ManVis Report 2

Preliminary Results from the 1st Round of the ManVis Delphi Survey[1]

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[1] The results are based on a preliminary data set. Slight changes in further analyses are possible.

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1. The Aim of this Report

The specific support action "Manufacturing Visions – Integrating Diverse Perspectives into Pan-European Foresight (ManVis)" (Contract No NMP2-CT-2003-507139) started early 2004. Its aim is to accompany the ongoing policy process of enhancing European competitiveness in manufacturing industries and to include views of European manufacturing experts collected through a Delphi-survey, and views of stakeholders collected at workshops. ManVis has a supporting role in the policy process assembled under the catchword "Manufuture". Hence, the outcome of the discussion process in a series of workshops held in the context of the ManVis project was already presented in the first ManVis report. In December 2004 the project team presented preliminary results of the pan-European Delphi expert survey at the Manufuture Conference “Making Research work” in Enschede, the Netherlands.

This second report presents preliminary findings and first implications of the first ManVis Delphi-Survey, which will be subject to further investigation within the next steps of the ManVis project. It starts with a description of the methodology and the ManVis database. Chapter 3 describes the general findings in an overview. The second section focuses on issues discussed in the Manufuture process. Chapter 4 summarises the results and derives some conclusions of interest for future policy making and the next steps in the ManVis project.

It is important to highlight the role of foresight exercises based on surveys and expectations like Delphi-Studies as a *starting point* or *one of several inputs* to public debates on future developments. It does not replace other research or strategic planning activities as for instance scenario building, patent data analysis or other technology assessment methods or interpretation of innovation indicators.

2. Delphi Survey and ManVis database

2.1. The Delphi Approach in ManVis

Powerful visions do neither appear all of a sudden nor can they be declared by state authorities. They cannot be based on single perspectives or specialised approaches. For this reason, a new knowledge community concerned with the future of manufacturing has to be created, including as many actors and stakeholders as possible from Europe and beyond. As a tool for initiating future-oriented thinking and to promote the linking of such diverse perspectives, a pan-European Delphi survey dealing with manufacturing issues was started. The Delphi process can be defined as

- a systematic method for eliciting and collating informed judgements on a specific topic, through
- the circulation of a set of carefully designed, sequential questionnaires giving feedback to the respondents between circulation rounds to allow them to modify their later opinions, should they wish to, taking into account of the earlier responses as a whole.

The Delphi methodology is a long-established tool for forecasting future technological (and other) developments. Foresight activities are a systematic effort of supporting policy by setting priorities in science and technology policy thereby stimulating communication between actors in innovation systems. Delphi studies have often been used as a tool to collect a wide range of opinions as a base for further panel debates (e.g. in the U.K. Foresight programme or the German Delphi Survey 1998). The advantage of the approach is its ability to collect a large amount of information in a structured form. However, there are certain aspects that do not allow Delphi to be used as the sole mean of a Foresight exercise. A Delphi do not describe steps and milestones towards visions, do not substitute other technology and innovation indicators nor do they include societal values or political targets.

The ManVis-Delphi survey was launched in 22 European countries. A core team of researchers from eight European institutes has conceptualised and conducted the Delphi survey. All these institutes have a solid background in research on manufacturing foresight issues, each of them focussing on particular aspects needed for a holistic view on manufacturing. National partners from 22 European nations support the survey in their countries (cf. ManVis Report No 1). Through several workshops have approximately 280 manufacturing experts, from Europe and overseas and from both the research community and industry, contributed to the shaping of the survey. Furthermore a number of policy actors took part in the discussions (cf. ManVis-Report No. 1).

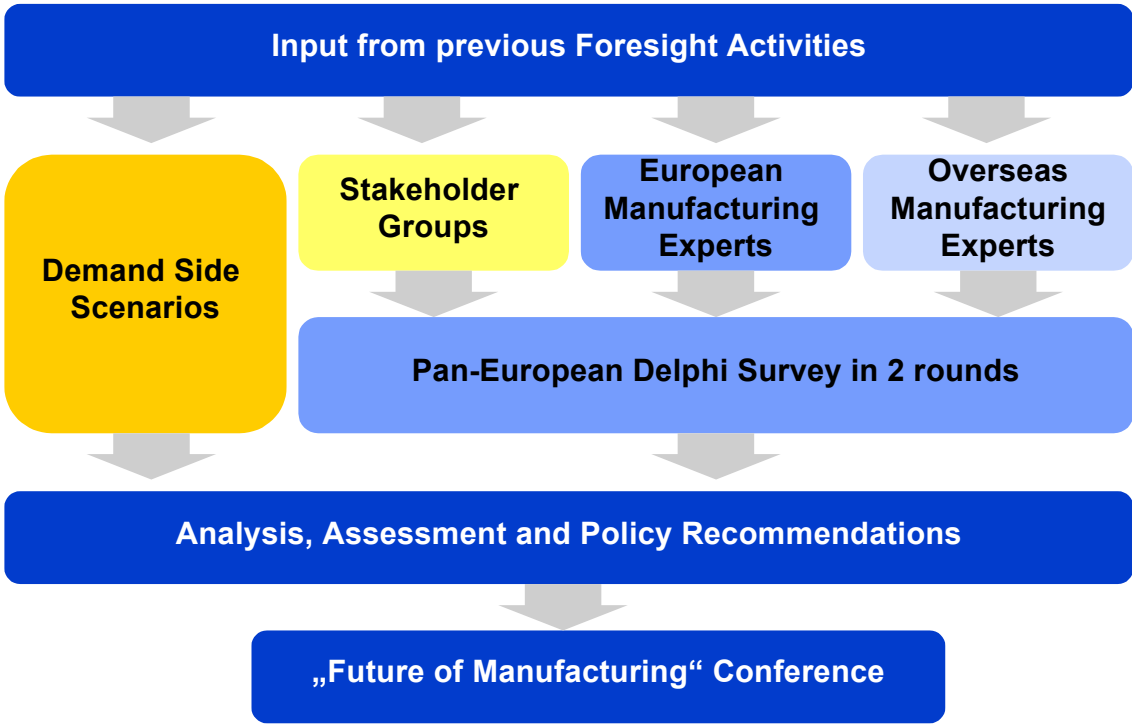

Figure 1: The ManVis-approach.

In order to avoid an isolated view experts from overseas were involved in the assessment of the statements of the Delphi questionnaire and will also comment on the results of the survey (cf. Figure 1).

The Delphi survey covers developments in all relevant aspects of manufacturing from technologies via organisational concerns to questions of the working environment. Further, enabling technologies for developments in all these areas are examined. New demands on skills and competencies can be derived from the results, while sustainability issues are a special focus throughout the whole project. Some statements in the Delphi questionnaire deal with sector specific developments such as transport, machinery, or traditional products (the questionnaire is available in ManVis-report No. 1).

In particular the following steps were undertaken in ManVis:

- During the Kick-Off meeting in January 2004 the frame conditions for the Delphi survey (scope of manufacturing to be covered by the project, criteria for expert selection, dimensions to be asked in the survey, sector coverage, structure of questionnaire) were determined as planned (WP J1, Deliverables D1, D2).
- A first set of statements on different aspects of the future of manufacturing to be used in the Delphi survey was developed (WP D1). This set was based on the results of previous projects (Informan and FutMan) and on the "Manufuture" document that was developed by a European expert group for the Manufuture conference held at Milan in December 2003. In a two days meeting of the ManVis project team this set of statements was discussed and finalised. The document comprising 150 statements on the future of Manufacturing was then sent out to all national partners to be discussed in their workshops (Deliverable D3).
- The national workshops (WP D2) have been carried out as planned in the participating 22 countries. In these workshops the set of statements on the future of manufacturing was discussed and assessed by 280 national experts. Furthermore, new statements were developed. All workshops results have been properly documented to be evaluated for the final statement generation (Deliverable D6).
- The electronic questionnaire was developed as agreed by the partners. Furthermore, the supporting features like help function and welcome page were developed and translated. The preparation phase, translation and address collection ended in September. The survey started September 1st and was closed in October 2004.
- The database was established in November 2004.
- First results were discussed in a project core team meeting in Delft Mid-November 2004 preparing the ManVis input for the Enschede Conference “Manufuture – Making Research Work” early December 2004

2.2. The ManVis database

The national correspondents of the ManVis team were responsible for the selection of experts following the criteria decided upon by the steering board. Special emphasis was put on fair representation of different types of organisations such as research institutes, manufacturing companies and government or other public organisations. The target number of 3000 experts participating from all over Europe was allocated to the different countries according to the number of employees in the selected sectors in each country. For statistical reasons, enabling later comparisons between countries, smaller countries aimed to deliver a minimum number of approximately 30 answers per statement regardless of the number of employees in the manufacturing industry (NACE D) within each country respectively.

Resulting from the great differences in the countries' number of targeted experts, country specific ways to approach the experts developed. In general, the selected experts

were addressed by mail and received a personalised internet based questionnaire with a unique password. In addition some countries sent out printed letters, while others phoned the experts to increase the number of replies. A co-nomination link was established allowing the experts who participated at the national workshops to nominate other experts. To ensure expertise of the participants, an open self-nomination, for instance via the internet, was not possible. Thanks to the great efforts of the national partners, the ambitious aim of an overall participation of 3000 experts was missed only by 7.[2] Of these 2993 experts, 54 % relate to manufacturing companies, 37 % to research institutes and 9 % to government or other public institutions. However, this relation between experts' different background, vary by country (see Annex 1). In Belgium, for instance, 78 % of the participants belong to the industry sector compared to 28% in Poland. At this point it is notable that two thirds of the participating countries do present a share of industry experts in the range 45 – 65 %, and thus fulfils the criteria set by the steering board. Expert's origin according to individual statement was being cross checked. Here, no preferences in the assessments are shown, comparing the views of industry experts, researchers and other public representatives.

Since the realised number of participants per country differed from the set targets, each country's contribution to the overall picture was weighted with respect to national employment within their manufacturing industries (NACE D). This prevents potential over or under representation of countries and allows a fair overview on Europe (here the ManVis countries). A comparison between different countries (without weighting) is still possible with the gathered data, but it has to be kept in mind that for some of the smaller countries and statements the number of answers can drop below the statistically critical count of 30 (this applies to some extent for Netherlands, Austria, Belgium, Denmark, Norway and Estonia).

It was decided to include all answers of the experts regardless of the experts' self assessment of expertise per statement. Since this general Delphi study aims at reflecting the vision on manufacturing of a wide range of experts. It also avoids the over enthusiasm of experts with the highest expertise per statement, which has been observed in several former Delphi studies. A first comparison of experts with the higher expertise and the overall answers showed an over-all slightly higher assessment of the importance of the statements. However, no significant changes in the ranking of importance

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[2] However, this is the number of the preliminary data set which includes not all answers of the experts. After including all answers there are 3121 experts which participated in the survey. Please note that the analyses in this report are based on the preliminary data base with 2993 experts. Further analyses which will be based on the complete data set, may reveal slight changes in the results.

among the statements were observed. Even the detailed assessment of some statements on very specialised technical issues with very high percentages of experts with low expertise show no significant difference. A detailed analysis of the groups of different expertise will therefore be part of the final interpretation only.

Because of the complex structure of the questionnaire, covering various areas of expertise, not all experts completed it entirely but chose to answer only those sections with which they felt most comfortable. Each statement has been answered by more than 1200 experts, allowing a solid statistical analysis for all the statements. The median number of answers per statement is 1289. Since no systematic differences have been discovered after the first round (for instance with respect to expert origin, country etc.), it was considered risk-free to include all answers, regardless of the number of statements each expert answered, for this preliminary first analysis.

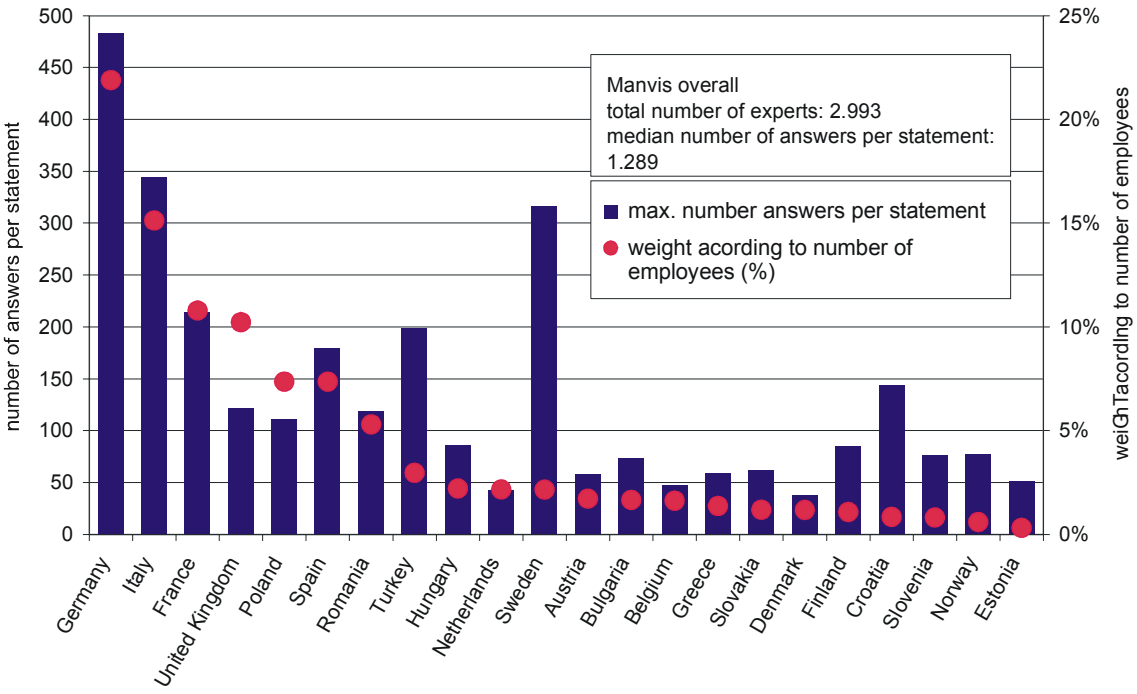


Figure 2: Expert participation of ManVis for participating countries and relative weight according to employment in manufacturing (n=2993).

3. Results of the first round of the ManVis Delphi

This chapter presents the results of the general statements concerning the following issues (see Figure 3 for the ManVis questionnaire):

- Importance of statement for European Manufacturing Industry
- Time of realisation (in intervals as: until 2010, 2011-2015, 2016-2020, later than 2020 or NEVER)
- Expected effects of realisation for Europe compared to today
- Main barriers in Europe blocking the realisation of the statement
- Highest R&D level

Please note that statements with focus on specific industry sectors are not yet analysed.

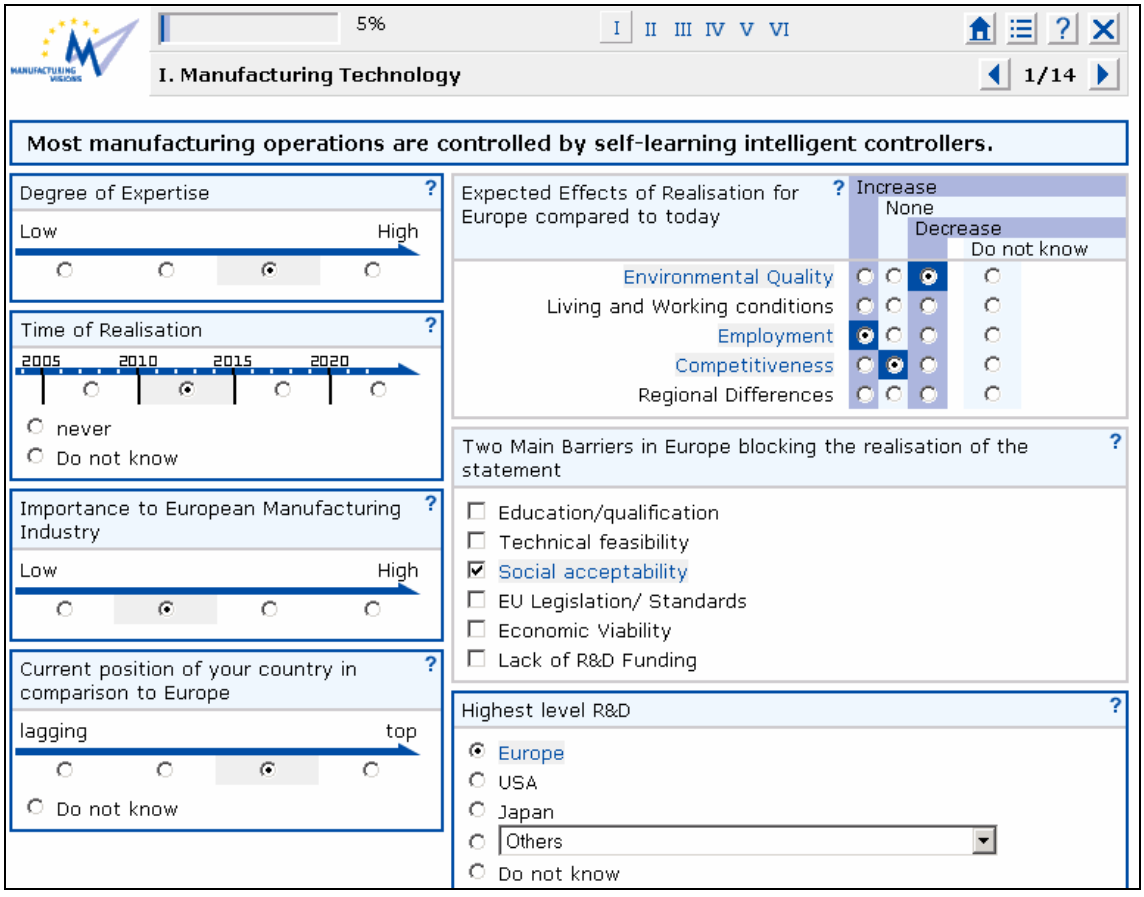


Figure 3: Statement S001 in the ManVis questionnaire.

Throughout this report different keywords, as well as short forms and numbers representing different statements are used. Please refer to the appendices for further details.

3.1. General findings

The following chapter is structured as follows: Firstly, results are presented according to different dimensions (importance, time of realisation, expected effects, main barriers and highest R&D level) that the experts had to take into account when giving their opinions. Secondly, the results of the statements are analysed with respect to certain topics emphasised by the Manufacturing Vision Document and of specific interest and importance for the preparation of the 7th framework programme.

3.1.1. Importance for European Manufacturing Industry

Figure 4 presents the statements ranked according to the importance for European manufacturing industry. Overall, the experts think that all statements are of high importance. The majority of experts believes that almost all statements are of high or very high importance. This confirms that the statements which were selected in national workshops of all participating countries are highly relevant for almost all European countries. However, to some extent the importance rankings differ across the countries. Experts with the highest level of expertise think that the statements are even more important than all experts do.

The experts regard statement S045 as the most important statement. This indicates that the benefits of high automation outweigh the advantages of lower labour costs. Slightly less important than S045 is statement S022 which states that SME in specialised networks compete successfully on global markets. In terms of technologies and their impact on the manufacturing industry, experts believe that active components by micro electromechanical systems (activators, sensor) will be used all over the factory (S005). Statement S046 is considered to be the most important development concerning working conditions for the manufacturing industry sector. Experts think that learning in the company that includes a fixed working time for acquiring new competences is an important issue for Europe's working conditions.

Surprisingly, most of the statements which are affiliated to the working conditions within the questionnaire, i.e. self employed manufacturing workers (S048), work from home for certain manufacturing tasks (S050), share of females in manufacturing workforce according to population proportions (S049) and co-management of competence development by trade unions or other employee representatives (S055) are considered to be of rather low importance for the manufacturing industry.

Across the different expert groups there are only minor differences in the importance given to statements. The only remarkable exception is the vision of production that integrates environmental technologies resulting in zero waste and emissions (S011). The average expert regards this statement as being moderately important (rank 13). However, government officials and experts from other public institutions (not research) consider this statement to be most important. Remaining expert groups think that this statement concerned with integrated sustainable manufacturing (S011) is of much lower importance.

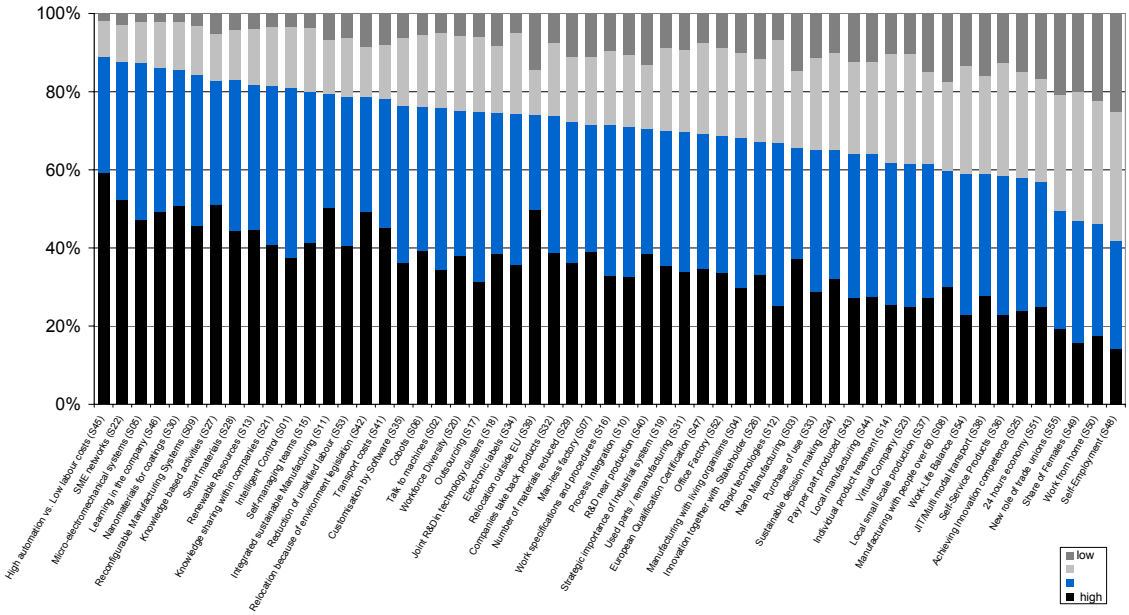


Figure 4: Overall importance for European Manufacturing. Assessment by all experts (n=2993).

3.1.2. Time of realisation

More than 50 percent of the experts expect all statements to be realised between 2010 and 2020. This allows for the development of manufacturing visions that are far enough in the future to be of interest for the European Commission, at the same time being already close enough to be discussed right now. The average time horizon for planning within a company of up to 5 years is much shorter than the estimated realisation time of the statements. Industrial experts participating in the survey were therefore encouraged to think beyond there day to day planning horizon.

The value in the category "never" represents the percentage of all experts that claim that a realisation of this statement will never occur. For example, 43 percent of all experts estimate that relocation outside the EU will never take place. As presented in Figure 5 there is no correlation between the estimated time of realisation and the share of experts neglecting the realisation of a statement. This means that statements which are expected to be realised in the near future have no lower "never" rates than others. Within a Delphi study, never rates of up to 43 percent are considered to be relatively high. This can be traced back to the underlying questionnaire design aimed at including also provocative statements stimulating a debate in the expert community all over Europe.

According to the experts the following statements are expected to be realised in the near future (see Figure 5).

- Closely defined procedures and specifications of work methods are common in most companies to maximise the efficiency (S016).
- To reduce costs and to focus on core competencies, companies outsource twice the percentage of manufacturing activities and support functions outsourced today (S017).
- Companies promote the sharing of knowledge amongst individuals through the establishment of a communication friendly organisational culture and the provision of communication channels across formal structures (S021).
- Self-managing teams with a wide range of tasks, including planning and controlling, are widespread in the shop-floor organisation of production (S015).

All statements are affiliated to the strategy, organisation, and management section of the questionnaire. Together, they paint a picture of well defined and organised companies using the advantages of decentralisation and knowledge sharing well before 2015. Only 10 percent of all experts think that these statements will never be realised.

In terms of technologies, the most challenging is the nano-manufacturing (S003). Experts think that manufacturing through self-assembly of atoms or molecules will not take place before 2020.

Across the different expert groups (industry, academic, research) there are only few statements with variance in the answers.

