated calls for IP for SMEs:**
  We fear that this new Instrument, specifically adapted to SME traditional (but high tech) industries has been insufficiently promoted, and not sufficiently explained, nor clarified in due time.

  Nevertheless, we think that IPs for SMEs can be a well suited instrument under the following conditions:

  - If it is clear that SMEs must lead these projects by having a decisive vote in their management, it must also be clear that any competent organisation (such as IAGs or Research Organisation) should have full possibility to daily co-ordinate such project, from the technical aspects, up to the financial and administrative ones. Most SMEs of traditional industries do not have the structure, the human resources, or the time to manage such a project.
  - "Breakthrough" must not be limited to a perception of entering "new paradigms" or creating scientific "rupture". Breakthroughs must also be accepted as bringing new competitive industrial edges. For example, a RTD project that will bring a 3% gain in competitiveness should be considered as a breakthrough project.
  - A project spanning a time period of four to five years is too long for SMEs. Conditions should be found to help SMEs to enter or leave an IP with **strict but simple** rules (e.g. participating in one specific work package instead of the whole project).
  - "SMEs with RTD capacities" must also be understood as SMEs that have the necessary resources (industrial equipment, human resources) to conduct an industrial validation of a new process resulting from the laboratory findings of an R&D Organisation.

7. Breakthrough Technologies in Mechanical Engineering

It is obvious that this sector also has experienced its share of major breakthroughs, although these have only been sparingly publicised, and hence are therefore generally less known. Breakthroughs have mainly been promoted in the B2B domain although their direct impact on end-user products has been huge. Those innovations enabled the creation of totally new products and considerably improved existing products, in particular from the price/quality perspective. One example is the constant improvement of machining precision. On Figure 1 we can view a combination of continuous improvements (evolution of one curve), which have been followed by breakthrough technologies (three different curves). This precision increase in machining is known as *Taniguchi's Law*. If one compares this to the better-known *Moore's Law* (figure 2), we see that the improvement of the machining technology goes hand in hand with the increased transistor density, enhancing the performance of the chip. In fact the machine tool industry enabled *Moore's Law* by constantly being able to produce more precise machines.