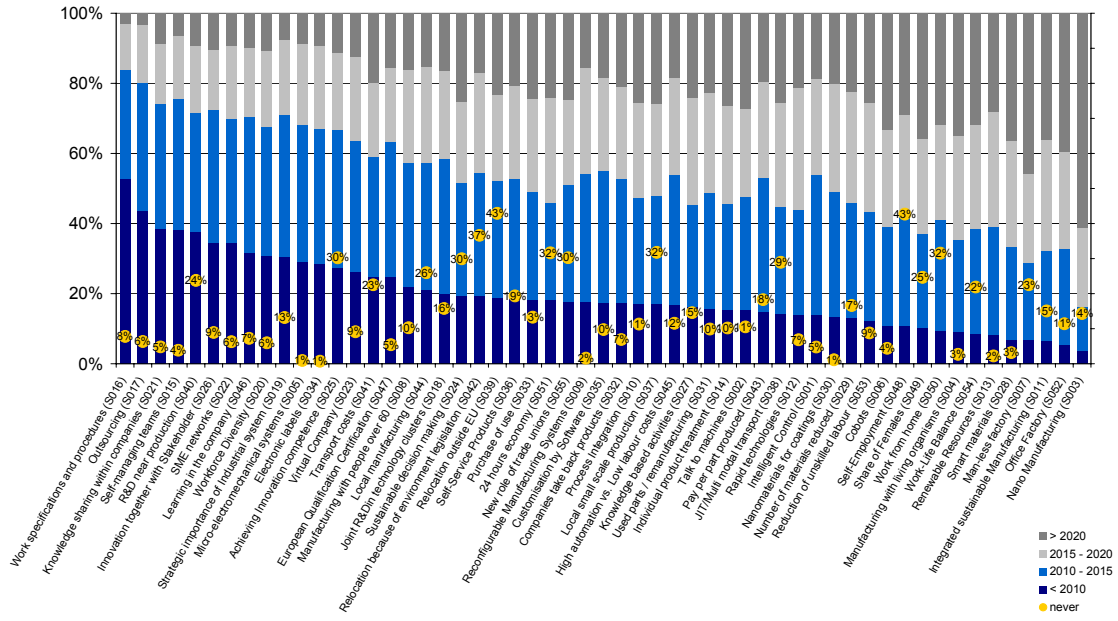


Figure 5: Time of realisation for each statement and never rates. Assessment by all experts (n=2993).

3.1.3. Expected effects

Within this section the experts were asked to estimate the expected effects in the case of a realisation of each statement. They were asked to assess the effects in five categories:

- Expected effects on environmental quality
- Expected effects on living and working conditions
- Expected effects on employment
- Expected effects on competitiveness
- Expected effects on regional differences

Figure 6 and Figure 7 present the expected increasing and decreasing effects on environmental quality, living and working conditions, employment, competitiveness and regional differences. Please note that only the three highest ranked statements for each effect are illustrated in the figures (for the complete assessment of expected effects over all statements please see annex).

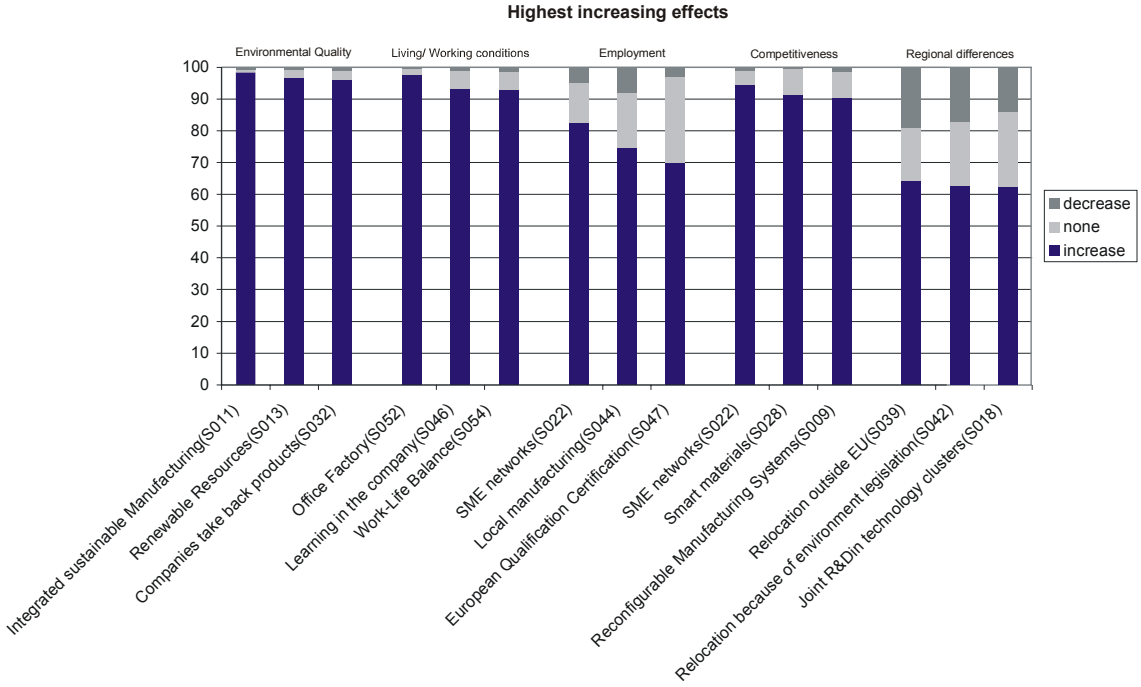


Figure 6: Expected increasing effects (three highest scores). Assessment by all experts (n=2993).

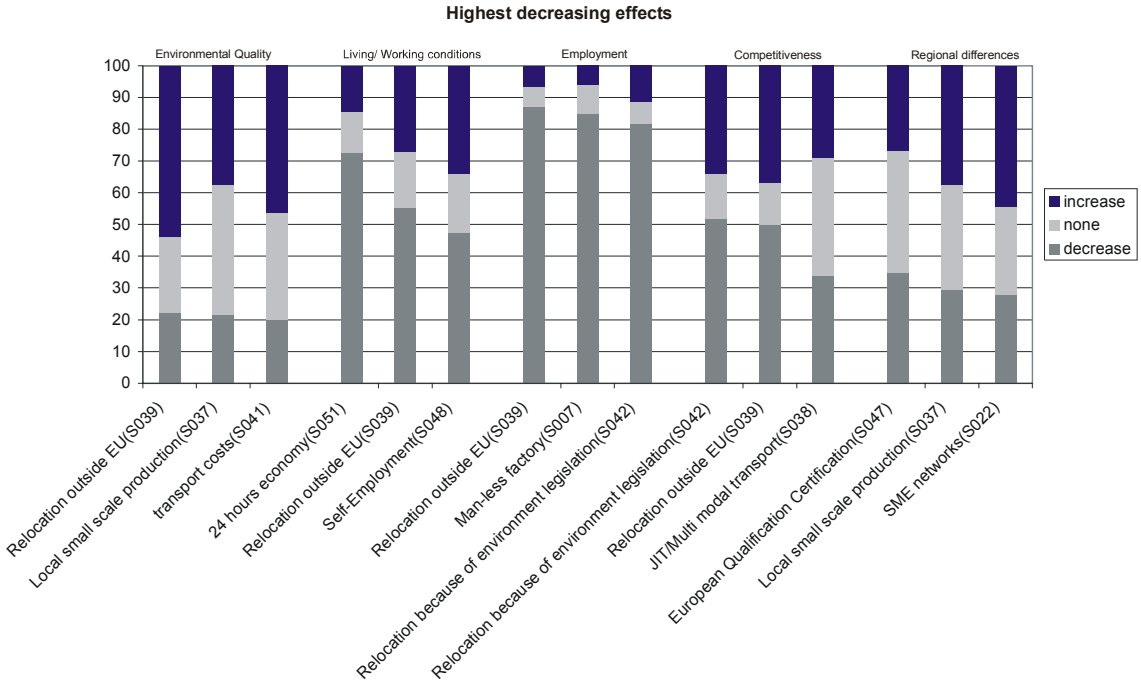


Figure 7: Expected decreasing effects (three highest scores). Assessment by all experts (n=2993).

Environmental quality

There is a high consensus among the experts on the statements which generate an increase of the environmental quality. For the following statements almost all experts (96-98 percent) estimate an increase in the environmental quality (see Figure 6):

- S011: Environmentally friendly technologies will be integrated into all production processes so that zero waste and zero emission manufacturing is achieved without using technologies that reduce factory emissions at the end of the manufacturing process (filters etc.) (98 percent).
- S013: Manufacturing processes are significantly altered to cope with the specific characteristics of renewable resources (materials and energy) (97 percent).
- S032: Most products contain used parts that have been remanufactured (96 percent).

In terms of a decrease of the environmental quality through a realisation of a statement, the following statements reach the highest scores:

- S039: Production is subsidised or almost completely relocated outside Europe.
- S037: The majority of products are almost completely produced in local small scale production sites using multifunctional equipment.
- S041: High transport costs outweigh the advantages of lower production costs outside the EU.

Thus, approximately 20 percent of all experts believe that relocation of the production outside Europe, a small scale local production and a high amount of transport decrease the quality of the environment. However, it is interesting that although the statements S039, S037 and S041 reach the highest scores in terms of a decrease of the environmental quality, 38 to 54 percent of all experts propose that the realisation of these statements will have a positive impact on the environmental quality.

Thus, the experts' estimations on the decrease of environmental quality are less unified than the estimations on the increase of environmental quality. A possible explanation is that experts state their opinions with different definition of the term environment. For instance, relocation of production outside Europe can have a positive impact on the environmental quality of EU member states because there is a decrease in production output which therefore leads to fewer emissions of toxic substances. At the same time, relocation can negatively influence the global environment as the environmental standards of production outside the EU are less restricted.

In addition to the interpretation of the statement with the three highest scores on environmental effects it can be stated, that neither nano-technology nor smart materials are

expected to cause environmental problems to a large extent. Concerning new business strategies that are often considered to be one possibility towards sustainability one can reveal that purchase of use (S033), pay per part produced (S040), and local production strategies are thought to offer only low or medium potential of an increasing environmental quality compared with other statements.

Living and working conditions

Similar to the expected effects on environmental quality there is also a high consensus among the experts concerning the effects of certain statements on the living and working conditions. As presented in Figure 6, the following statements are considered to have the most increasing impact on the living and working conditions:

- S052: Innovations in machine technology will transform the factory's environment into one that resembles an office environment (e.g. no noise, no pollution, space, no accidents) (98 percent).
- S046: A fixed part of working time is used for acquiring new competencies, using resources provided by the employer (93 percent).
- S054: Tailored configurations of working conditions and benefits reflecting age and family situation are the norm in manufacturing companies (93 percent).

Thus, almost all experts agree that an office factory, possibilities to learn within the company and a balance between work and family positively influence the employees' living and working conditions.

In terms of a decrease of the living and working conditions, the majority of the experts (73 percent) assumes that the 24 hours economy (S051) and relocation outside the EU (S039) (55 percent) will negatively influence the employees' living and working conditions. 47 percent of the experts estimate that the vision of self-employed workers (S048) also worsens the living and working conditions.

In sum, most of the general statements are considered to have a rather positive or increasing than a negative or decreasing influence on the living and working conditions.

Employment

Figure 6 presents the experts' scores concerning the influence of each statement on employment. The following statements are supposed to have the most increasing impact on employment:

- S022: Networks of specialised SMEs compete successfully in the global marketplace (83 percent).
- S044: Local manufacturing is widely used to minimise the risks of global distribution chains (74 percent).
- S047: Occupational training certificates for production workers which can be acquired at any point of the professional career are developed throughout Europe (70 percent).

Thus, increasing employment rates could mainly be achieved through networks of SME companies, local manufacturing, and higher qualified production workers. Besides statement S044, various other statements on local and closed loop production strategies (S037, S032, S031) are also supposed to have particularly increasing employment effects.

Negative impacts on employment rates are primarily caused through relocation outside EU (S039), Man-less factory (S007) and relocation because of environmental legislation (S042). Thus, almost all experts presume that relocation of production sites and the vision of a man-less factory reduces employment in Europe. Concerning statement S039 "Relocation outside EU" it is already for the third time that experts rank this statement as the most decreasing factor for Europe's economy. Almost all experts believe that relocation outside EU negatively influences the environmental quality, the living and working conditions and Europe's employment rates.

In addition, the results reveal that there is a strong dissent among the experts on the employment effects of high automation (S045). A minority of approximately 10 percent of the experts expect no effect at all. The majority of the experts expect increasing and decreasing employment effects. Of these, there are about the same number of experts expecting an increase or a decrease of employment rates.

Competitiveness

Overall, the majority of the experts think that the covered statements will increase Europe's competitiveness. The effect of each statement on the competitiveness is illustrated in Figure 6. According to the experts, the following statements have the most increasing impact on competitiveness:

- S022: Networks of specialised SMEs compete successfully in the global marketplace (94 percent).
- S028: Smart materials that adapt to different conditions by changing properties (e.g. dynamics, size, shape, thermal behaviour) are in widespread use (91 percent).

- S009: A reconfigurable manufacturing system achieved by coupling simple machine modules to create complex systems (plug and produce) is in widespread use (90 percent).

As in the case of employment specialised SME networks are assumed to have a very strong positive effect. There is not only a very strong increasing impact on the competitiveness but also on the employment rate. Thus, almost all experts believe that SME networks have a positive influence on Europe's economy.

As regards effects on competitiveness it is also noteworthy that statement S030 and S003 take rank four and five. Both, nanomaterials for coatings (S030) and nano manufacturing (S003) positively influence the competitiveness of Europe. Apparently, the nano technology is considered to have a positive impact on Europe's economy.

Concerning the decreasing effects on Europe's competitiveness, it is again the relocation of production sites that reaches the highest scores. 50 percent of the experts assess that relocation because of environmental legislation (S042) as well as relocation outside EU (S039) negatively influences Europe's competitiveness. Another group of statements considered to have a negative effect on the competitiveness comprises the following statements: local manufacturing strategies (S044, S037), closed loop production (S032), and other sustainability effects (S024, S011). For these statements there seems to be a trade-off between the effects on employment and competitiveness, since they have been assessed to be particularly positive effects on the employment.

Regional Differences

The following statements are estimated to have the most increasing effects on regional differences:

- S039: Production is subsidised or almost completely relocated outside Europe (64 percent).
- S042: European companies almost completely relocate production (except final assembly) because of environmental standards set by the EU (63 percent).
- S018: Competitive production sites in Europe are almost exclusively contained within technology clusters where pre-competitive R&D activities between various neighbouring industrial partners and research organisations are common (63 percent).

Once again, the relocation statements reach high scores concerning their effects.

Statements regarding as having the most decreasing impact on regional differences are:

- S047: Occupational training certificates for production workers which can be acquired at any point of the professional career are developed throughout Europe (35 percent).
- S037: The majority of products are almost completely produced in local small scale production sites using multifunctional equipment (29 percent).
- S022: Networks of specialised SMEs compete successfully in the global marketplace (28 percent).

Overall, there is a lower degree of consensus among the experts' regarding the expected effects of regional differences than within the other effects. For certain statements 80 percent to almost 100 percent of all experts believe that those statements will have an increasing effect on environmental quality, living and working conditions, employment, and competitiveness. At most, only approximately 60 percent of all experts believe that certain statements have an increasing effect on regional differences.

Short summary on expected effects

Experts' estimations are particularly clear in two aspects. First, the majority of all experts assumes that a relocation of production sites outside the EU (S039 and S042) has a negative effect on almost all categories which were included in the survey. Experts' assessments unambiguously show that relocation activities to non-EU countries have a negative impact on the environmental quality, the living and working conditions, Europe's employment rates, and competitiveness. Experts also believe that relocation activities increase Europe's regional differences. Second, estimations on the effects of SME networks are also unambiguous. Almost all experts believe that specialised SME networks which compete successfully in the global marketplace enhance Europe's competitiveness and employment rates. In addition, SME networks are expected to reduce the regional differences within Europe.

However, please note that these results concerning the estimated effects of statements cannot be regarded in an isolated way. In order to draw conclusions from these results it is very important to take all other results such as importance or time of realisation into consideration. For instance, although the effects of relocation outside the EU are clearly negatively estimated one has to bear in mind that there are after all 43 percent of all experts assuming that relocation outside the EU will never occur.

3.1.4. Main barriers

Experts were asked to assess the two main barriers which could possibly block the realisation of a statement. Estimations for the following barriers were asked:

- Education/ qualification
- Technical feasibility
- Social acceptability
- EU legislation/standards
- Economic viability
- Lack of R&D funding

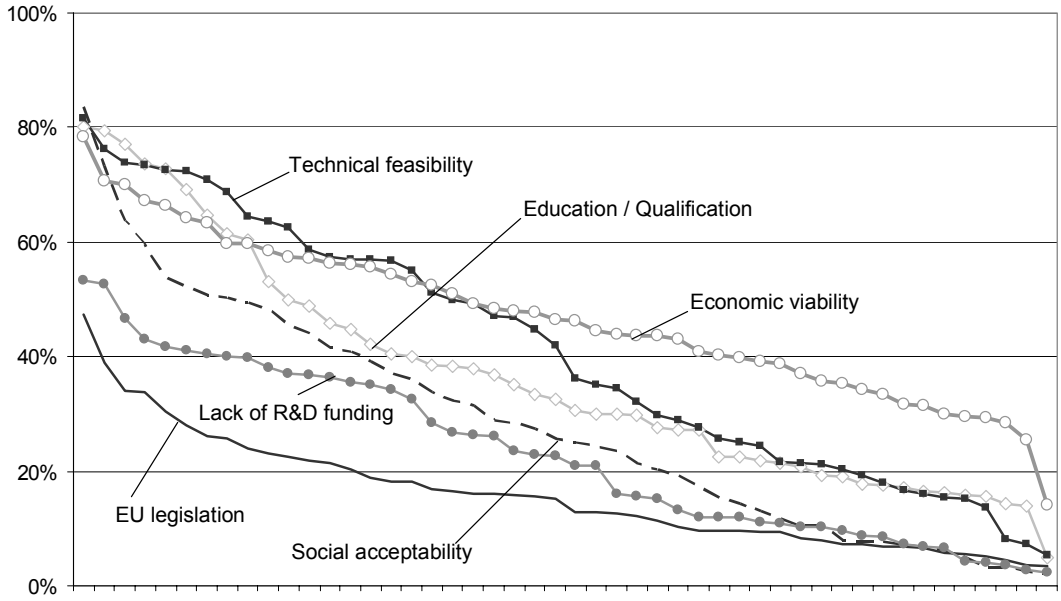


Figure 8: Overall estimations on different barriers (each barrier sorted by frequency) for all statements (n=2993).

Experts think that "economic viability" is a possible barrier for the realisation of almost all statements. For most of the statements the assessment of the economic viability seems to be rather difficult and opinions are diverse at this time. The other barriers are more strongly focused on only a few statements (steeper inclination of the curve). It is surprising that the experts think that the barriers "education/qualification" as well as "social acceptability" are of merely medium importance for all statements, however still more important than "lack of R&D funding". Only for very few statements EU legislation seems to be a relevant barrier.

Figure 9 shows the barriers education/ qualification, technical feasibility, social acceptability, EU legislation/standards, economic viability and lack of R&D funding. Please

note that only the three highest ranked statements are considered for each barrier (for the estimations of all statements please see annex).

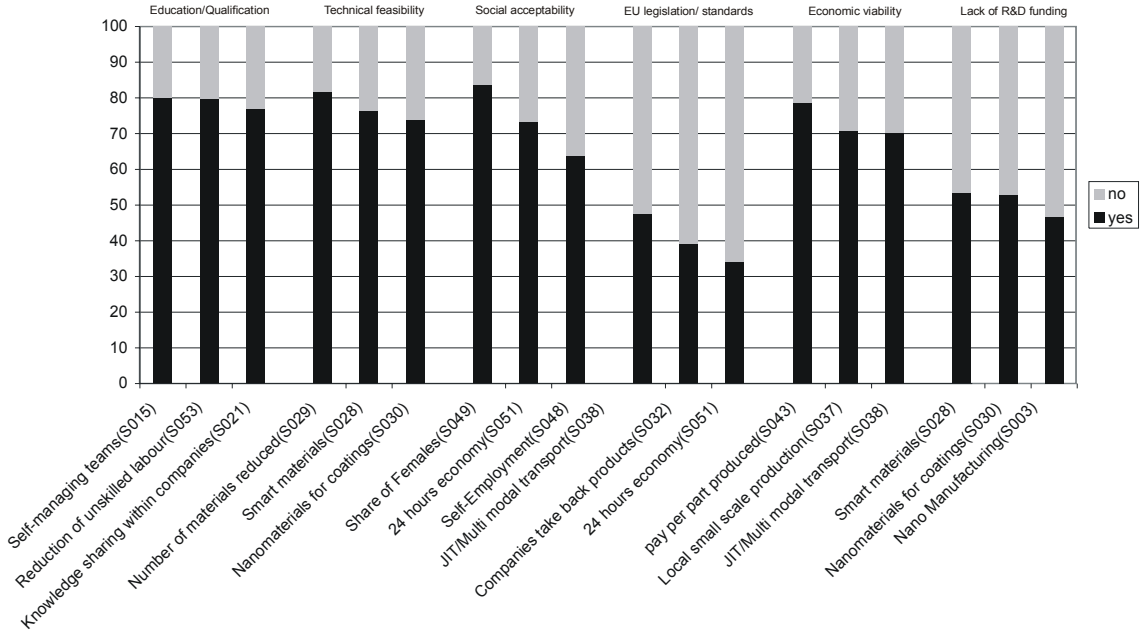


Figure 9: Main barriers (three highest scores). Assessment by all experts (n=2993).

Education/ Qualification

The majority of the experts assumes that education and qualification are the barriers for a realisation of the following statements:

- S015: Self-managing teams with a wide range of tasks, including planning and controlling, are widespread in the shop-floor organisation of production (80 percent).
- S053 Knowledge based manufacturing leads to a share of less than 10 percent of unskilled labour in the workforce (80 percent).
- S021 Companies promote the sharing of knowledge amongst individuals through the establishment of a communication friendly organisational culture and the provision of communication channels across formal structures (77 percent).

Two statements of the strategy, organisation and management section and one referring to the working conditions section are estimated as being difficult to realise because the level of employees' education and qualification is regarded as insufficient.

Interestingly enough, four statements of the section strategy, organisation, and management are among the top five ranks. Thus, in order to realise new organisational

concepts comprising higher qualified and more diversified employees such as self-managing teams or knowledge companies, the qualification of the employees is apparently estimated as being not high enough.

Technical Feasibility

According to the experts, technical feasibility is a main barrier in order to realise the following statements:

- S029: The number of different materials in each product is reduced by half (82 percent).
- S028: Smart materials that adapt to different conditions by changing properties (e.g. dynamics, size, shape, thermal behaviour) are in widespread use (76 percent).
- S030: Nanomaterials are in widespread use to apply coatings with special features (e.g. self-cleaning, anti-reflexive, anti-fouling) to a variety of products (74 percent).

It is noteworthy that these highest ranked statements do all stem from the section product features and concepts. Thus, especially the realisation of new product concepts in terms of technical feasibility is being regarded as critical.

Social Acceptability

The majority of the experts believe that a realisation of the following statements will not be socially accepted.

- S049: The proportion of female employees amongst technical specialists and management in the manufacturing sector has reached their share of the population (84 percent).
- S051: Due to the 24 hours economy, research, engineering and design departments work around the clock (73 percent).
- S048: The majority of workers in production are self-employed and offer their services to a number of customers in different places (64 percent).

More than 80 percent of all experts think that a higher share of females amongst technical and manufacturing specialists is not accepted socially. This result is surprising and contrary to the EU's policy on female employment. Obviously expectations of policy makers significantly differ from the views of the manufacturing experts. It is noteworthy that these statements for which the social acceptability presents the main barrier all stem from the section working conditions. This implies that particularly changes

of working conditions have to be treated with caution as they might not be accepted in society.

EU Legislation/ standards

EU legislation and standards are considered barriers as regards the realisation of the following statements:

- S038: Transport by train and ship prevails in the EU due to restrictions on delivery by truck (47 percent).
- S032: Companies generally take back their products and take care of their end-of-life treatment (39 percent).
- S051: Due to the 24 hours economy, research, engineering and design departments work around the clock (34 percent).

Compared to the estimates of the other barriers, relatively few experts consider the EU legislation as a main barrier for the implementation of the statements. Between 30 and 50 percent of all experts believe that the EU legislation could block the realisation of any statement.

Economic Viability

The economic viability is regarded as a main barrier for the realisation of the following statements:

- S043: 80 percent of all industrial equipment is not bought and owned by manufacturing companies, but instead the equipment providers are paid per parts produced (78 percent).
- S037: The majority of products are almost completely produced in local small scale production sites using multifunctional equipment (71 percent).
- S038: Transport by train and ship prevails in the EU due to restrictions on delivery by truck (70 percent).

All these statements are affiliated to logistic and supply chain issues. Thus, particularly profitability is a main barrier for new logistic and supply chain concepts.

Lack of R&D Funding

Insufficient R&D funding is the main barrier for the realisation of the following statements:

- S028: Smart materials that adapt to different conditions by changing properties (e.g. dynamics, size, shape, thermal behaviour) are in widespread use (53 percent).
- S030 Nanomaterials are in widespread use to apply coatings with special features (e.g. self-cleaning, anti-reflexive, anti-fouling) to a variety of products (53 percent).
- S003 Products can be manufactured bottom-up through the self-assembly of atoms or molecules (47 percent).

Although nano and smart materials are considered to be crucial for the future of Europe the majority of the experts assume a lack of R&D funding for these technologies.

Short summary of main barriers

Three aspects are particularly noteworthy. First, there is a unanimous assessment concerning statement S049 which includes the vision of a higher proportion of female employees in the manufacturing sector equally to the share of females in the population. Almost all experts think that an increasing proportion of female employees will not be accepted in society. This is a very surprising result as the manufacturing sector is more and more dependent on qualified male and female employees. Second, experts are rather sceptical in terms of new product features and concepts. For smart materials (S028) as well as for nanomaterials for coatings (S030) experts think that the development of these new materials is technically not feasible yet. In addition, Europe's R&D funding in these materials is considered to be insufficient. Third, experts believe that there is a potential for companies' profitability in new logistic or supply chain systems. Almost all experts think that pay per part produced and local small scale production sites have a positive effect on the economic viability.

3.1.5. Highest R&D level

Figure 10 shows the R&D levels for Europe, USA, Japan and other countries. Please note that it was not requested in all statements to estimate the R&D level. The following figure shows all statements where the R&D level was asked for:

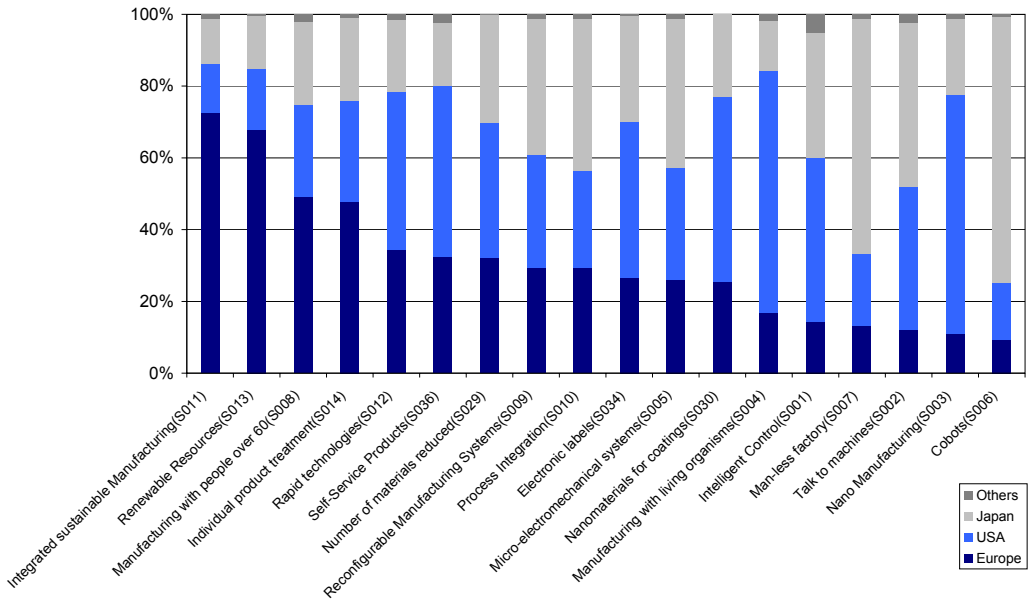


Figure 10: R&D levels in Europe, USA, Japan and other countries - Assessment by all experts (n=2993).

In the experts' opinion the following statements display the two highest R&D levels for Europe:

- S011 Environmentally friendly technologies will be integrated into all production processes, so that zero waste and zero emission manufacturing is achieved without using technologies that reduce factory emissions at the end of the manufacturing process (filters etc.).
- S013 Manufacturing processes are significantly altered to cope with the specific characteristics of renewable resources (materials and energy).

The USA have the two highest R&D level for the following statements:

- S003: Products can be manufactured bottom-up through the self-assembly of atoms or molecules.
- S004 Manufacturing processes for inorganic (non organic) products that utilise the functions of micro-organisms or other living organisms are put into practical use.

For Japan the experts considered the two highest R&D levels for the following statements:

- S006: Robots move freely in factories, flexibly assisting workers in various tasks, instead of being confined to a fixed working space (Co-bots).
- S007 Fully automated production in the man-less factory is as flexible as production with humans.

In sum, Europe's highest R&D level is considered to be in environmental friendly production and technologies, the main R&D activities of the USA are predominantly in biotechnology and Japan's highest R&D levels are in the field of automation and robot systems.

3.2. Analysis of selected Manufuture topics

In this report the ManVis project team focuses on subjects of special interest within the Manufuture process. These topics are emphasised by the Manufacturing Vision Document or of importance for the preparation of the 7th framework programme. In particular, the following issues are discussed:

- Technologies in Manufacturing:
  - emerging product technologies
  - new manufacturing technologies
  - prospects of flexible automation
- Ways of making business:
  - learning organisation as key element of knowledge-based manufacturing
  - changes in the manufacturing system necessary for competitiveness including the outsourcing and relocation issue
  - the challenge for sustainability

In this chapter the results of the ManVis-Delphi's first round are presented in a condensed, topic-oriented way. According to the general way of using Delphi-data, the project team suggests this approach for the interpretation of the results rather than general overviews.

3.2.1. Technologies in manufacturing

Emerging product technologies

In the ManVis survey the experts were asked to assess developments in product technologies which were proved to be influential on manufacturing during the statement

generation process. Of these technologies nanomaterials applied for coatings (S030) are considered to be the most important technology for new products. Of almost similar importance are smart materials adapting to different conditions while in use (S028). For both statements the experts agree that they will be in widespread use after 2015 (nano-coatings) respectively 2020 (smart materials) (see Figure 11).

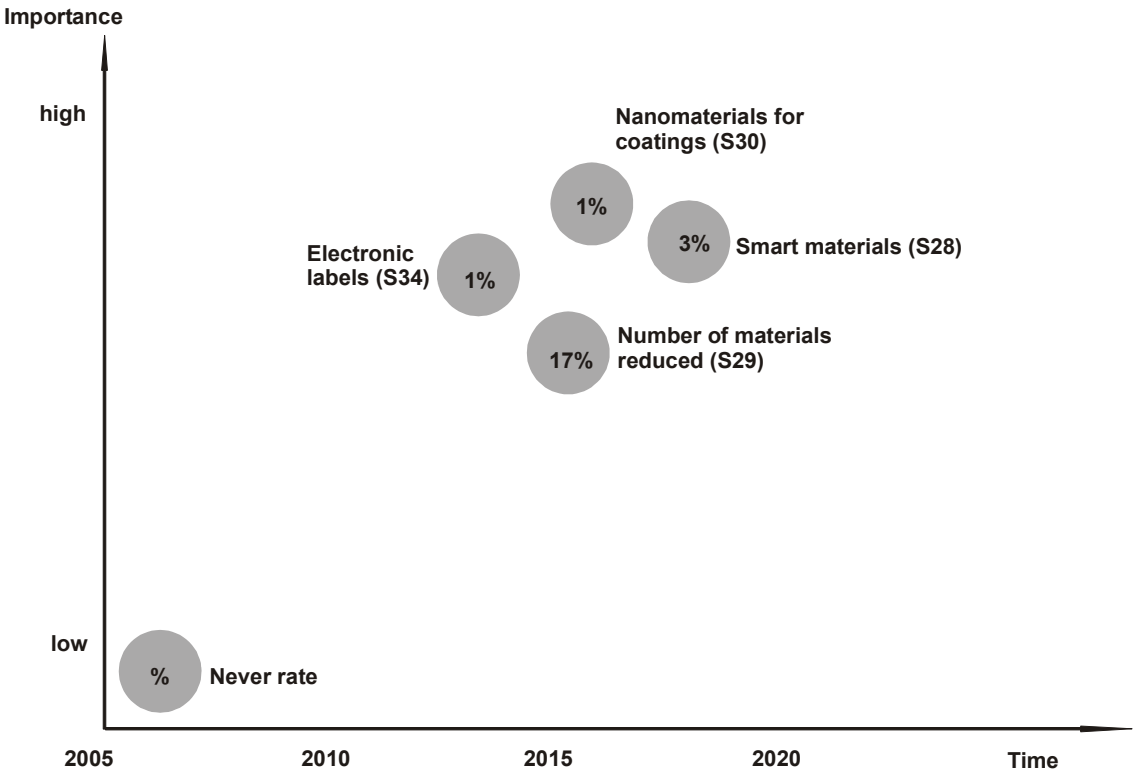


Figure 11: Importance and time of realisation of selected emerging product technologies. Assessment by all experts (n=2993).

However, in the experts' views one main barrier for the realisation of the nanomaterials for coatings (S30) and for smart materials (S028) is the technical feasibility of these technologies (see Figure 12). Around three fourth of all experts assume that the realisation of these new technologies could be blocked through their technical complexity. In addition, half of the experts believe that there is a lack of R&D funding for the realisation of the nanomaterials (S030). In terms of the R&D level of nano-coatings (S030) though, the majority of experts suppose that the USA have the highest R&D level for this technology, followed by Europe and Japan.

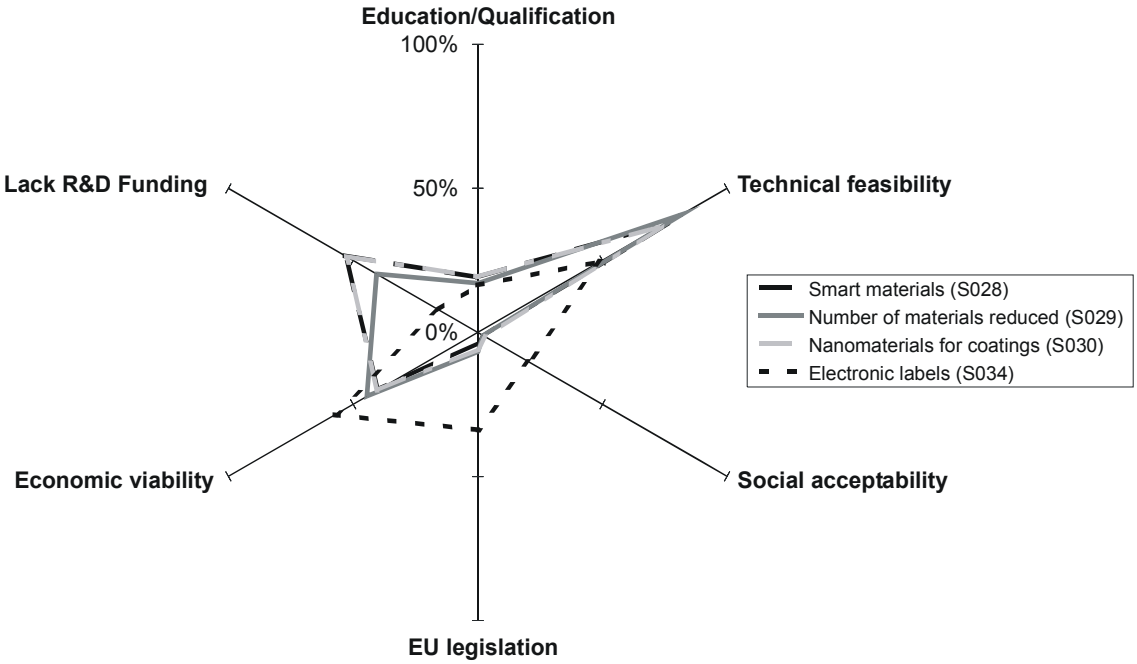


Figure 12: Main barriers for selected emerging product technologies - Assessment by all experts (n=2993).

These two statements are estimated as having a rather positive impact (see Figure 13). Around 90 percent of all experts believe that the realisation of nanomaterials for coatings (S030) and smart materials (S028) will improve Europe's competitiveness. Two thirds of the experts also assume that the implementation of these two statements could possibly have a positive impact on the employees' living and working conditions in Europe. At least one third of the experts expect an increase in the employment rate if the nanomaterials for coatings and smart materials would be realised.

Of lower importance are electronic labels containing relevant product and process information (S034). The experts believe that the realisation in most manufactured products will take place until 2015. Although experts consider this less important, 70 percent of all experts expect a stimulating effect on Europe's competitiveness if electronic labels are embedded in most manufactured products (S034). However, experts' estimations also reveal that the economic viability and technical feasibility could hinder the realisation of electronic labels (S034). As with the nanomaterials for coatings the USA are expected to have the highest R&D level for electronic labels.

The vision of reducing the number of different materials (S029) is - compared to the three other selected statements (S028, S030, S034) - the one with lowest importance rate (see Figure 11).The experts are relatively sceptical as regards the realization hori-

zon and think that this will be realised only after 2015 (never rate = 17 percent). As with statement S028, S030 and S034 the technical feasibility could also be a potential barrier for the realisation of material reduction (S029). In addition, 40 percent of all experts expect a lack of R&D funding in order to reduce the number of different materials. The majority of the experts also thinks that the USA have the highest level of R&D in this technology.

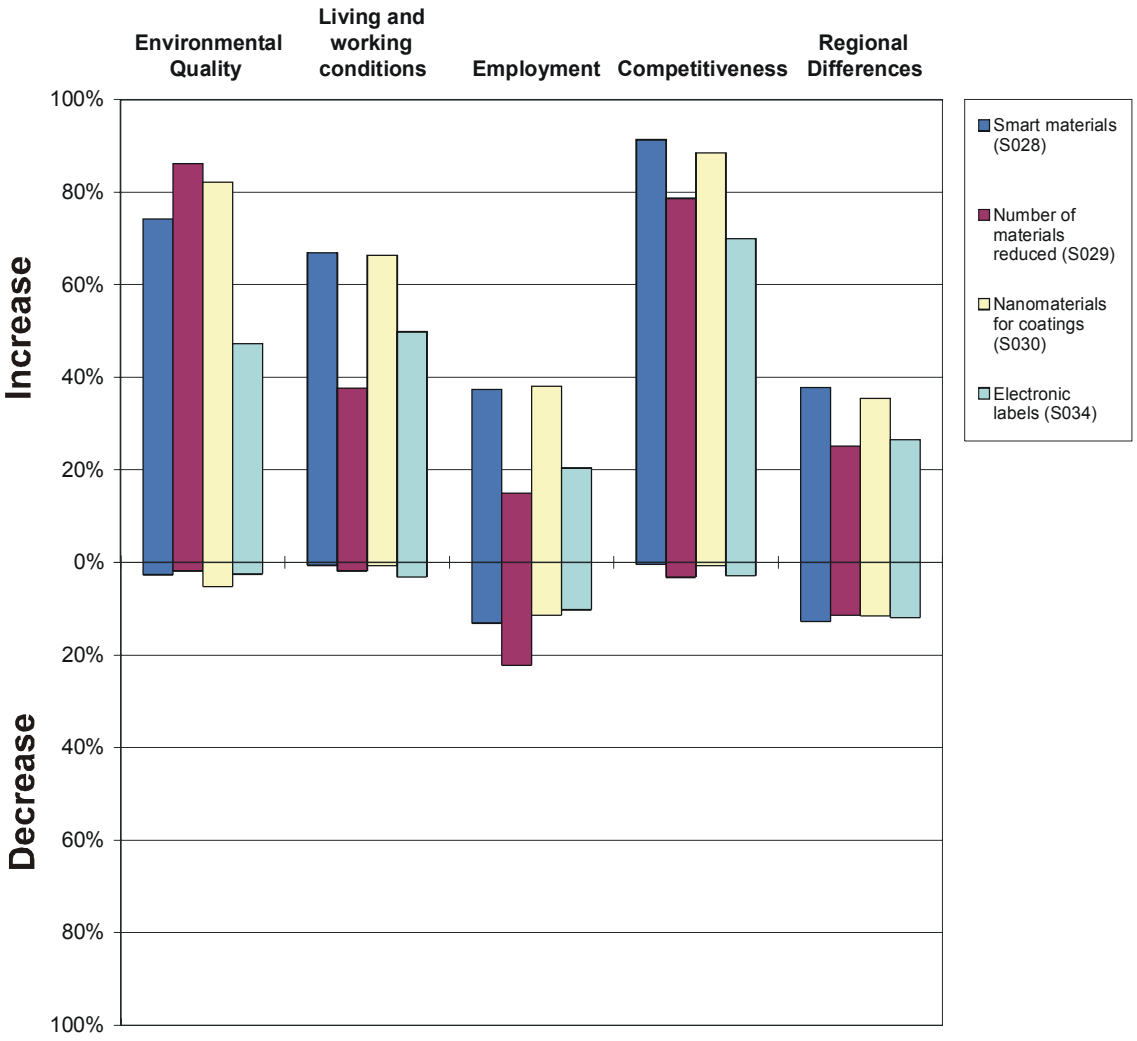


Figure 13: Expected increasing and decreasing effects for selected emerging product technologies - Assessment by all experts (n=2993).

Possible effects of a reduction of materials are mainly considered in terms of competitiveness and environmental quality. About 80 percent of all experts believe that by re-

ducing the number of different materials the environmental quality as well as the competitiveness might be increased. On the other hand, the results reveal reducing materials having a negative effect on the employment rate.

Overall, all four statements concerning emerging product technologies are estimated rather positive than negative. Most of the experts expect rather increasing than decreasing effects of the implementation of nanomaterials for coating (S030), smart materials (S028), electronic labels (S034) and a reduction of materials (S029).

To conclude, these results underline the importance of new materials as most influential vision of product technologies as far as their impact on manufacturing is concerned. With a view to the results of the Futman studies stating the difficulties in the development of profitable process technologies for new materials, this highlights again the interfaces of materials research and manufacturing technology development for a competitive manufacturing. The main barrier for new product technologies is their technical feasibility. New materials are estimated to be most influential for Europe's competitiveness. Experts believe that the development of new product technologies has a negative effect on the employment rate.

New process technologies

Within the ManVis survey emerging process technologies are of special interest. According to the experts, the most important development of process technologies is the micro-electromechanical systems (MEMS) (S005) which are considered to be used all over the factory until 2010 (see Figure 14). This technology may enable quicker reactions on product changes as well as enhancing process quality and operating times.

However, about 50 percent of the experts assume that the technical feasibility and the economic viability hinder the use of micro-electromechanical systems all over the factory. 38 percent of the experts also believe that the employees' education and qualification is not high enough for a widespread use of MEMS in the company (see Figure 15).

On the other hand, there is a broad consensus among almost all experts that the factory-wide use of micro-electromechanical systems as active components (S005) has a positive impact on Europe's competitiveness (see Figure 16). 90 percent of all experts expect an increase in competitiveness if the company-wide use of MEMS is realised. MEMS is also regarded as having a positive impact on people's living and working conditions. However, the experts suppose that a use of MEMS all over the factory decreases the employment rates. In terms of R&D level of MEMS, 41 percent of the ex-

perts think that Japan has the highest R&D level; about one third of the experts voted for the USA and Europe.

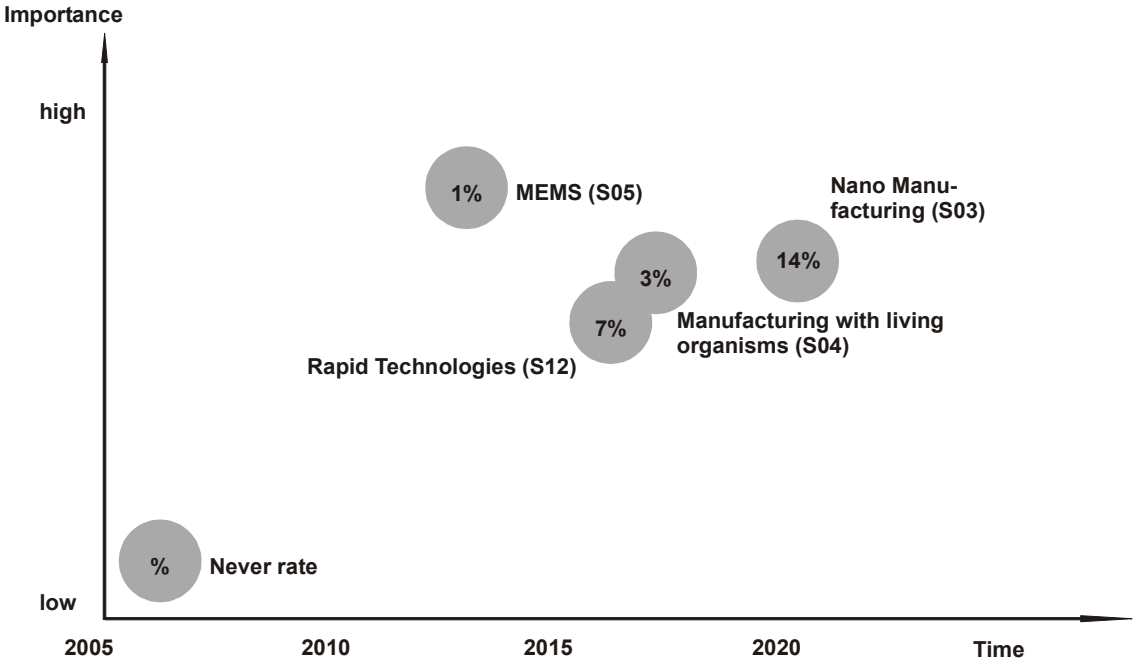


Figure 14: Importance and time of realisation of selected new process technologies - Assessment by all experts (n=2993).

The more radical bottom-up technologies such as rapid technologies (S012), nano-manufacturing (S003) and manufacturing with living organisms (S004) are of lower importance, with longer realisation horizons and more scepticism whether the realisation of the statements could ever occur.

In particular, nano-manufacturing technology (S003) where products can be manufactured bottom-up through the self-assembly of atoms or molecules is not supposed to be realised before 2020. With regard to the time of realisation one possible explanation for this scepticism of nano-manufacturing is its technical feasibility and lack of R&D funding. About 50 percent of the experts suppose that there is not enough R&D funding and around 70 percent think that nano-manufacturing is too technically complicated so that this technology will be used in the near future. However, if products can be produced through self-assembly of atoms and molecules there will be an increasing effect on Europe's competitiveness. Another noteworthy result in terms of nano-manufacturing is that 67 percent of all experts believe that the USA have by far the highest level of R&D

for this technology. Only 21 percent assume that it is Japan and no more than 11 percent think that Europe holds the highest level.

It is surprising that the experts' estimations on bio-manufacturing with living organisms (S004) are less reserved than those concerning nano-manufacturing (S003). 14 percent of the experts think that manufacturing through molecules and atoms will never occur whereas only 3 percent think that manufacturing through living organisms will never take place. But still, bottom-up manufacturing, even in the prototype stadium through self-assembly of atoms and by living organisms (S004) is not expected to take place before 2020. One reason for this rather long period of realisation of bio-manufacturing is probably its technical feasibility and social acceptability. One fourth of the experts believes that bio-manufacturing would not be accepted by the society. Even though this is not the majority opinion, it is mainly bio-manufacturing where experts assume a certain resistance in society. Contrarily, manufacturing with living organisms is expected to positively affect Europe's competitiveness and environmental quality. Almost 80 percent of the experts think that bio-manufacturing will improve Europe's environment. According to the experts, the highest amount of R&D funding for this technology invest the USA.

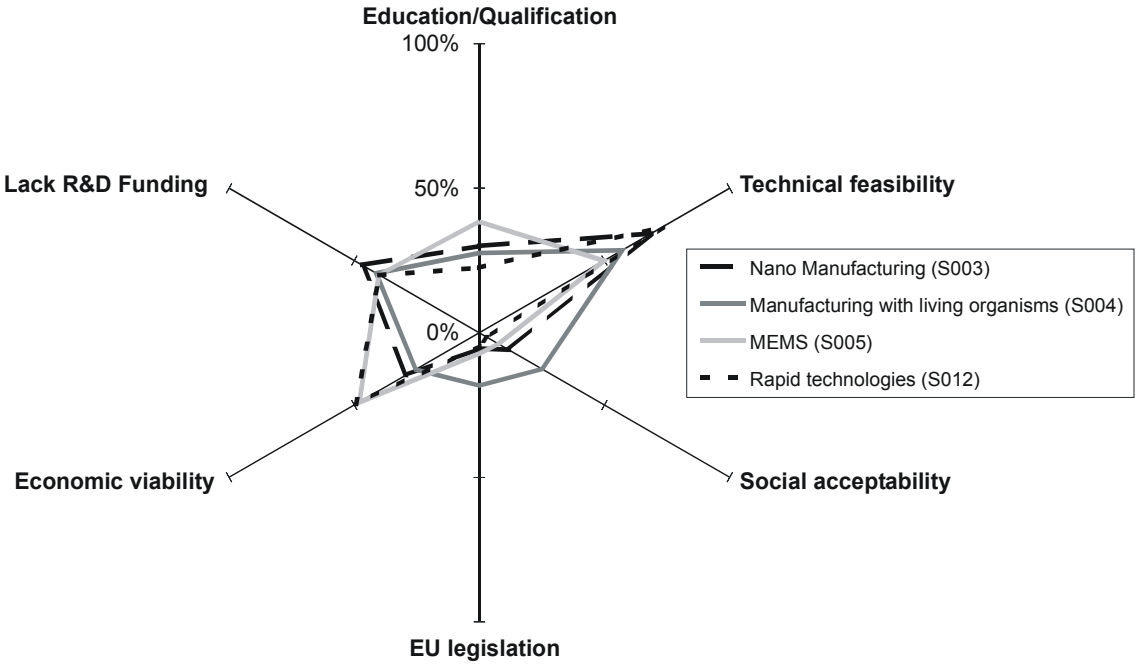


Figure 15: Main barriers for selected new process technologies - Assessment by all experts (n=2993).