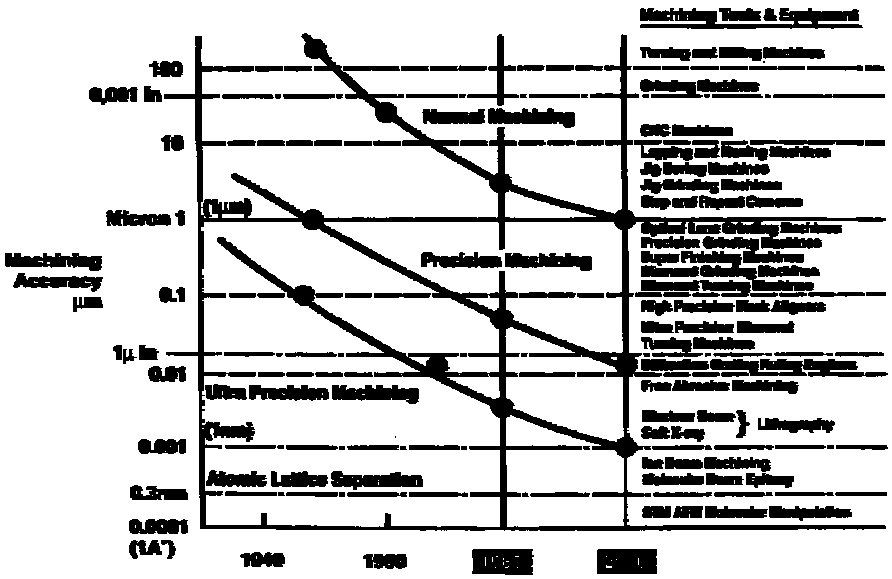

Figure 1. Taniguchi's Law

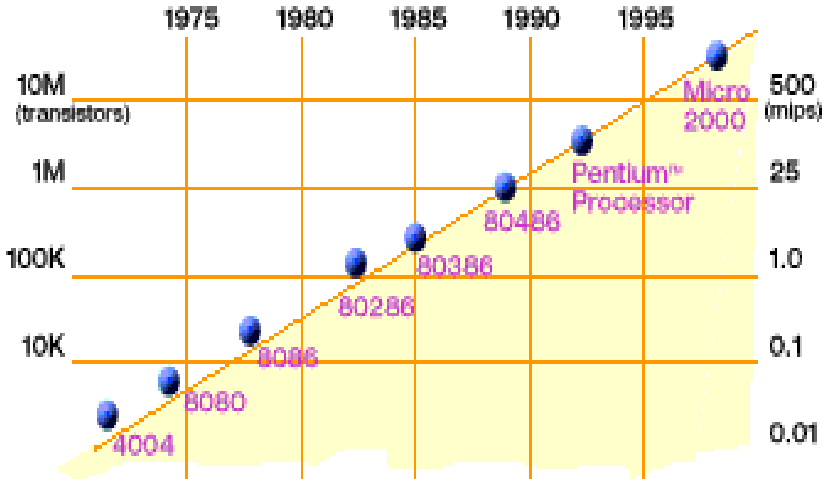

Figure 2. Moore's Law

The only way, however, to achieve such breakthroughs and sustained competitiveness has been to work with continuous improvement of processes, products and services. Then a combination of factors and the capability to integrate various interdisciplinary fields can be identified to boost a radical improvement.

This fundamental dependence between the various activities within all industrial environments has in our view largely been neglected in the 6th FP and the view that breakthrough technologies can be "ordered" to appear, if enough funding is made available, seems to have been used as a guideline. This is unrealistic.

A leading industry on global markets

The mechanical engineering industry is one of those relatively few sectors where European companies are the world market leaders. The breakthrough transition from "product supplier / ownership" to "value/access provider" can be seen as the most relevant challenge for this SME-

dominated industry. The value transition and management of life cycle challenges are key issues for sustainable growth and strengthening the position on the world market.

There is great need to develop the scientific and theoretical foundation for the paradigm shift from "product supplier/ownership" to "value/access provider" in the engineering industry. The 6th FP and future programmes must direct sufficient funding for research on this particular development of the mechanical engineering industry.

Due to the long-term scientific approach of the previous framework programmes and the lack of flow of results into real practice, much of industry has lost interest in participating in European Research because companies today also require results in the short term. The research mechanism should work more efficiently in a collaborative way by dynamic company networks. All the research and implementation partners should be involved in long-term vision and technology roadmap building.

8. Conclusions

With this paper, Orgalime aims at creating a better understanding of the RTD-priorities of the Mechanical Engineering industry, in particular in view of its diverse and varied structure and the high-tech solutions provided that are considered as vital to ensure that the whole European industry will be able to maintain its competitive advantage on a global level.

The concerns of Orgalime are mainly related to the following points:

- If one examines the present thematic priorities of 6th FP, we believe that the mechanical engineering industry is being neglected through insufficient funding. The activities appropriate to mechanical engineering are currently dispersed across all thematic priorities, and major issues for the mechanical engineering industry are not being addressed at all. It is necessary that major topics of mechanical engineering industry are addressed much more visibly, and concentrated under one major priority that encompass all key enabling technologies which this sector relies on.

- The instruments need to be adjusted to allow and encourage participation of mechanical engineering companies. The instruments need to be more adapted to the typical innovative company of the mechanical engineering sector, which normally lies in the "mid-range" employing between 250-1000 people. These companies are not being at all adequately addressed in the current 6th FP, and it is precisely they who are the main drivers of innovation within this sector. Moreover, this sector is dominated by SMEs. We have therefore also given a few suggestions on how to facilitate SMEs to actively participate in IP's. Finally, we believe that the Networks of Excellence need to be conceived in a way which ensures strong industrial guidance and leadership. In their current conception, NoE will most likely not serve the needs of the mechanical engineering industry.

- Breakthrough and radical innovations are vital ingredients also of this sector. These have very often not been advertised due to the B2B environment in which these breakthroughs usually occur. Very often, breakthroughs in another domain (e.g. ICT equipment) cannot happen unless they are preceded by major developments in the machines that produce this equipment. It is important to realise that the work programmes of the 6th FP and future programmes must answer the real needs of companies in terms of the competitive environment in which they operate. Therefore a too visionary approach could be counter-productive if industrial participation is to be enhanced.

- Orgalime hopes that the European Commission will take these arguments into consideration and place this important sector of European industry more in focus for future RTD framework programmes of the European Union.