As in the case of nano- and bio-manufacturing, the experts also believe that the substantial replacement of cutting and forming technologies (S012) will not take place before 2015. One barrier for the realisation of rapid technologies is the technical feasibility. More than 70 percent of the experts believe that replacing the cutting and forming technologies by rapid technologies is blocked due to their technical feasibility. On the other hand, rapid technologies (S012) are expected to increase Europe's competitiveness. Once again, the highest R&D level with regard to rapid technologies is held by the USA.

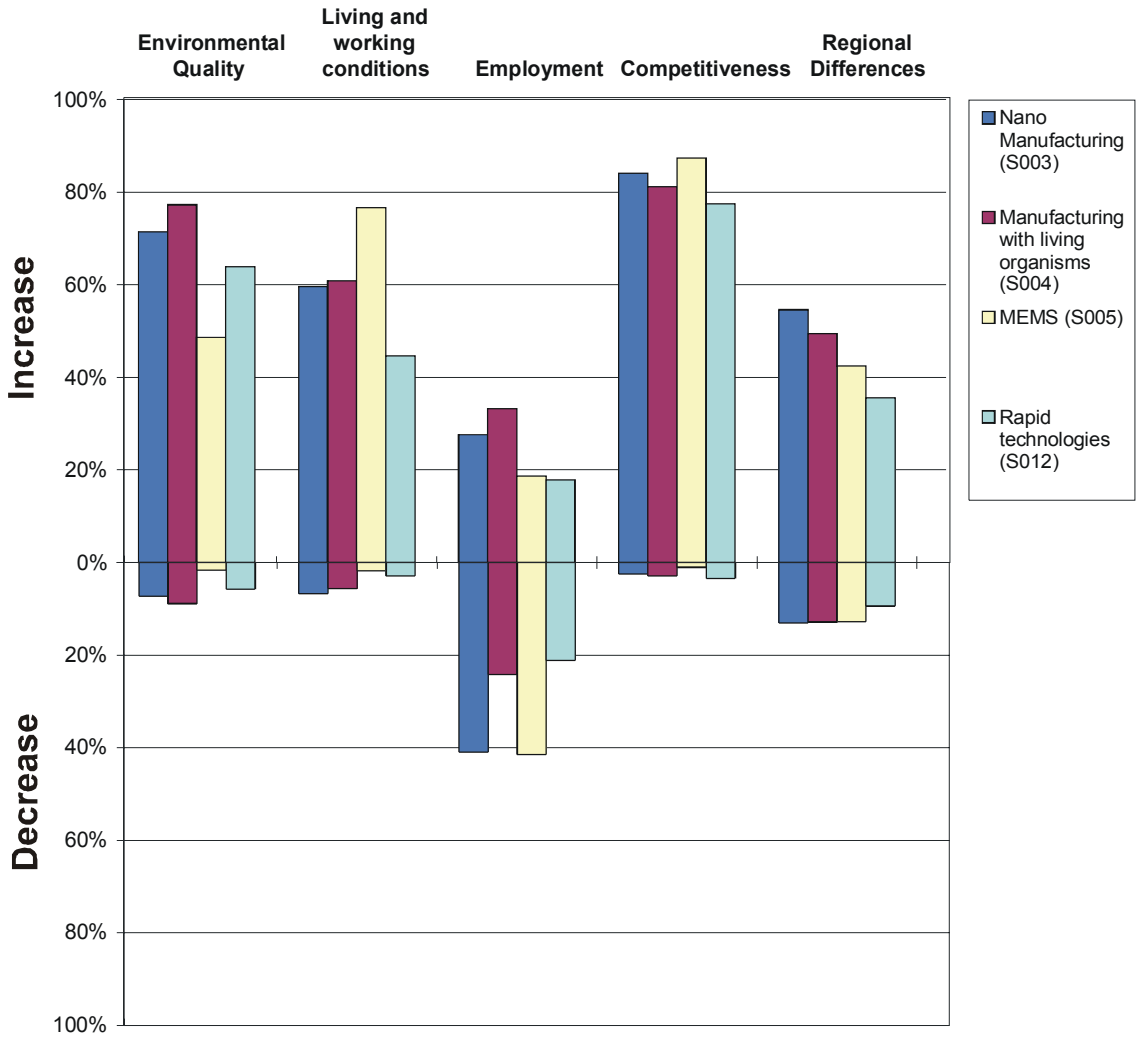


Figure 16: Expected increasing and decreasing effects for selected new process technologies - Assessment by all experts (n=2993).

To conclude, experts' estimations concerning radical changes in process technologies reveal that these technologies will not be realised before 2015. The use of MEMS in the factory may boost productivity as well as further automation possibly could also do. For all analysed new process technologies, their technical feasibility and lack of R&D funding is considered to be the main barrier for the realisation. The experts estimate that the new process technologies will mainly improve Europe's competitiveness and decrease Europe's employment. The highest R&D levels are predominantly held by the United States. For any new process technology the experts do not believe that Europe has the highest level of R&D.

Prospects of flexible automation

According to the experts, statement S045 indicating that the benefits of higher automation outweigh the advantages of lower labour costs outside the European Union was considered as the most important statement for manufacturing industries (see Figure 17). However, 12 percent of the experts doubt that this positive outcome of automation will ever occur. Furthermore, most of the experts estimate that this statement will be realised approximately in 2015. For this statement we revealed significant differences in terms of experts' nationalities. High NEVER rates occur in Germany, Scandinavia, Austria and in other high wage countries. Surprisingly, above average this statement also receives higher importance ratings by these countries. These two estimations are contradictorily as some experts do not think that it will ever occur and some believe that it is of high importance. One possible interpretation of these results is that on the one hand the experts see automation as an important instrument for price competition but on the other hand experts are unsure whether high automation will be a successful strategy.

This interpretation is supported by the experts' assessment of the fully automated production in the man-less factory (S007) which is considered only of medium importance. Furthermore, the share of experts thinking that this vision will never be realised is almost 25 percent, reaching even one third in the high wage countries.

Hence, the trade-off between more automation and maintaining flexibility for many sizes and numbers of product variants will remain the challenge of the future. With regard to this trade-off the experts assess statements on reconfigurable manufacturing systems (S009), intelligent control (S001), cobots (S006) and talk to machines (S002) as approximately equally important, yet differing as regards the time horizon. Reconfigurable manufacturing systems (plug and produce) of single machines are considered to be realised until 2015 (S009), self-learning intelligent control systems until 2020

(S001), free moving robots working jointly with workers until 2020 (S006) and communication between machines and humans as easily as among humans themselves after 2020 (S002).

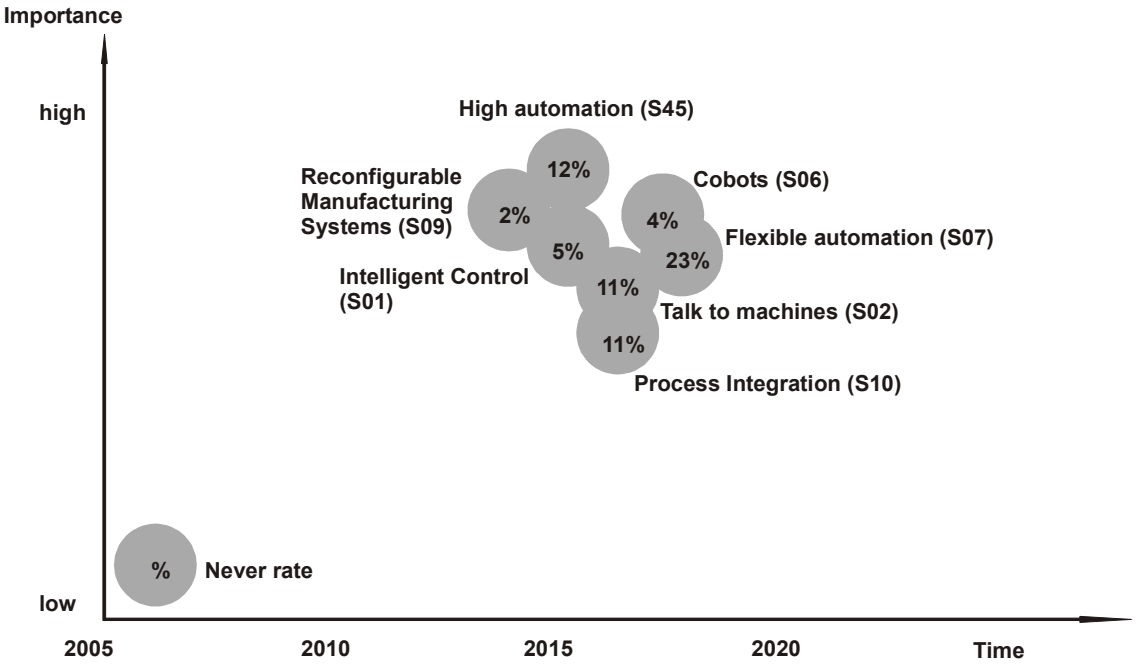


Figure 17: Importance and time of realisation for selected statements of flexible automation – Assessment by all experts (n=2993).

The alternative way of integrating different processes into one machine in order to make complete products (S010) was considered to be less important than the flexible automation developments mentioned above. Thus, different ways of making business rather than the known business models, e.g. local production concepts close to the markets, are not supported by the analysed technological visions yet.

Overall, with regard to flexible automation the majority of experts estimate that the main barriers for all statements are their technical feasibility and their economic viability (see Figure 18). Except for self-learning intelligent control systems (S001) and communication between machines and humans (S002) more than 50 percent of the experts think that all technologies concerning flexible automation might be impeded by their technical complexity.

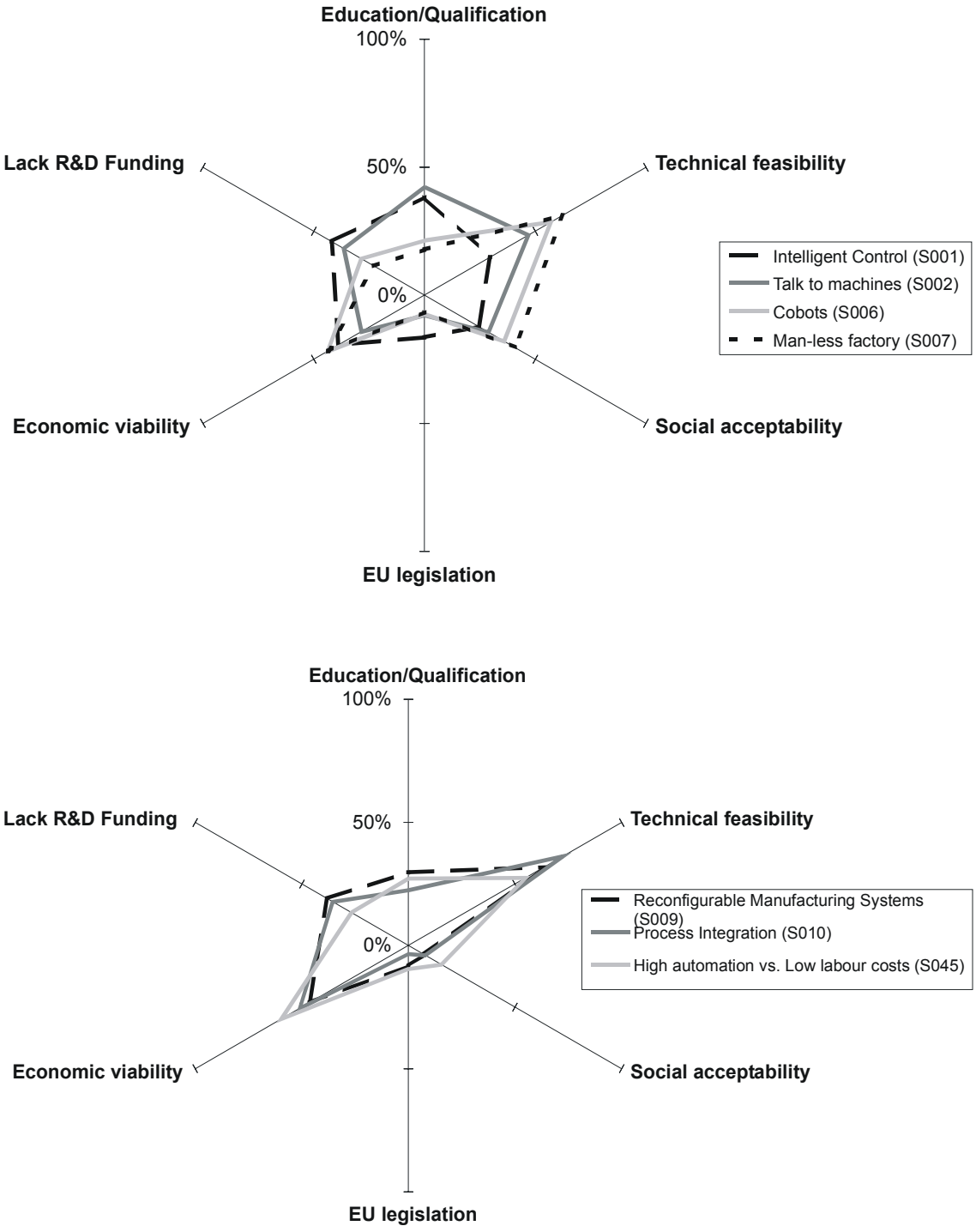


Figure 18: Main barriers for selected statements of flexible automation – Assessment by all experts (n=2993).

The main effects a realisation of the statements concerning automation might yield are an increasing competitiveness and improved working and living conditions. On the

other hand a decrease in employment may also occur (see Figure 19). Particularly, as regards communication between humans and machines (S002) and the cooperation between humans and robots (cobots) (S006) most experts assume that these automation technologies will improve the living and working conditions.

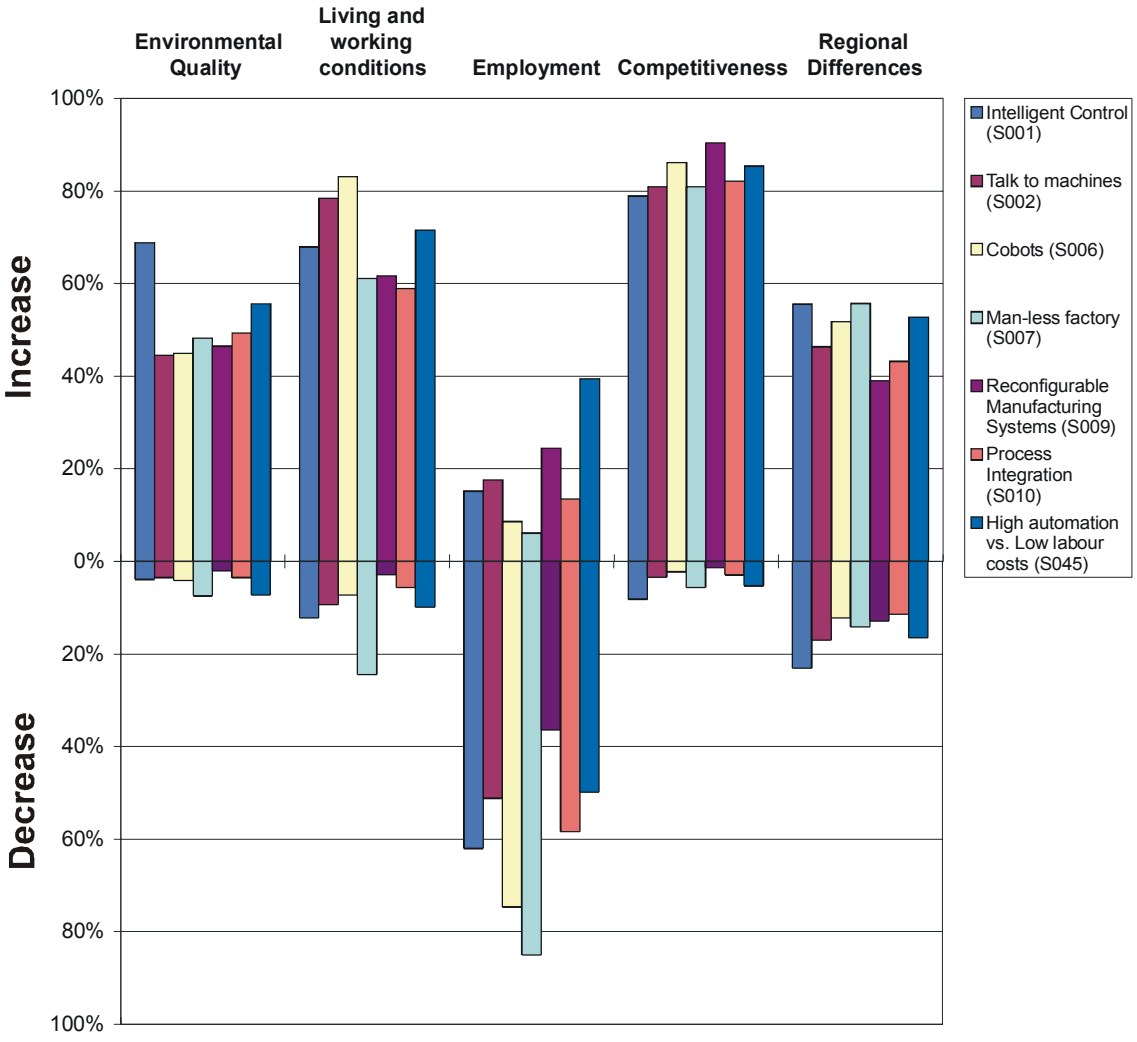


Figure 19: Expected increasing and decreasing effects for selected statements of flexible automation – Assessment by all experts (n=2993).

Except for the intelligent controlled manufacturing operations (S001), the highest R&D level for automation is expected to be in Japan. For statement S001, the USA are supposed to have the highest R&D level. It is noteworthy that at least 3 percent of the experts think that China has the highest R&D level with respect to intelligent control

(S001). This is the highest score for a country with rather low R&D levels for all other statements. The experts think that Europe's R&D level with regard to automation is relatively low.

To conclude, both high and flexible automation is considered to be very important for the future of European manufacturing. Main barrier for the development of automation is predominantly the technical feasibility. High and flexible automation is expected to increase Europe's competitiveness and lead to a decrease in the employment rates. Japan has by far the highest R&D level with regard to further developments in automation.

3.2.2. Ways of making business for manufacturing industries

One of the core arguments within the Manufuture debate is the expected changes in the business models for manufacturing companies. Knowledge intensity, globalisation and the systems approach will lead to new ways of making business in manufacturing, e.g. expanding the scope of activities by including services and meeting the challenges for sustainability. Hence, the results of the first Delphi round will be presented as follows:

- The learning organisation as core of knowledge-based manufacturing.
- Relocation of manufacturing activities as most pressing actual political issue.
- Radical industrial system changes and their perception by the experts.
- The sustainability challenge as a long term vision.

The learning organisation

As a consequence that knowledge-based manufacturing is part of the Manfuture visions, ways of how the organisation is learning and attracting highly qualified people is of strategic importance. Referring to this issue, the experts have an unambiguous opinion. Learning in the company during working hours (S046), an organisation culture supporting knowledge sharing (S021), and self managed teams (S015) are considered to be the most important developments for the vision of a learning organisation (see Figure 20). Most of the experts believe that all these statements will be realised between 2010 and 2015. However, one main barrier for the realisation of these statements is supposed to be the level of education and qualification. Experts think that the employees are not adequately qualified to learn and exchange knowledge and to work within self-managed teams. Furthermore, in order to realise learning in the company

during working hours (S046) the majority of the experts is convinced that this is not economically efficient (see Figure 21).

Of lower importance are the statements concerned with manufacturing workforce as self-employed persons working for different companies (S048) and of a virtual company characterised by changing networks of individual specialists (S023). In general, the experts' assessments reveal a clear preference of competence development on an organisational level and provided by the manufacturing company. The competence development on an individual level is not regarded as a realistic option.

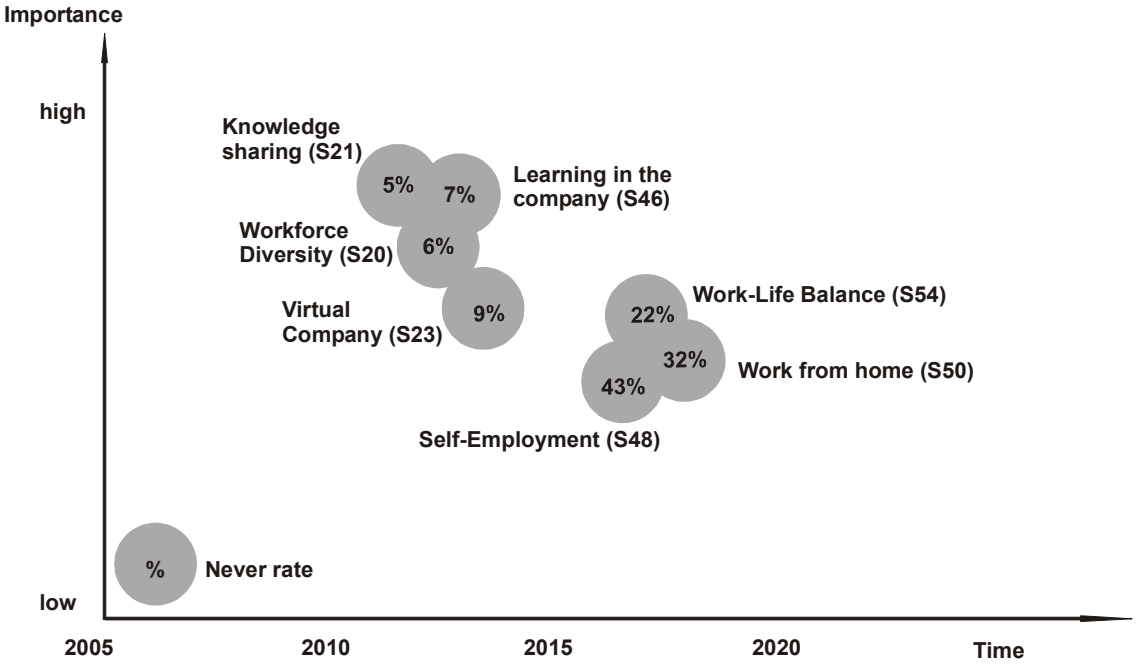


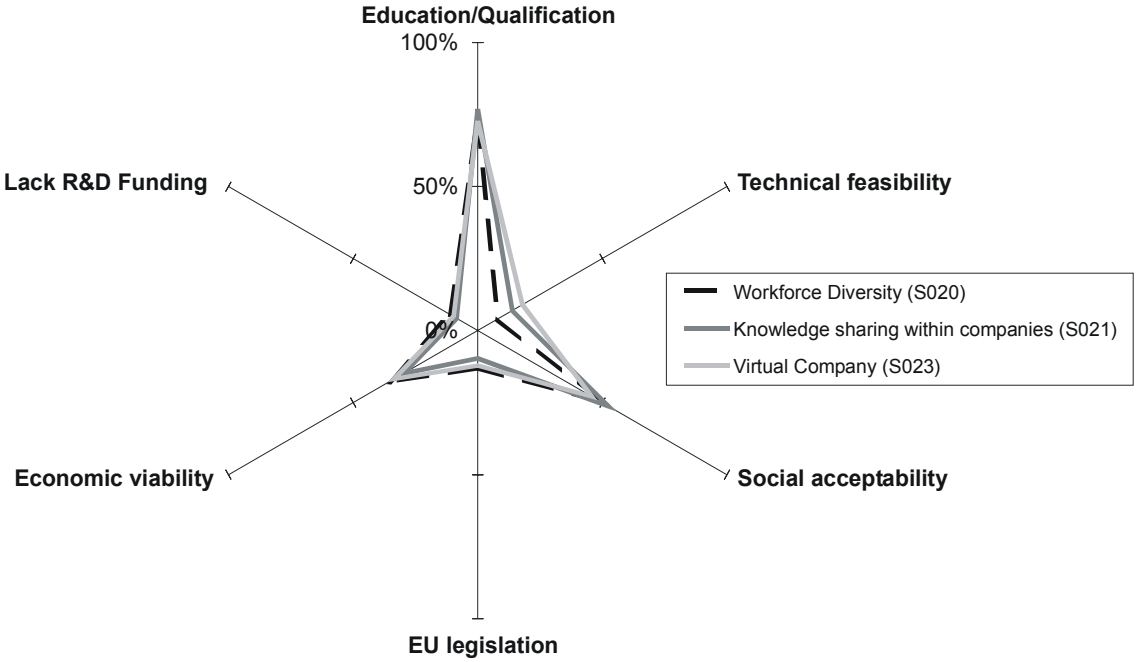
Figure 20: Importance and time of realisation for selected statements of learning organisation – Assessment by all experts (n=2993).

Organisational theory as well as management practice strongly emphasise the importance of core competences for a company's competitiveness. In order to develop core competences a diversely qualified, sustainable and flexible work force with a rather low fluctuation rate is necessary. Bearing this argument in mind, the experts' assessments are surprising and even confusing. Special configurations of working conditions reflecting age and family situation (work-life-balance) (S054), work from home in manufacturing (S050) or achieving a share of females in the workforce according to the population proportions (S49) are considered to be of rather lower importance. Some experts even

suppose that the realisation of these statements will never occur. The shares of experts thinking that the realisation of these statements will never take place are 25 percent for fair female employment (S49), 22 percent for work-life balance (S054) and 32 percent for working from home (S050).

Thus, although industrial psychologists emphasise the importance of instruments attracting motivated people and developing a flexible and sustainable workforce, the experts think that these instruments are not important or even not realisable.

One possible barrier for the realisation of a learning organisation and the statements such as learning in the company during working hours (S046) or knowledge sharing within companies (S021) is the employees' insufficient level of education and qualification. Most of the experts believe that the workers' qualification is not high enough to share knowledge or learn in the company. Another barrier for a fair share of females in manufacturing (S049) is also noteworthy. 84 percent of all experts believe that a proportion of female workers in the manufacturing sector as high as their respective share in the population (S049) is not accepted socially.



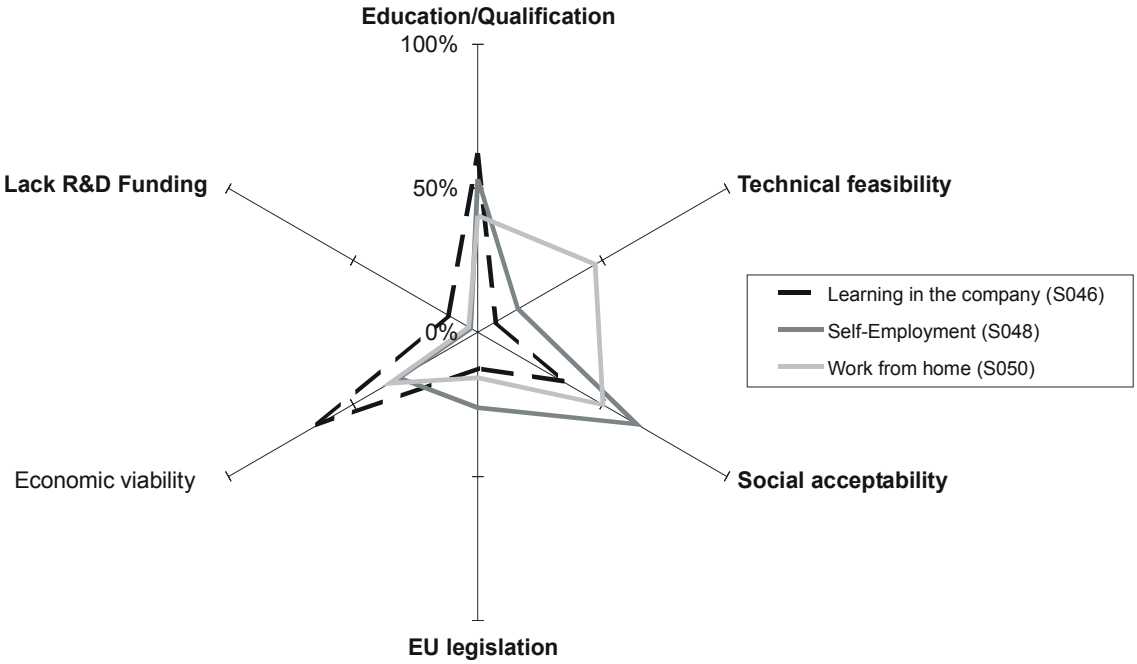


Figure 21: Barriers of selected statements of learning organisation – Assessment by all experts (n=2993).

However, most experts agree that the realisation of the above statements has a positive impact on the living and working conditions as well as on competitiveness (see Figure 22). Except for the vision of self-employment (S048) the large majority of experts thinks that there will be an improvement in the employees' living and working conditions.

To conclude, providing an organisational culture of knowledge sharing and learning is considered a very important issue for the future of manufacturing. In order to enable learning and knowledge sharing companies need to recruit and maintain highly qualified people. However, many experts do think that instruments for attracting and maintaining highly qualified people such as work-life balance or work from home are unimportant or not realisable. In addition, it is very surprising that the experts think that the employees' education and qualification is not adequate to realise a learning organisation.

It has to be discussed whether competence and knowledge development within the company can be achieved without the support of advanced work organisation solutions. However, these results may change across different countries. Further analyses will reveal whether these results may differ across EU countries.

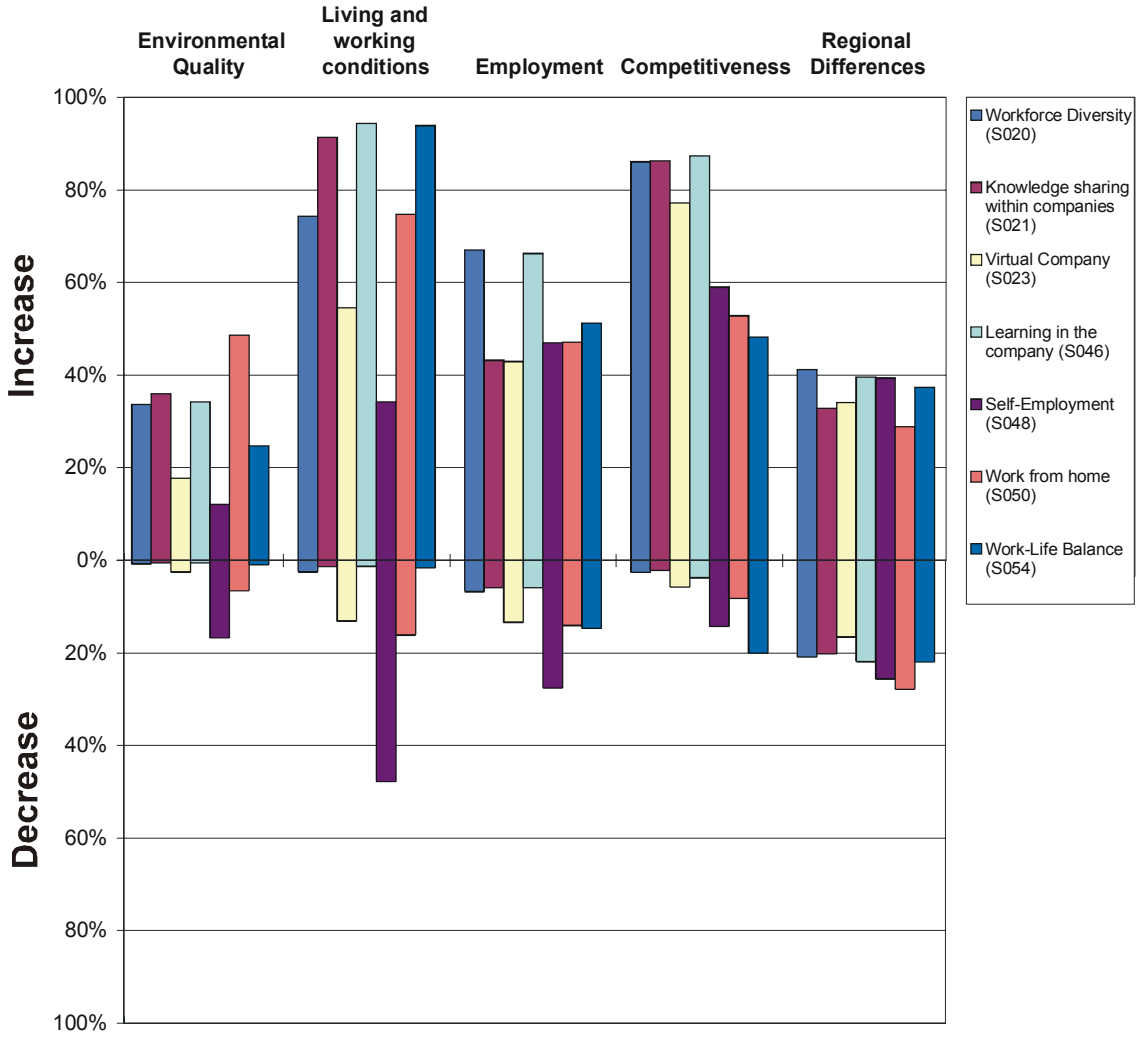


Figure 22: Expected increasing and decreasing effects for selected statements of learning organisation – Assessment by all experts (n=2993).

Relocation of manufacturing operations

The vision that companies will outsource twice the percentage of manufacturing and support activities they have already outsourced today is expected to be taking place in the near future (S017) (see Figure 23). The majority of experts expects increasing outsourcing activities of companies by 2015 at the latest. In terms of importance, experts estimate that the outsourcing activities are of medium importance. 6 percent of the experts think they will never happen. Experts from companies expect earlier realisation than experts from government and research. However, one main barrier of increasing outsourcing activities of companies (S017) is considered to be the social acceptability (see Figure 24). Almost 50 percent of the experts think that an increase in outsourcing

is not accepted socially. Furthermore, more than half of the experts think that statement S017 will cause higher unemployment rates. One positive effect is considered to be an increase of Europe's competitiveness through higher outsourcing activities (see Figure 25). This statement (S017) highlights the importance of restructuring supply chains and the need for decisions towards new manufacturing locations. Thus, possible developments that foster and prevent further changes in manufacturing activities within and outside Europe are of high political relevance.

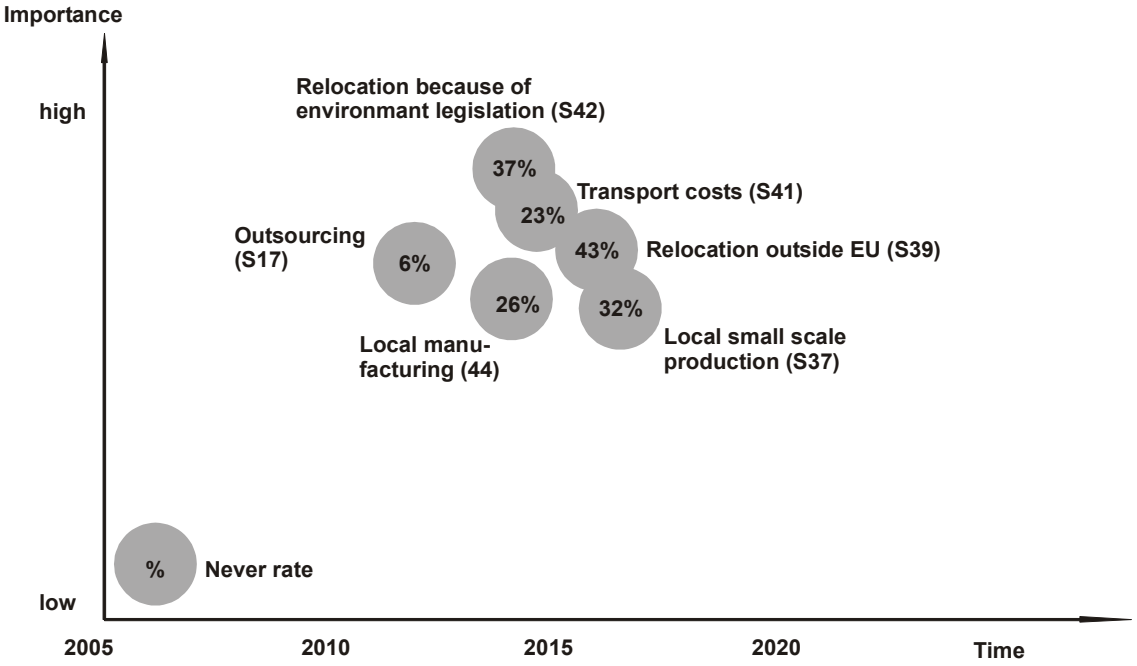


Figure 23: Importance and time of realisation for selected statements of relocation– Assessment by all experts (n=2993).

As discussed earlier, 90 percent of all experts believe that high automation (S045) outweighs the advantages of lower labour costs outside the EU. Of lower importance is statement S041 concerning transportation costs. Three forth of the participating experts believe that high transportation costs could balance lower labour costs outside the European Union. Of these experts more than 50 percent are certain that this will be taking place before 2015. The evaluations differ with the types of experts. Experts from industry assign the statement S041 more importance than researchers do.

Almost 40 percent of all experts do not think that the environmental standards of the European Union will force European companies to relocate their site outside Europe (S042). Contrarily, most experts believe that this vision is important and will be realised by 2015. Thus, these estimations are rather contradictory: one part of the experts sup-

poses that relocation because of environmental standards is rather unrealistic, another part thinks that it is very important and will happen rather soon. Feasible impacts of relocations triggered off by environmental standards are a decrease in Europe's employment situation and an increase of the environmental quality and the regional differences.

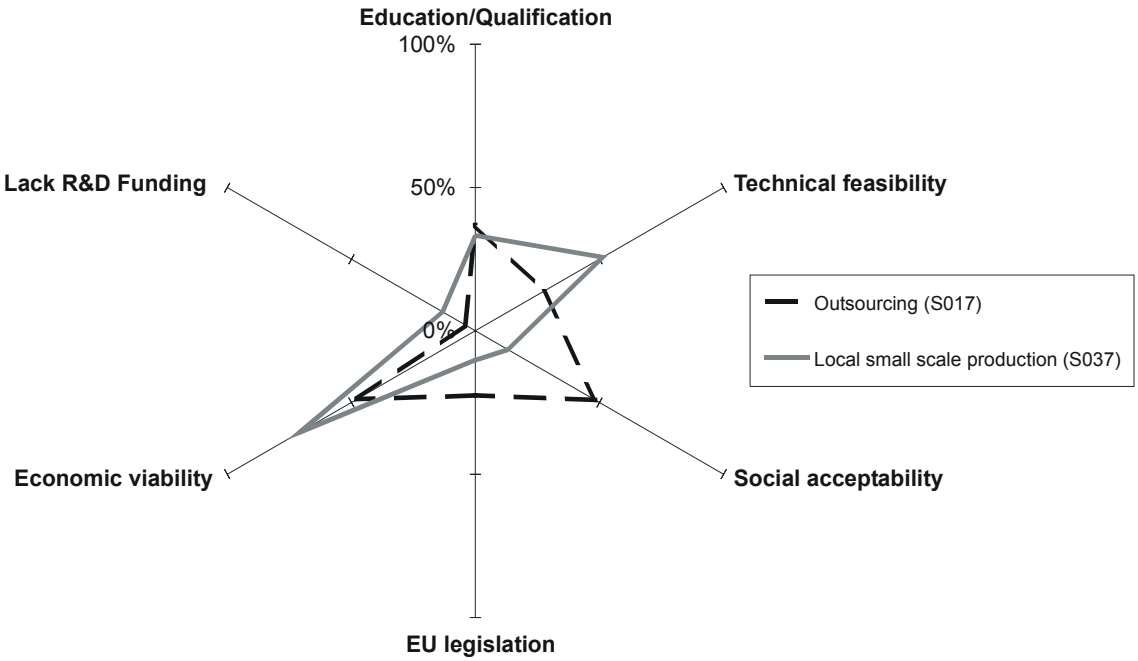


Figure 24: Main barriers for selected statements of relocation – Assessment by all experts (n=2993).

The analysis of the second statement considering relocation outside the EU (S039) reveals similar results as statement S042. 43 percent of all experts believe that an almost completely relocation of production activities outside the EU will never occur. This represents the highest percentage within the whole ManVis survey where experts think that the statement will never be realised. However, other experts think that it is an important statement and it will be realised approximately in 2015. As with the results of statement S042, almost all experts believe that an increase in relocations will lead to increased unemployment and regional differences. About half of the experts believe that the living and working conditions will decrease as a result of increasing relocation outside the EU.

Statements S037 and S044 both dealing with local manufacturing and representing an alternative approach of relocation are supposed to be of rather low importance compared to the statements concerning outsourcing and relocation. Furthermore, many experts think that a widespread use of local manufacturing will never be realised. One explanation for this scepticism is probably technical feasibility and economic viability. Half of the experts believe that the vision of producing almost completely in local small scale production sites using multifunctional equipment (S037) will be impeded by its technical feasibility and even 70 percent think this economically not efficient. However, around two thirds of the experts assume that local small scale production (S037) as well as local manufacturing (S044) positively influences the employment rate.

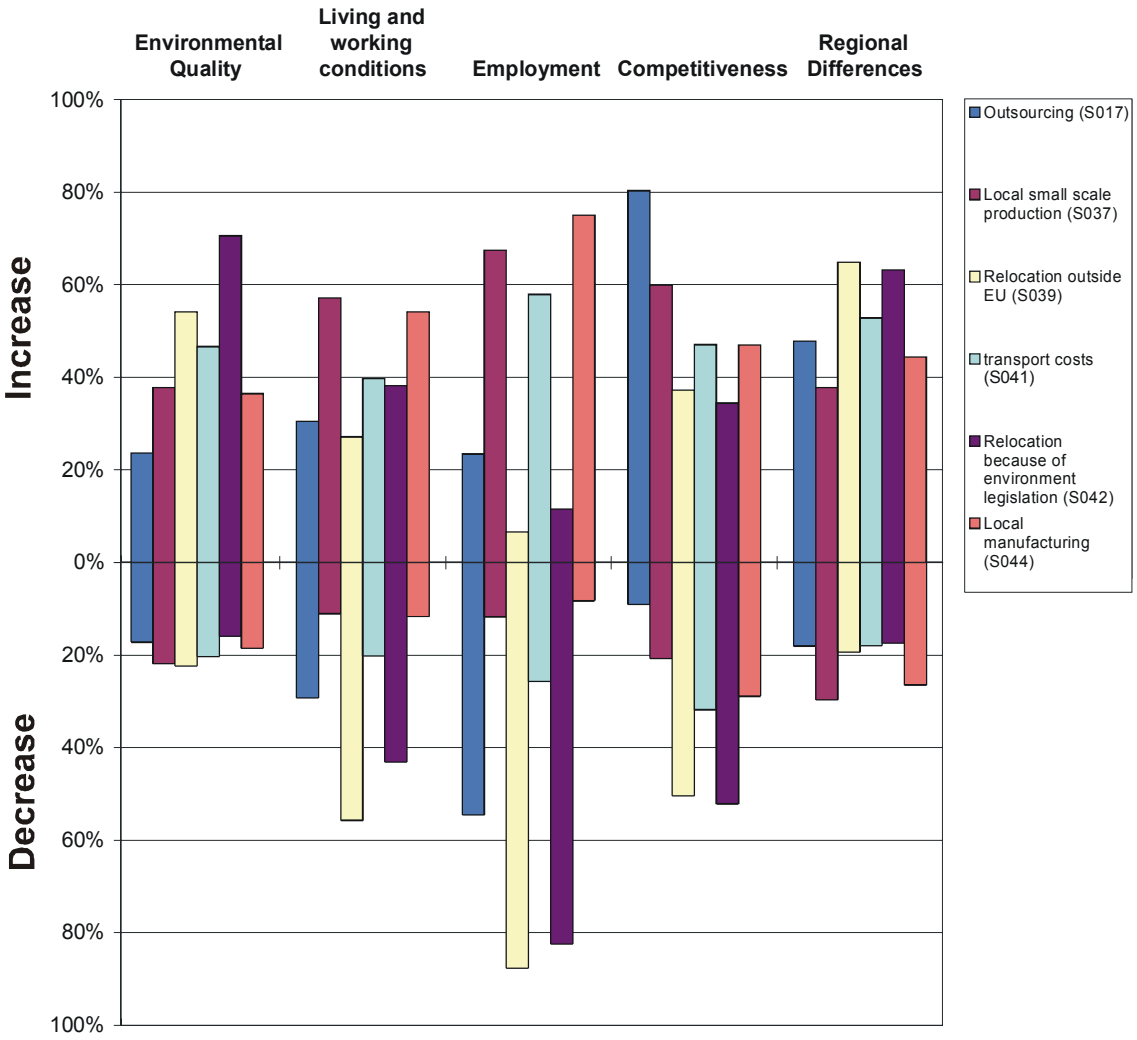


Figure 25: Expected increasing and decreasing effects for selected statements of relocation – Assessment by all experts (n=2993).

To conclude, statements concerning relocation are rather contradictory. On the one hand, many experts believe that relocation is an importance issue and will be realised more or less soon. On the other hand, many experts suppose that an almost complete relocation outside Europe will never occur. However, experts agree on increased employment rates through increased local manufacturing but also on decreasing employment rates through higher relocation and outsourcing activities.

Changes in the industrial system and business models

The vision document by the Manufuture high-level group has elaborated the necessity of mastering the concept of adding value to design, production, distribution and services simultaneously. Therefore, statement S019 implies that the speed of improvement of the whole industrial system is more important than the individual products for the competitiveness. The experts, however, think that this statement is of rather low importance as the ranking of this statement is even below average (see Figure 26). It is still not clear whether the experts actually do not share the high-level group's vision or whether they estimated it lower relatively to the other statements.

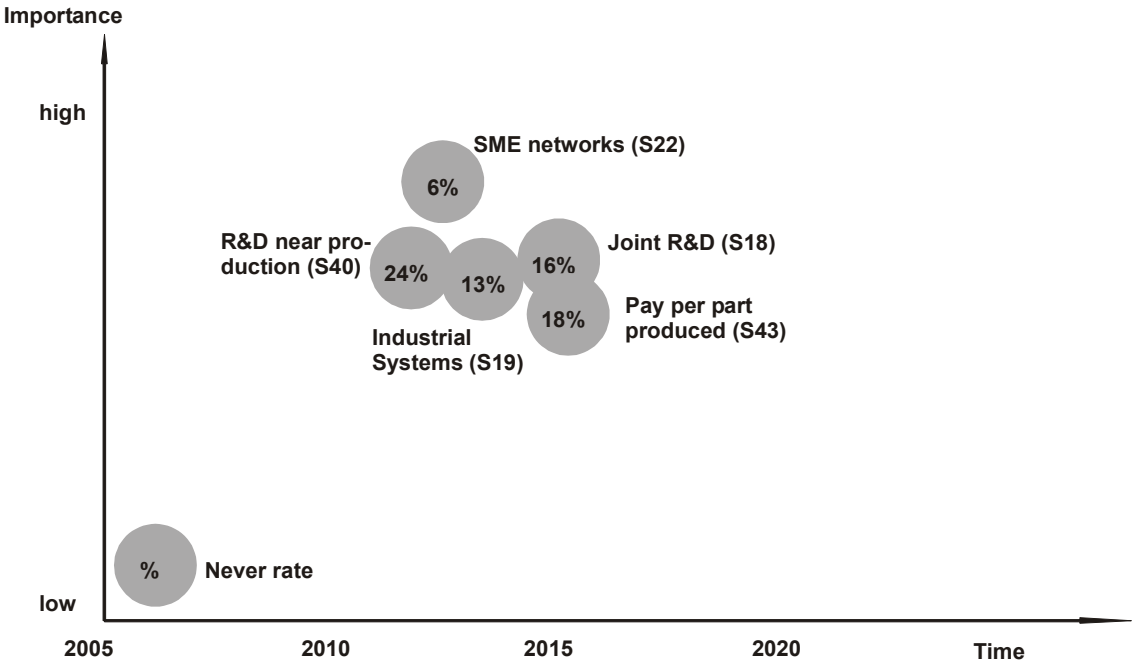
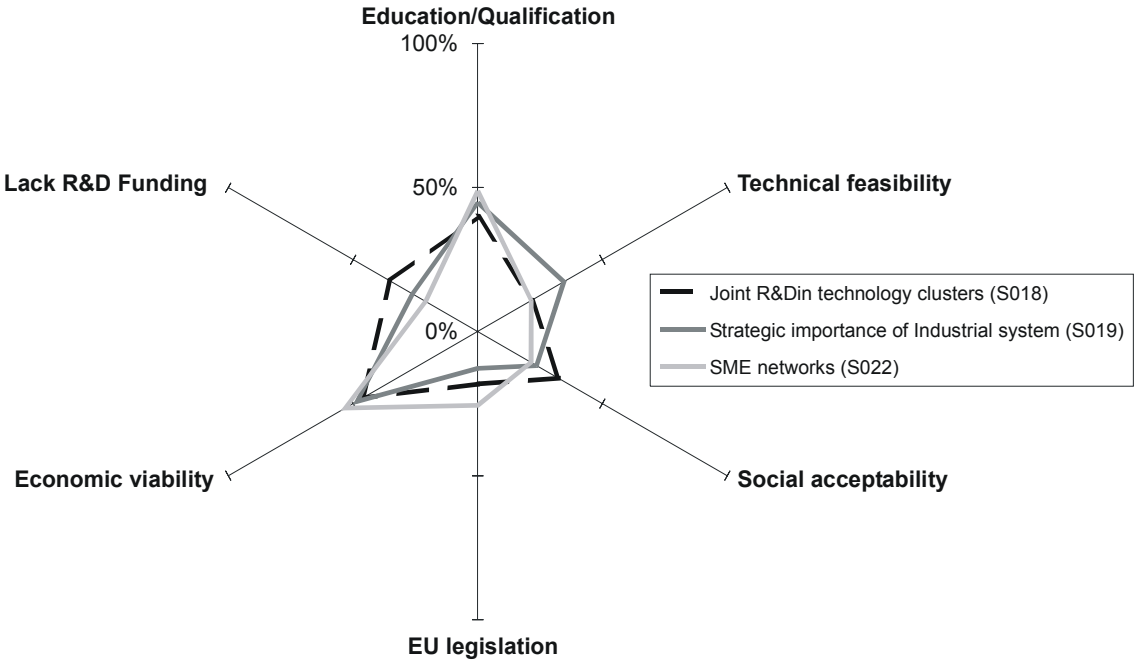


Figure 26: Importance and time of realisation for selected statements of industrial system changes – Assessment by all experts (n=2993).

In terms of different strategies for an implementation of the high-level group's vision the results reveal rather diverse views of the experts. The most important includes statement S022 which indicates that networks of specialised SMEs will compete successfully in the marketplace. In addition, experts estimate that these SME networks will be realised rather soon already in 2010. However, 50 percent of the experts believe that the employees' qualification and education and the economic viability could possibly be a main barrier for specialised SME networks to be successful (see Figure 27). But almost all experts also think that specialised SME networks will increase Europe's competitiveness and employment rates (see Figure 28).

Another approach for joining forces across firm's boundaries is joint research and development activities of companies and specialised research institutes in technology clusters (S018). Experts assess this as a long-term strategy which will be probably realised in 10 to 15 years. In terms of different estimations of experts, political actors are more enthusiastic about joint R&D than experts from industry. 85 percent of all experts believe that joint R&D in technology clusters increases Europe's competitiveness.



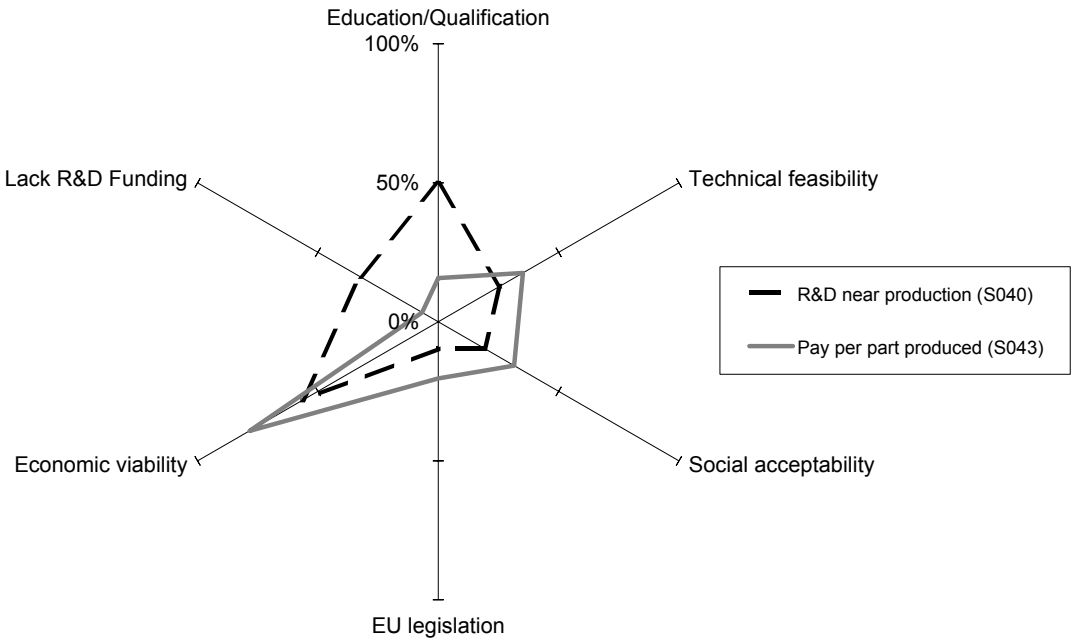


Figure 27: Main barriers for selected statements of industrial system changes – Assessment by all experts (n=2993).

There is an ongoing and lively discussion whether R&D and production should be linked geographically. The results of statement S040 reveal that there are diverse opinions concerning R&D near production. On the one hand, 24 percent of all experts think R&D and production will not be closely linked. On the other hand, about 70 percent of the experts think that R&D will performed close to the manufacturing sites will occur in the next 5 to ten years, thus very soon. These results underline that there is no agreement on this issue. One possible explanation for this contradictory estimation is possibly a barrier which hinders the realisation of this statement. 50 percent of the experts believe that the level of education and qualification is not high enough to realise a R&D near production. On the other hand, most of the experts believe that there will be an increase of Europe's competitiveness through R&D near production.

Finally, radical new business concepts such as pay per part produced instead of owning production equipment (S043) are not supposed to be in a broader use before 2020. 18 percent even think that this business concept will never become reality. One explanation for this scepticism is probably the barriers of realisation. Almost 80 percent of all experts are convinced that a broad use of pay per part is not viable from an economic

point of view. Nevertheless, 60 percent of the experts think that pay per part will increase competitiveness.

To conclude, the Manufuture vision is not shared yet by the participating experts and the estimations are rather divided. On this issue a more detailed description of possible paths and milestones towards this vision is needed to explain and convince more stakeholders and experts.

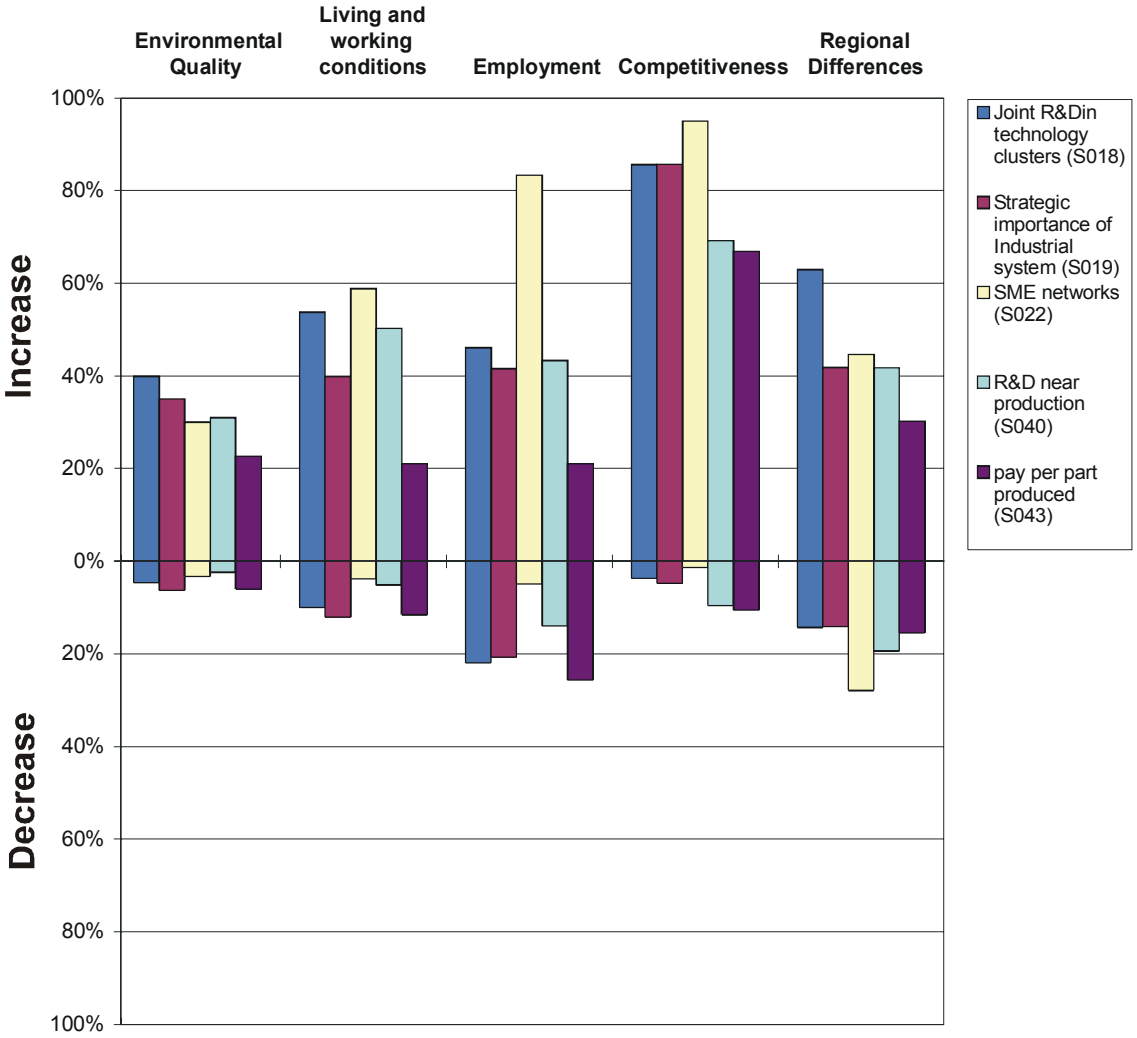


Figure 28: Expected increasing and decreasing effects for selected statements of industrial system changes – Assessment by all experts (n=2993).

The sustainability challenges

The sustainability goals set by the European Commission at the Gothenburg Summit have economic, ecological and societal goals equally on the political agenda. Manufacturing industries and research will play an important role in reaching this goal.

In this regard experts were asked to assess statements which can be affiliated to different strategies of sustainability.

One strategy is the reduction of the ecological damage by enabling manufacturing to cope with renewable resources (S013) and by integrating environmentally friendly technologies with zero-waste/zero-emission production (S11). Another strategy is closing the loop of product cycles by taking back products (S032) or by remanufacturing of used parts and products (S31). The last strategy is the purchase of use instead of products (S033) and the equality of social, environmental and economic aspects in companies' decision making process (S24).

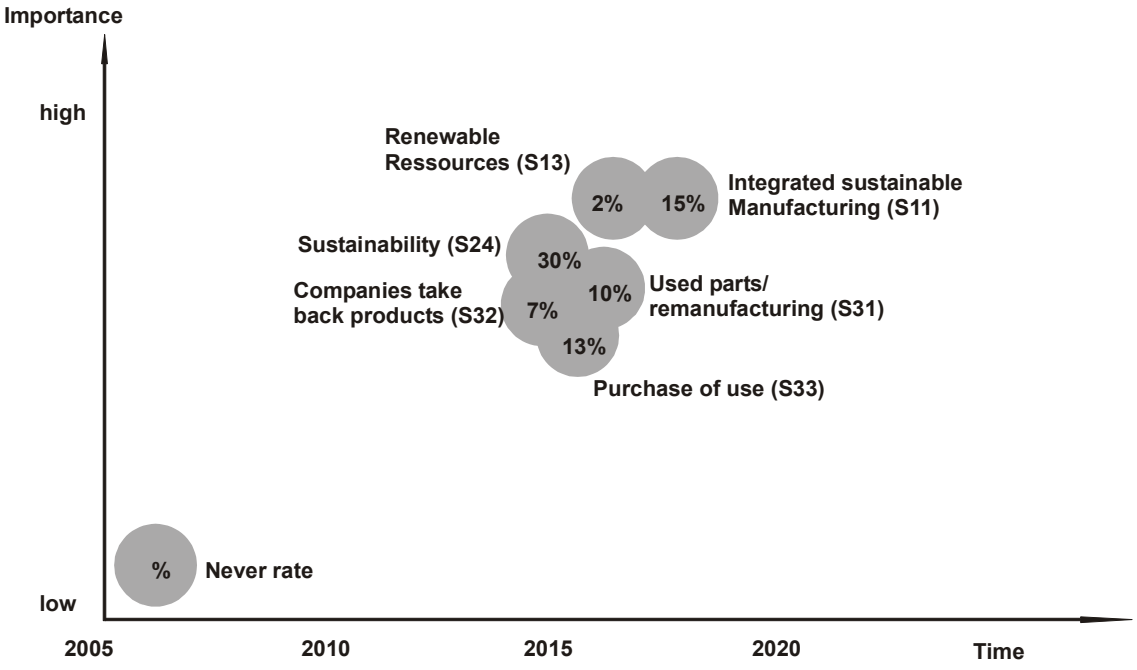


Figure 29: Importance and time of realisation for selected statements of sustainability – Assessment by all experts (n=2993).

The two statements (S011, S013) within the strategy for reducing the ecological damage are considered to be the most important compared to the two other strategies.

However, 50 percent of the experts believe that this strategy could be blocked because of its lack of technical feasibility and economic viability. But almost all experts assume that by implementing integrated environmentally friendly technologies (S011) and renewable resources in the manufacturing process the quality of our environment and therefore the living and working conditions will increase. As regards the R&D levels of these concepts, Europe is by far the region with the most intensive R&D level. Approximately 70 percent of all experts believe that Europe has the highest R&D level.

Manufacturing activities which close the loop of product cycles (S031, S032) are considered to be less important than those of the preceding strategy. This is surprising as there is national and European legislation expected. One possibly explanation is the experts' estimation concerning the barriers of recycling activities. Experts think that one possible barrier which hinders recycling activities of companies is the economic ineffectiveness of these activities.

According to the experts, statements S024 and S033 are of least importance and are rather sceptical. 30 percent of the experts think that the vision of equal importance of social, environmental and economic aspects (S024) will never occur. One possible reason is the social acceptability and the economic viability hindering the realisation of this vision. The majority of the experts assumes that purchase of use (S033) and sustainability in terms of balancing social, environmental and economic aspects (S024) will not be realised before 2015.

To conclude, the analysis of the experts' estimations across different European countries needs more time and further analysis, because at first view there are no clear patterns. First impressions suggest that the expectation on the environmental impact of new technologies is rated more enthusiastically in the new member states of the European Union. This could be due to the higher pollution these countries have in some regions. In addition, the attitude towards equal importance of ecological and social factors in management decisions is also judged favourable in these countries. According to the origin of experts, the industrial experts are by no means more sceptical than other experts on sustainability issues. The sustainability issue is a long-term challenge to manufacturing whereas radical business models are not very prominent among the experts yet. Technology developments reducing the environment impacts are regarded as offering more promising opportunities.

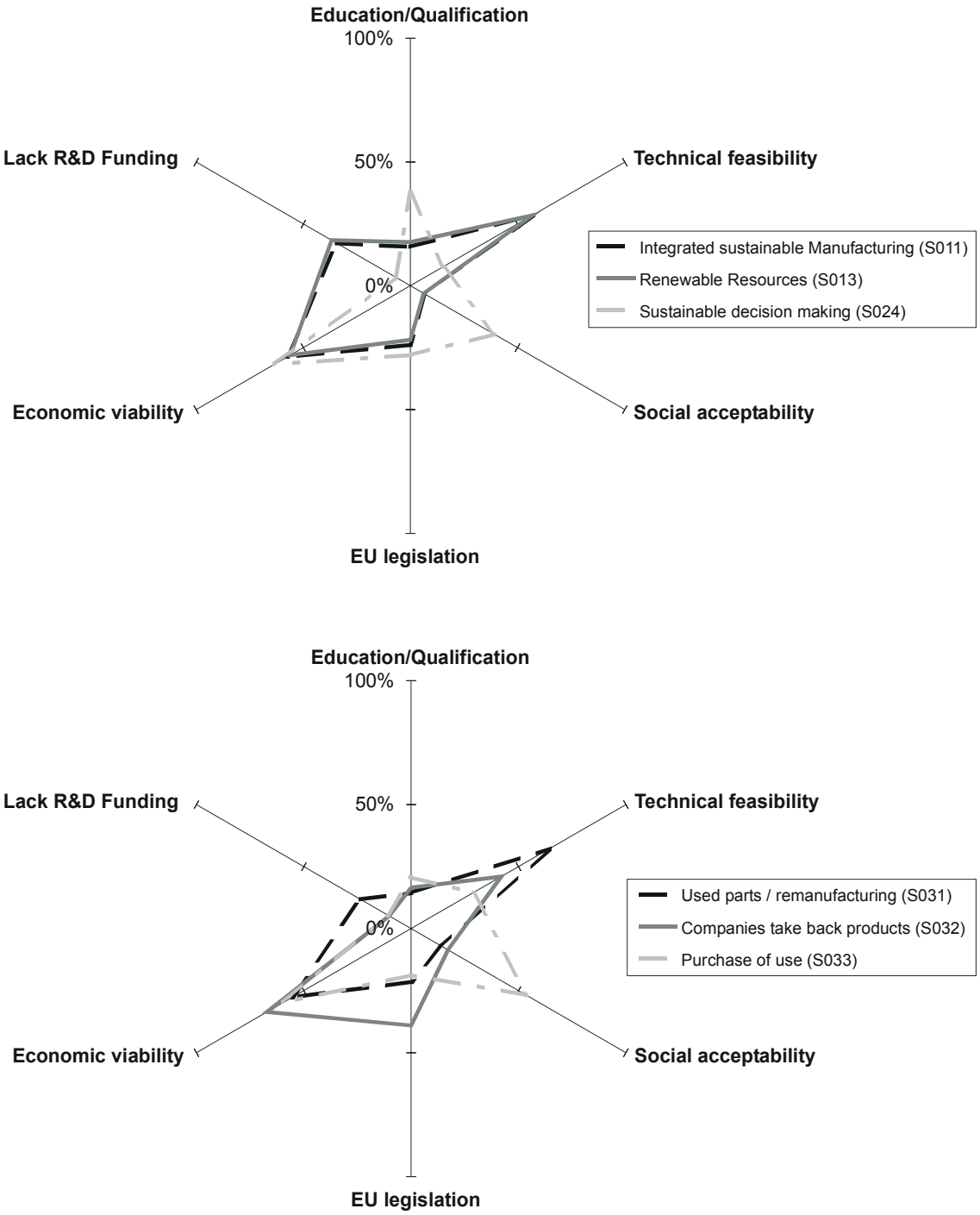


Figure 30: Main barriers for selected statements of sustainability – Assessment by all experts (n=2993).

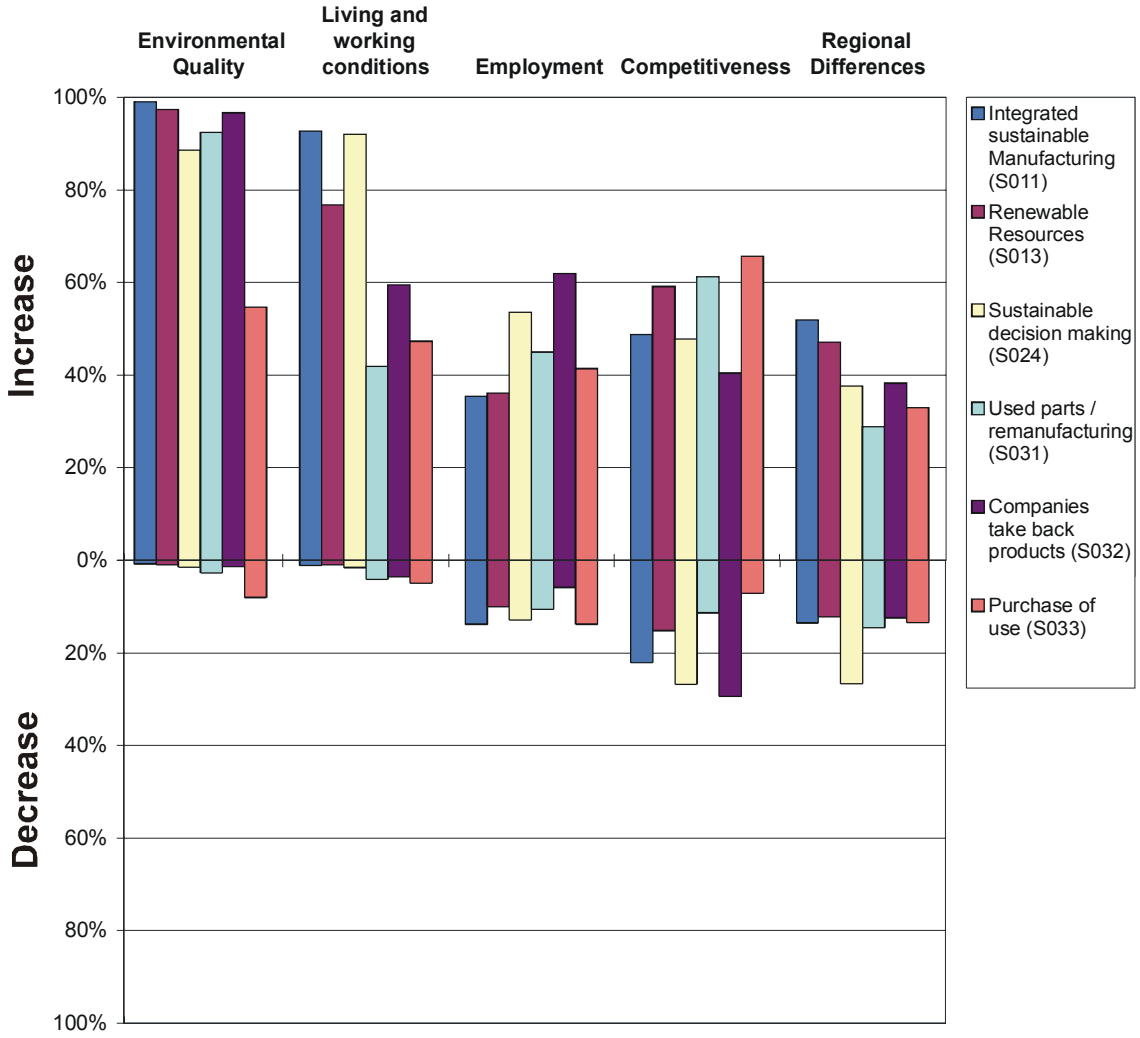


Figure 31: Expected increasing and decreasing effects for selected statements of sustainability – Assessment by all experts (n=2993).

4. Summary, Conclusions and Next Steps in ManVis

The ManVis project has delivered preliminary results of the 1st round of a Delphi survey in 22 European countries comprising the view of almost three thousand manufacturing experts.[3] These first results are based on evaluation of statements dealing with possible developments in manufacturing concerning their impact on European manufacturing industries, the time horizon of their realisation, expected effects and barriers associated with their realisation. ManVis presents rather the scope of the experts' views than an in-depth analysis. Therefore, this report is merely a starting point for more detailed analysis and – more important – for further discussions.

Nonetheless, a couple of first messages can be identified and a few conclusions for the debates within the Manufuture process can be drawn.

Summarising First ManVis Messages

Some preliminary messages could be derived from the presented findings:

Innovating production

- Micro-electromechanical devices, smart materials, products using nanocoatings – in this order – are representing long-term developments in new type of products with disruptive character for markets. These product challenges offer an opportunity for strengthening competitiveness which can only be exploited if appropriate manufacturing equipment is available and is incorporated into these technologies. Hence, generic technology development needs complementary manufacturing technology research involvement.
- New manufacturing technology principles as bottom-up manufacturing technologies are expected only in the long-term. Manufacturing technologies using biotechnologies for creating and manipulating inorganic material and products as nanomanufacturing as well should be on the long-term-“radar” of RTD-policy.
- Micro-electromechanical systems as well as flexible organisation and automation strategies combined e. g. in reconfigurable manufacturing systems supporting flexible business strategies are important for the short-term research agenda.
- Long-term automation visions comprise the human-machine interfaces as man-machine speech recognition, self-learning systems and co-bots.
- Environmental technologies are regarded as more relevant at the moment than new business concepts fostering sustainability.

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[3] The results are based on a preliminary data set. Slight changes in further analyses are possible.

- In addition, in the field of environmental technologies Europe is seen as the research leader compared to USA and Japan. Research leadership in other fields is assessed differently by the experts: USA are seen at the forefront in bio-, nano-manufacturing and electronics. Japan leads in co-bots and other long-term man-machine interactions or hybrid man-machine working systems.

Organising manufacturing business

- Sustainability issues in general, stakeholder involvement and new sustainable business concepts in particular are assessed very sceptically by the experts.
- A very prominent issue for the experts is the emergence of competitive SME-networks as an alternative to OEM focussed value chains.
- Knowledge based manufacturing needs a learning organisation. The experts endorse companies' responsibilities for this issue, using own resources and developing individual organisation cultures. However, they do not see self-employed individuals as a realistic vision for manufacturing operations.
- There is a marked tension between the low importance ratings on improving work-life balance conditions for manufacturing workforces on one side and the positive views on long-term competence development on the other side. Therefore, the often-seen pre-requisites are rated lower than the preferred outcome of competence building. Further debate on this issue is needed as adequate education and qualification is seen as the most relevant barrier in this field.
- Relocation and outsourcing are important political issues. The experts do not believe that Europe will be without manufacturing industries. Some regulation issues may influence related cost (dis-)advantage as e.g. transportation. The experts were more sceptical about alternative concepts which are discussed in the political and research arena, e.g. focussing on regional technology clusters or elaborating local production strategies. Hence, one issue needs more analysis: The interaction between R&D activity and production and the necessity of having both functions close to each other or within one firm. The experts displayed diverging reactions on this issue, although it is crucial for relocation decisions as well as for the concept of knowledge based manufacturing.
- Finally, the need for new business concepts as highlighted by the Manufuture Vision Document received mixed reactions by the experts. The ManVis coordination team has the impression that scepticism on realisation chances, not understanding or knowing these concepts in certain Member States and missing specifications of the concepts might explain these mixed reactions.

These issues underline the need for research on industrial adoption and innovation management practices in manufacturing industries and intensive communication and further debate of the ManVis results.

Some conclusions

The Strategic Function of Manufacturing Research

Before transforming the first preliminary results into conclusions for research policy, a reconsideration of the function of manufacturing research is needed. The Manufuture vision document has highlighted the complexity, the multi-disciplinarity and urgency of holistic views of manufacturing engineering (p. 14). They reflect the developments on the markets maintaining or re-gaining for manufacturing industries' competitiveness today and to ensure it in the future. In addition, new technologies and new knowledge are provided which have to be exploited, adapted and put into practical use. Hence, manufacturing engineering is the motor which brings new products and services on the market using technological, organisational and human resources.

By research on technologies for manufacturing and on organisation and management research Manufacturing research provides manufacturing engineering with the necessary knowledge, tools and solutions.

The development of new generic technologies and knowledge challenges manufacturing research in two ways. First, it creates a need for manufacturing processes in order to produce the new products and provide the new services. Secondly, these new technologies and knowledge have to be integrated into the production processes themselves. Basic manufacturing research has to foresee and prepare for the new challenges and applied manufacturing research has to adapt and transform existing technologies and organisational processes. Furthermore, manufacturing research plays a decisive role in combining the long-term horizon in technology trajectories with the short-term need of firms to innovate successfully. This requires a good "timing" of research activities to have solutions and tools ready for industrial adoption.

Considering these functions of manufacturing research the ManVis first preliminary messages can be discussed as follows:

Emerging Technologies and Knowledge for Manufacturing Research

Basically, four groups of technologies were discussed in several ManVis-statements:

- bottom-up manufacturing technologies (bio- or nano-processes e. g. statements 3,4)
- advanced materials (e. g. statements 12,28)
- micro-systems technologies (e. g. statements 5,9)
- information and communication technologies (e. g. statements 2,34)

For these technologies the experts expressed different time horizons for realisation. Activities for basic and applied research have to be performed in advance (approx. 10 - 15 years basic research, 5 - 10 years applied research).

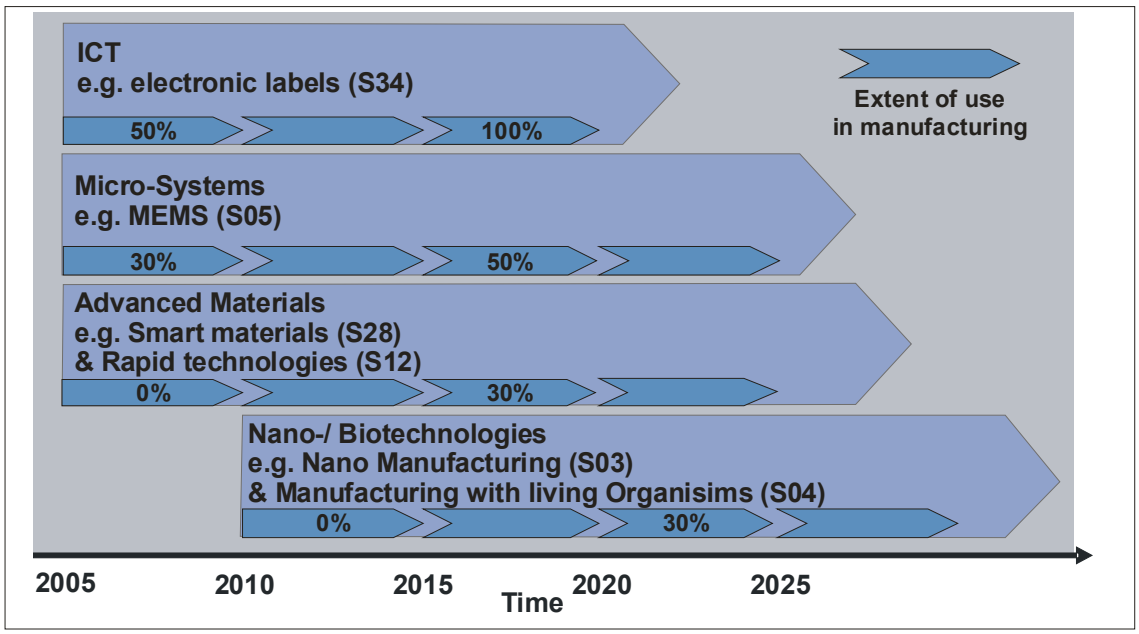


Figure 32: Implementation of generic technologies in manufacturing.

ICT will still play the decisive role in short term perspective; it will play an important role in supporting new forms of cross-company networks (c. f. also the importance of SME-networks). Hence, targeted applied research for SMEs on optimal organisation of networks and its ICT support can be derived as one priority.

Microsystems (together with intelligent controls) are key enablers for plug-and-produce systems aiming at more flexible manufacturing systems as well as for process integration into multi-functional machinery. For this second technology, the necessary link from developing new machinery to creating new business models (although not emphasised by the experts) could be crucial as well as research bringing together equipment suppliers and users.

For advanced materials, the problem of making processing and manipulation of these materials feasible and – more important - competitive has already been identified as an important research topic by the FutMan study. Hence, applied and targeted research on process technology for materials could be a third issue.

Finally, basic research on nano- or biotechnology has to be carefully monitored for emerging manufacturing research fields. In addition, cross cutting manufacturing research issues like workplace safety of nano- or bio-based processes etc. may facilitate the basic research activities in this field.

Placing the Issues into the Manufuture Scenarios

The four Manufuture scenarios (p. 13 in Vision Document) describe general trajectories for manufacturing enterprises. As outlined in Figure 32 some ManVis findings could be placed into the four quadrants focussing the research activities.

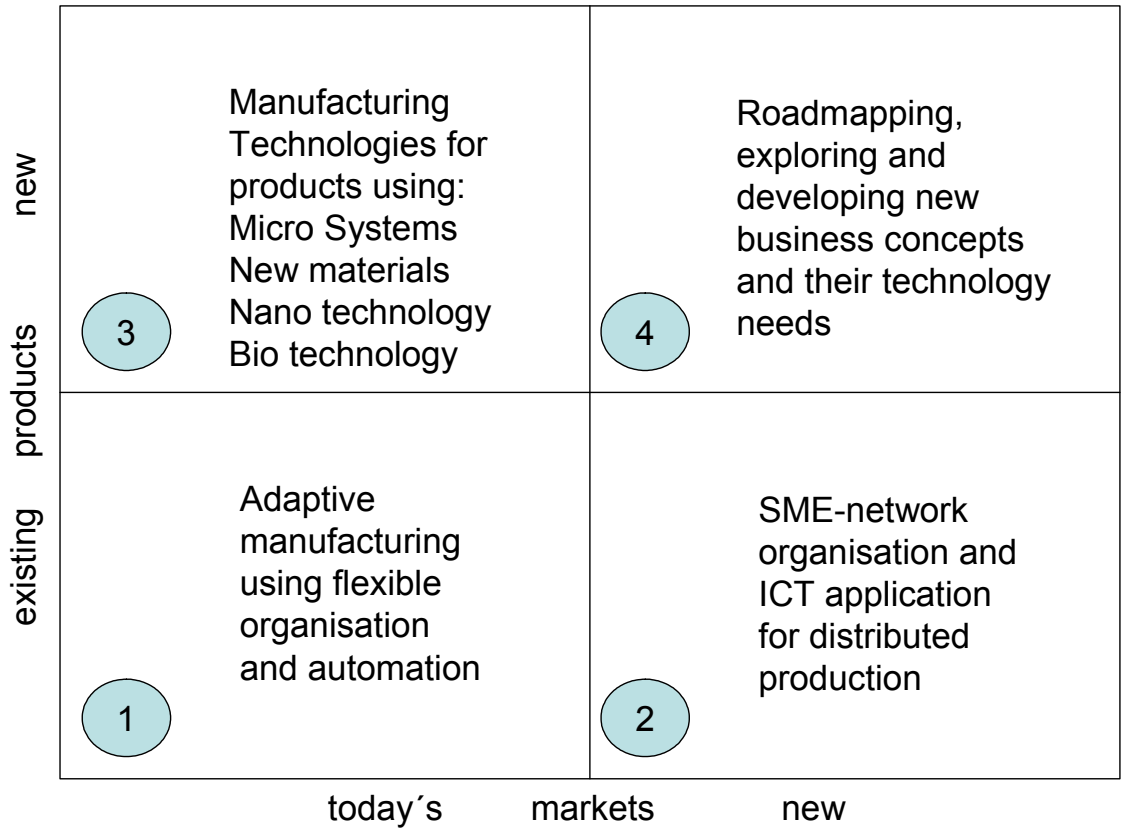


Figure 33: Selected Manufacturing research topics and their contribution to the Manufuture scenarios.

We also strongly recommend analysing the results of the Dortmund and Enschede workshops in a similar way i.e. using them to specify the merely general ManVis remarks. For example:

- The flexible organisation and automation efforts could be placed into the first scenario, enabling flexibility and price strategy based advantages. Although this is a reactive strategy, the Enschede Workshop A 'Innovating Production' has developed some thoughts on that, e. g. expanding existing applications of applied technologies like laser, electron-beams for SMEs.
- In the second scenario, distributed production is enabled by many ICT-applications for manufacturing. Here organisational solutions e.g. for SME-networks – as one of the most important issues for European industries in the view of the experts - can be supported by ICT. In order to elaborate these strategies more efforts in the direction of the Dortmund Workshop 3 results could be useful. In general, this should focus on enabling SMEs in going global.
- In the third scenario, the exploitation of the opportunities of new technologies could be the focus in manufacturing technology research (e.g. developing process technologies for products using micro-system-technologies, new materials, nano- and bio-technology).
- Mainly based on the technological knowledge created in scenario 3, the development of business strategies is at the forefront in scenario 4. The fourth scenario needs more specifications and roadmaps as input. The ManVis experts expressed their scepticism on new business concepts generally and even Manufuture suffers from the scarcity of examples.

At first view Scenario 3 requires first view mainly new technology competences. Scenario 1, Scenario 2 and – most important – scenario 4 require widely spread competences, skills, knowledge and capabilities in a company's workforce, organisation and management.

Knowledge Base and Knowledge Diffusion

Knowledge creation for excellence in technology on the one hand, and practical use based on broad workforce competencies on the other hand were highlighted by the experts at the same time. Manufacturing research has to transfer the knowledge created by research into practical experience and skills in companies. Hence, manufacturing research does not merely need technology but also knowledge roadmaps.

The most highlighted barrier by the experts was the inadequacy of education and qualification. Statements focussing on competence building **in** the companies were rated as very important. Broad knowledge diffusion reaching all company levels seems to be a crucial element for reaching EU manufacturing competitiveness. Although it might well overload manufacturing research promotion, ManVis results suggest that capability development in competences, skills etc. and developing tools for management has to be tackled on a much broader scale (e.g. in innovation actions or regional activities).

But ManVis experts also suggest that competences for manufacturing will be developed in the companies. This contributes an additional element to the Manufuture vision which has highlighted the role of education institutions for primary education and their role in life-long education but not the necessary internal changes in the companies themselves.

ManVis – Next steps

The ManVis project will evaluate and analyse the remaining questions of the survey in the following months in order to:

- add new information by including stakeholder and international views,
- to prepare the second round of the survey,
- to compare the ManVis-data for participating countries
- to give feedback to the participating experts,
- carry out sectoral analysis, and
- to prepare the final report.

In order to prepare the second round the ManVis-team has decided to make a methodological step forward by reducing the questionnaire and focussing on controversial topics confronting the experts with condensed interpretations. This allows for more intensive debate on these topics. The empirical evidence of other Delphi-surveys shows that changes of the assessment after the second round are minor on undisputed issues. In addition, this helps in maintaining the high response rate.

In order to give individual feedback to the expert community, ManVis will distribute the first round results. ManVis will prepare the documentation for the general public on the project's web page www.manufacturing-visions.org. The report on the Delphi results is due in autumn 2005, preparing a final conference in October 2005.

ManVis long term goal is to lay ground with the database for follow-up activities like stimulating workshops, planning, road mapping etc. for companies and policy actors. The ManVis findings shall be much more a starting point for public debates and shall be complemented by additional foresight activities.

Annex

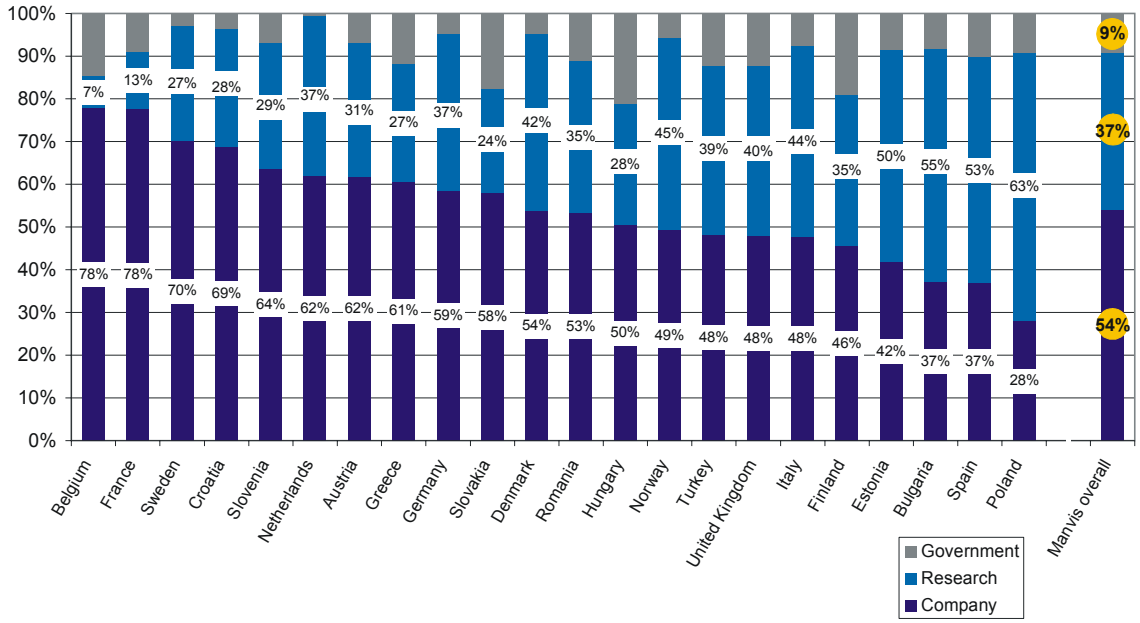
Annex 1: Expert's origin by participating countries

Annex 2: Expected effects for all statements

Annex 3: Main barriers for all statements

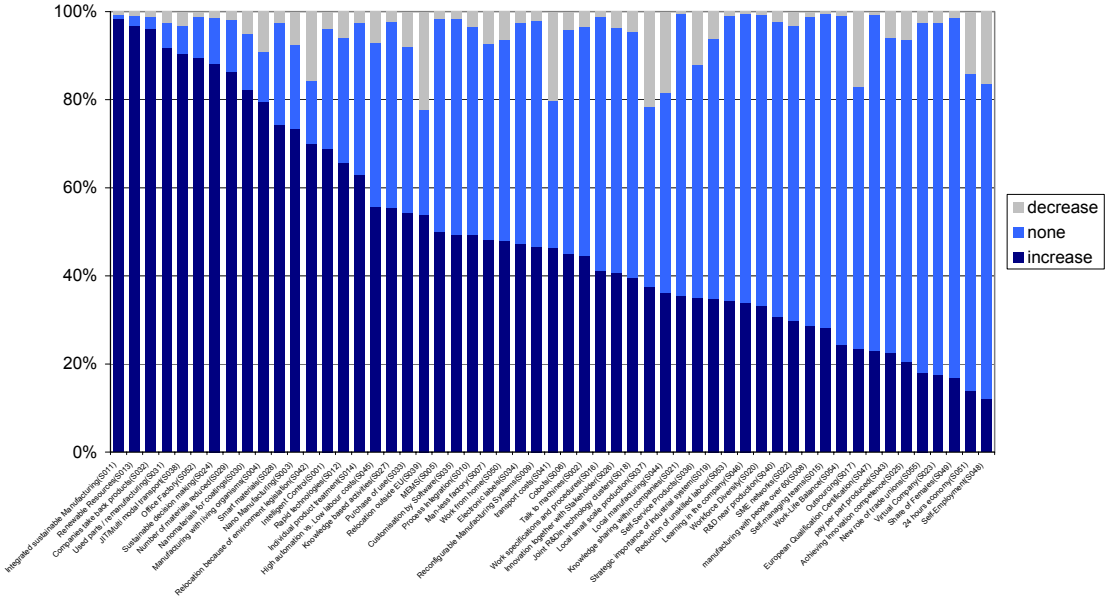
Annex 4: All results of the first round (statements of general section)

Annex 1: Expert's origin by participating countries

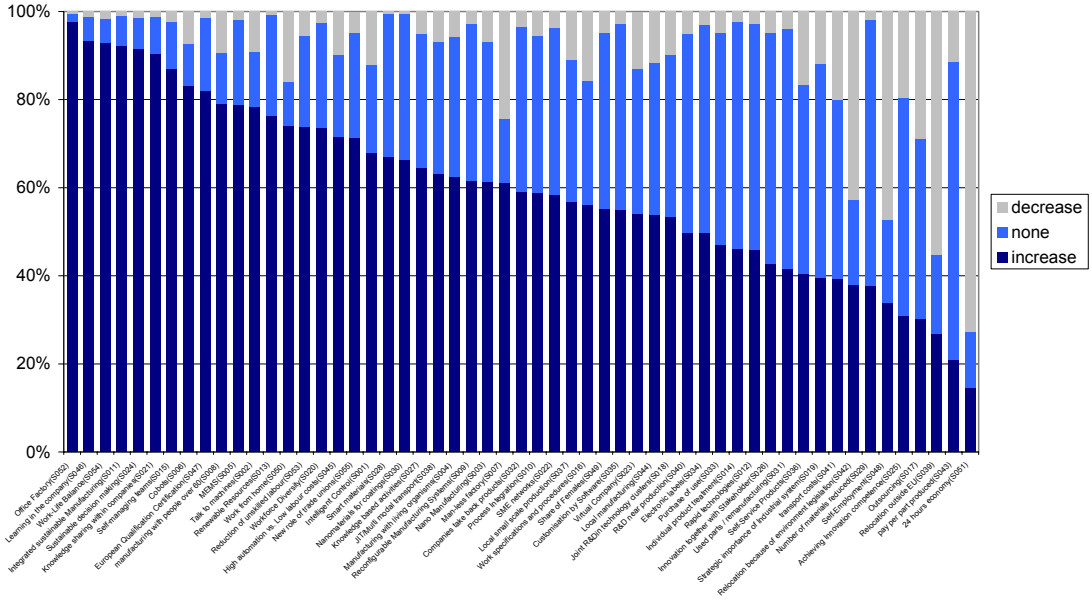


Annex 2: Expected effects for all statements

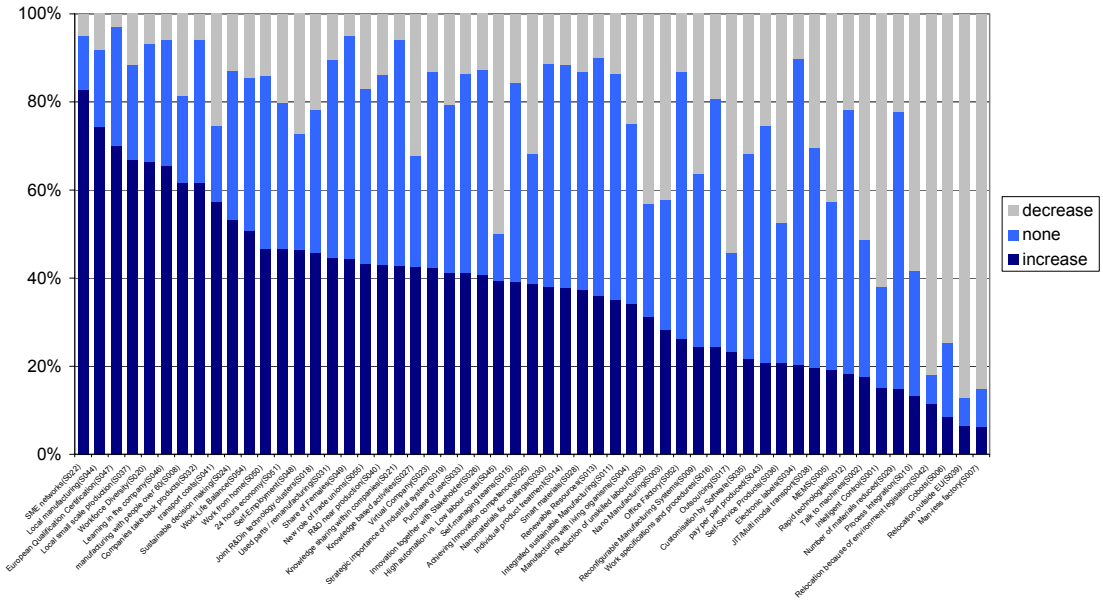
Effect: Environmental Quality



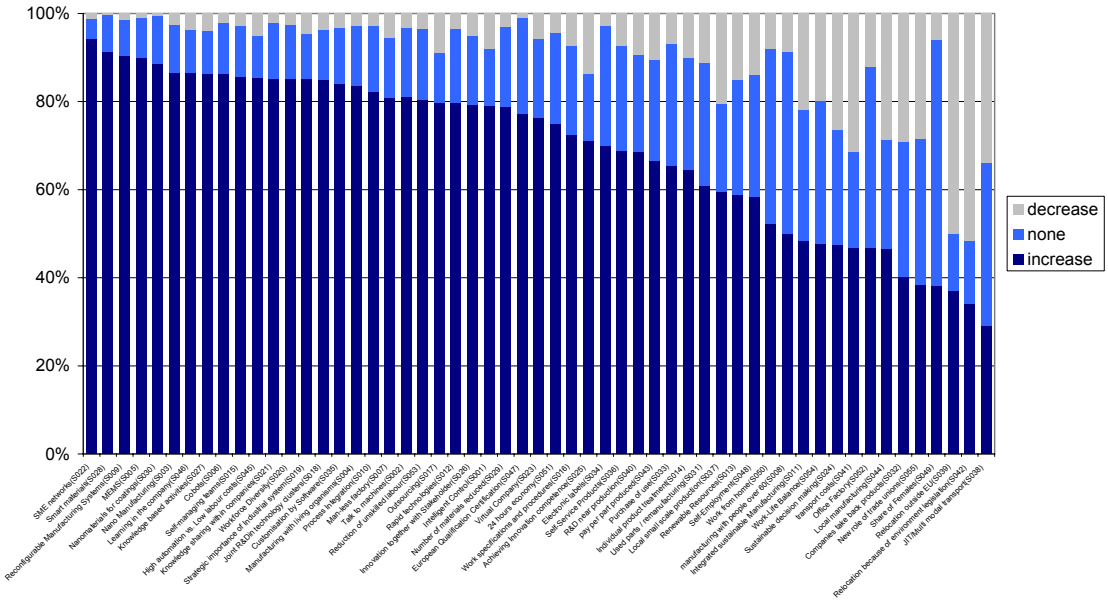
Effect: Living and Working Conditions



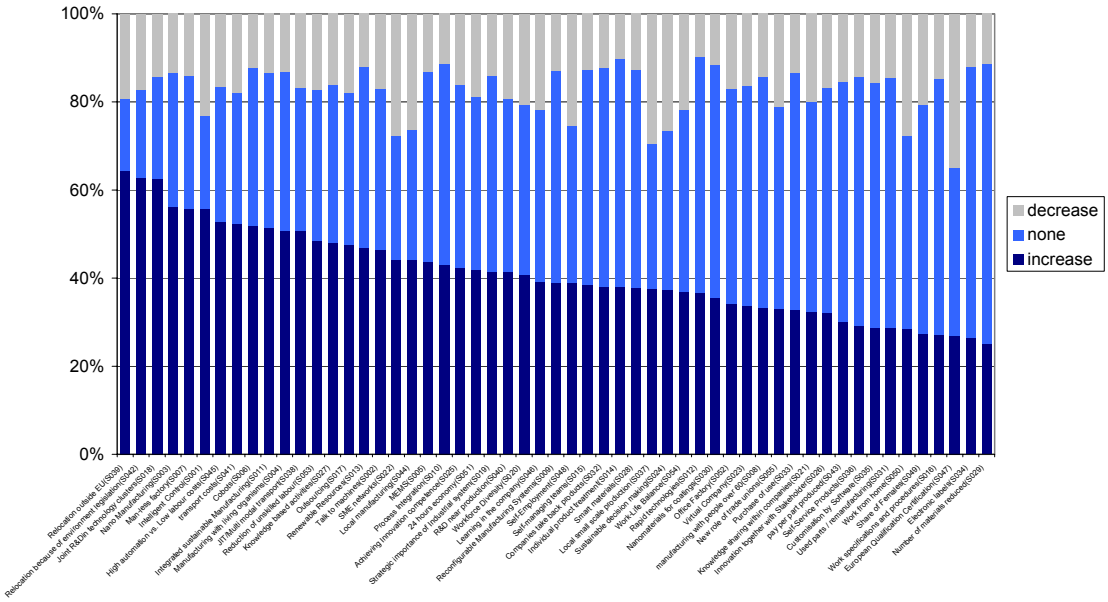
Effect: Employment



Effect: Competitiveness

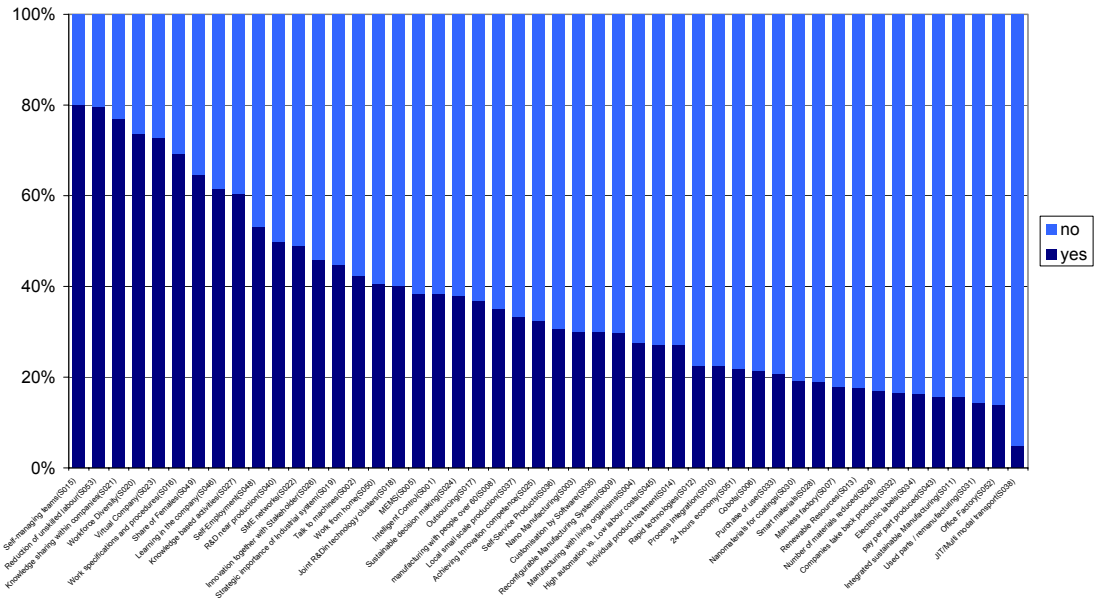


Effect: Regional Differences

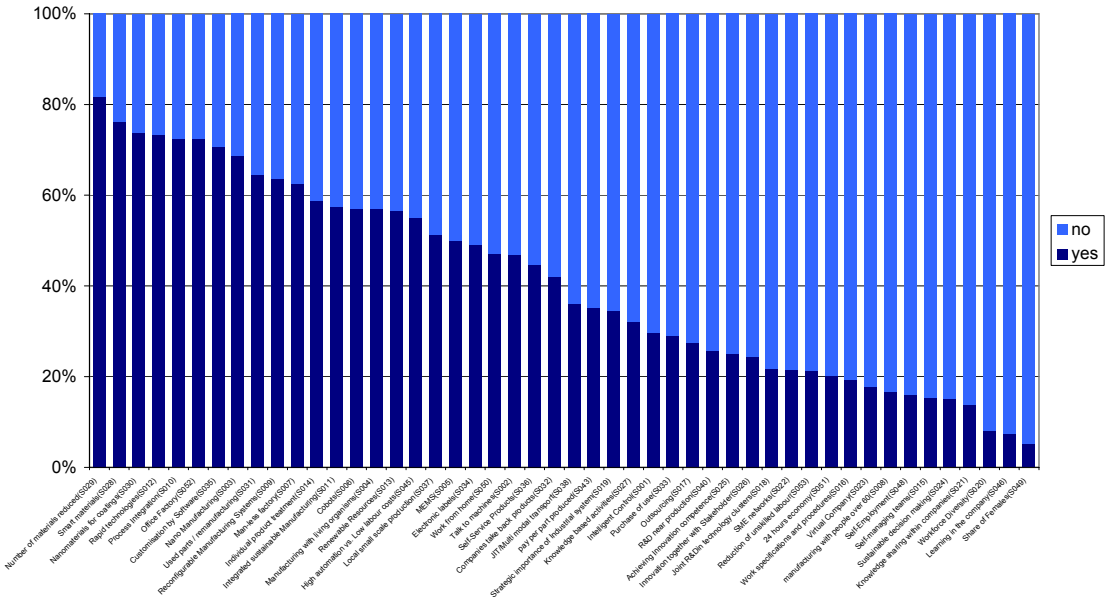


Annex 3: Main barriers for all statements

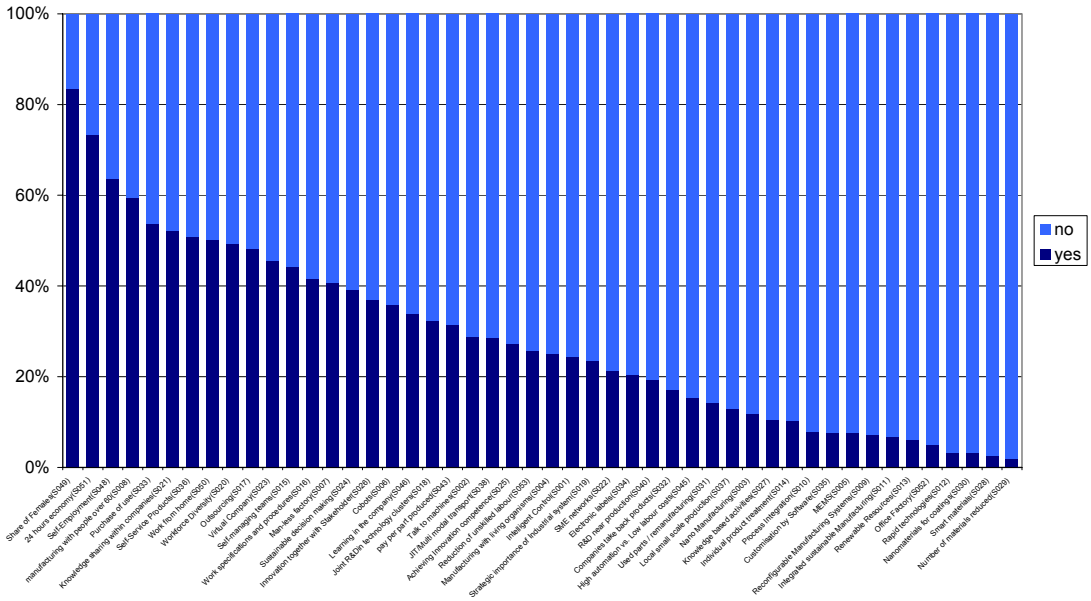
Barrier: Education/ Qualification



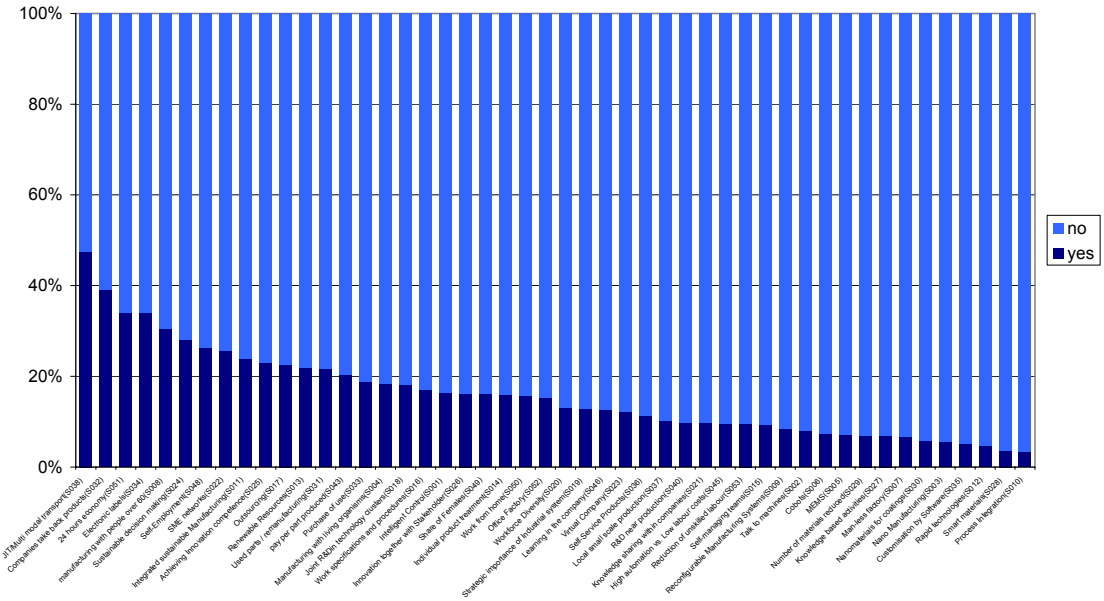
Barrier: Technical feasibility



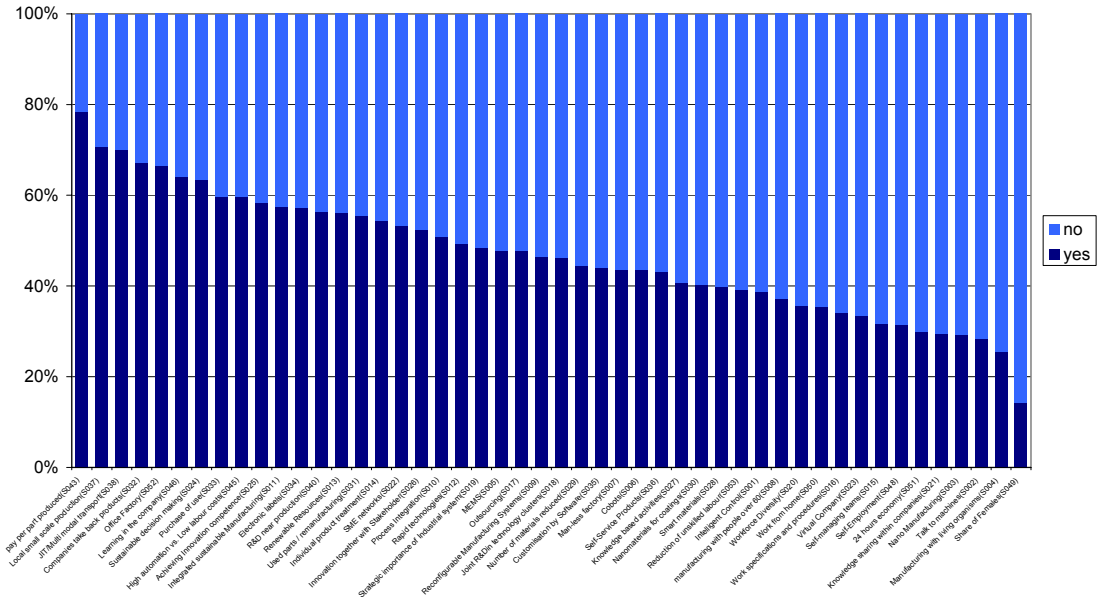
Barrier: Social Acceptability



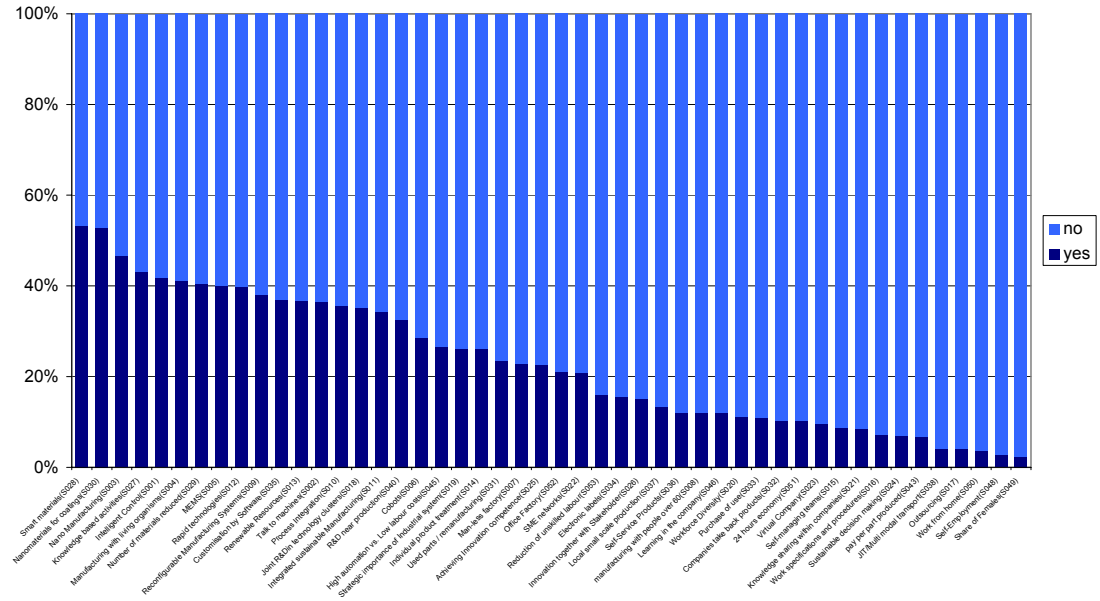
Barrier: EU legislation/Standards



Barrier: Economic Viability



Barrier: Lack of R&D Funding



Annex 4: All results of the first round (statements of general section)

Statement No	S001
Keywords	Intelligent Control
Statement	Most manufacturing operations are controlled by self-learning intelligent controllers.

			%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high			3	4	2	3
				16	15	16	13
				44	45	41	44
				38	35	41	41
Time of realisation	yes		<2010	14	17	9	13
			2010 - 2015	40	43	37	35
			2015 - 2020	27	24	30	35
			>2020	19	16	24	17
	never			5	6	4	3
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	62	62	62	54
			yes	38	38	38	46
	Technical feasibility		no	70	69	72	70
			yes	30	31	28	30
	Social acceptability		no	75	74	77	83
			yes	25	26	23	17
	EU legislation		no	84	81	87	83
			yes	16	19	13	17
	Economic viability		no	61	59	64	66
			yes	39	41	36	34
	Lack R&D Funding		no	58	65	49	54
			yes	42	35	51	46
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	4	4	3	3
			None	27	29	26	19
			Increase	69	67	71	78
	Living and Working conditions		Decrease	12	14	9	13
			None	20	23	16	18
			Increase	68	63	75	69
	Employment		Decrease	62	65	58	56
			None	23	21	25	27
			Increase	15	14	17	17
	Competitiveness		Decrease	8	10	6	5
			None	13	14	12	9
			Increase	79	76	82	86
	Regional Differences		Decrease	23	24	22	22
			None	21	21	23	17
			Increase	56	55	56	61
Highest R&D level			Europe	14	15	13	13
			USA	45	44	47	47
			Japan	35	35	34	35
			China	3	3	2	1
			Korea	1	0	1	2
			Australia	0	0	0	0
			emerging Asian markets	1	1	1	0
			South America	0	0	0	0
			Africa	0	0	0	0
			Others	0	0	0	1

Statement No	S002
Keywords	Talk to machines
Statement	Communication between humans and machines is as easy as communication between humans

			%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high			5	4	6	3
				19	19	19	20
				42	40	44	43
				34	36	31	34
Time of realisation	yes		<2010	16	18	12	10
			2010 - 2015	32	35	29	26
			2015 - 2020	25	24	26	30
			>2020	27	23	32	34
	never			11	9	12	14
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	58	54	64	54
			yes	42	46	36	46
	Technical feasibility		no	53	54	52	51
			yes	47	46	48	49
	Social acceptability		no	71	71	71	72
			yes	29	29	29	28
	EU legislation		no	92	91	93	93
			yes	8	9	7	7
	Economic viability		no	72	70	73	73
			yes	28	30	27	27
	Lack R&D Funding		no	64	68	56	67
			yes	36	32	44	33
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	3	4	3	3
			None	52	51	54	47
			Increase	45	45	43	50
	Living and Working conditions		Decrease	9	10	8	10
			None	12	14	11	6
			Increase	78	76	81	84
	Employment		Decrease	51	53	48	54
			None	31	29	35	25
			Increase	18	17	18	20
	Competitiveness		Decrease	3	4	3	0
			None	16	16	16	10
			Increase	81	79	81	90
	Regional Differences		Decrease	17	17	16	19
			None	37	37	37	31
			Increase	46	46	47	50
Highest R&D level			Europe	12	13	10	11
			USA	40	36	45	40
			Japan	46	48	43	44
			China	1	1	1	1
			Korea	0	0	0	1
			Australia	0	0	0	0
			emerging Asian markets	0	0	0	2
			South America	0	0	0	0
			Africa	0	0	0	1
			Others	0	1	0	0

Statement No	S003
Keywords	Nano Manufacturing
Statement	Products can be manufactured bottom-up through the self-assembly of atoms or molecules

			%	all experts	industry	research	government
Importance to European Manufacturing Industry		low - high		15	16	12	16
				20	20	19	17
				29	28	29	29
				38	36	40	38
Time of realisation	yes		<2010	4	5	3	4
			2010 - 2015	13	13	12	12
			2015 - 2020	23	21	24	23
			>2020	61	61	61	61
	never			14	16	13	11
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	70	67	74	69
			yes	30	33	26	31
	Technical feasibility		no	31	33	30	32
			yes	69	67	70	68
	Social acceptability		no	88	87	91	86
			yes	12	13	9	14
	EU legislation		no	94	93	96	97
			yes	6	7	4	3
	Economic viability		no	71	71	71	73
			yes	29	29	29	27
	Lack R&D Funding		no	53	58	47	51
			yes	47	42	53	49
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	7	10	5	3
			None	19	18	21	17
			Increase	73	72	74	80
	Living and Working conditions		Decrease	7	10	4	3
			None	32	28	35	35
			Increase	61	62	61	62
	Employment		Decrease	42	47	37	39
			None	29	27	32	32
			Increase	28	26	31	28
	Competitiveness		Decrease	3	4	2	1
			None	11	10	12	9
			Increase	87	86	86	90
	Regional Differences		Decrease	13	12	15	15
			None	30	31	31	25
			Increase	56	57	55	60
Highest R&D level			Europe	11	12	9	9
			USA	67	66	67	73
			Japan	21	19	23	18
			China	1	2	0	0
			Korea	0	0	0	0
			Australia	0	0	0	0
			emerging Asian markets	0	0	0	0
			South America	0	0	0	0
			Africa	0	0	0	0
			Others	0	0	0	0

Statement No	S004
Keywords	Manufacturing with living organisms
Statement	Manufacturing processes for inorganic (non organic) products that utilise the functions of micro-organisms or other living organisms are put into practical use

			%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high			10	11	9	8
				22	23	21	20
				38	36	41	37
				30	30	29	35
Time of realisation	yes		<2010	9	8	9	14
			2010 - 2015	26	29	24	20
			2015 - 2020	30	29	31	28
			>2020	35	34	35	38
	never			3	3	3	0
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	72	70	73	78
			yes	28	30	27	22
	Technical feasibility		no	43	44	41	47
			yes	57	56	59	53
	Social acceptability		no	75	75	75	76
			yes	25	25	25	24
	EU legislation		no	82	81	84	76
			yes	18	19	16	24
	Economic viability		no	75	74	76	70
			yes	25	26	24	30
	Lack R&D Funding		no	59	62	55	58
			yes	41	38	45	42
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	9	10	8	7
			None	11	11	11	14
			Increase	79	79	81	79
	Living and Working conditions		Decrease	6	7	5	5
			None	32	31	30	37
			Increase	63	62	65	58
	Employment		Decrease	25	28	22	25
			None	41	38	44	42
			Increase	34	35	34	33
	Competitiveness		Decrease	3	5	1	0
			None	13	13	15	10
			Increase	84	82	84	90
	Regional Differences		Decrease	13	13	14	12
			None	36	34	38	35
			Increase	51	53	48	53
Highest R&D level			Europe	17	17	16	18
			USA	67	65	70	66
			Japan	14	14	13	15
			China	1	2	0	0
			Korea	0	0	0	0
			Australia	0	0	0	0
			emerging Asian markets	0	0	0	0
			South America	0	0	0	0
			Africa	0	0	0	0
			Others	0	0	0	1

Statement No	S005
Keywords	MEMS
Statement	Micro-electromechanical systems such as actuators with integrated sensors and microprocessors are used all over the factory as active components (e.g. active workpiece fixtures)

			%	all experts	industry	research	government
Importance to European Manufacturing Industry		low - high		2	2	3	1
				10	11	10	6
				40	41	39	42
				47	46	48	51
Time of realisation	yes		<2010	29	33	25	26
			2010 - 2015	39	39	39	41
			2015 - 2020	23	21	26	22
			>2020	9	7	10	12
	never			1	1	1	0
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	62	59	63	69
			yes	38	41	37	31
	Technical feasibility		no	50	51	49	47
			yes	50	49	51	53
	Social acceptability		no	92	92	92	95
			yes	8	8	8	5
	EU legislation		no	93	93	93	92
			yes	7	7	7	8
	Economic viability		no	52	51	54	50
			yes	48	49	46	50
	Lack R&D Funding		no	60	62	58	57
			yes	40	38	42	43
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	2	2	1	0
			None	48	53	42	48
			Increase	50	45	57	52
	Living and Working conditions		Decrease	2	3	1	3
			None	19	21	17	19
			Increase	79	76	82	78
	Employment		Decrease	43	46	38	44
			None	38	37	39	40
			Increase	19	17	23	16
	Competitiveness		Decrease	1	2	1	0
			None	9	9	8	10
			Increase	90	89	91	90
	Regional Differences		Decrease	13	13	12	14
			None	43	43	43	46
			Increase	44	44	45	39
Highest R&D level			Europe	26	26	26	23
			USA	31	30	32	34
			Japan	41	43	41	40
			China	0	1	0	0
			Korea	0	1	0	1
			Australia	0	0	0	0
			emerging Asian markets	0	0	0	1
			South America	0	0	0	0
			Africa	0	0	0	0
			Others	0	0	0	0

Statement No	S006
Keywords	Cobots
Statement	Robots move freely in factories, flexibly assisting workers in various tasks, instead of being confined to a fixed working space (Co-bots)

			%	all experts	industry	research	government
Importance to European Manufacturing Industry		low - high		6	6	5	6
				18	18	19	20
				37	35	39	43
				39	41	37	31
Time of realisation	yes		<2010	11	11	12	10
			2010 - 2015	28	29	29	20
			2015 - 2020	28	27	27	33
			>2020	33	34	32	37
	never			4	4	5	7
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	79	77	81	81
			yes	21	23	19	19
	Technical feasibility		no	43	44	43	38
			yes	57	56	57	62
	Social acceptability		no	64	64	63	69
			yes	36	36	37	31
	EU legislation		no	93	93	92	96
			yes	7	7	8	4
	Economic viability		no	56	54	60	53
			yes	44	46	40	47
	Lack R&D Funding		no	71	74	68	73
			yes	29	26	32	27
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	4	5	3	3
			None	51	49	54	52
			Increase	45	46	43	45
	Living and Working conditions		Decrease	7	9	4	9
			None	10	9	10	10
			Increase	83	82	86	81
	Employment		Decrease	75	78	70	77
			None	17	14	20	17
			Increase	9	8	10	6
	Competitiveness		Decrease	2	3	2	0
			None	12	12	11	10
			Increase	86	85	87	89
	Regional Differences		Decrease	12	13	11	9
			None	36	35	35	47
			Increase	52	52	53	44
Highest R&D level			Europe	9	8	9	12
			USA	16	15	18	11
			Japan	74	76	73	77
			China	1	1	0	0
			Korea	0	0	0	0
			Australia	0	0	0	0
			emerging Asian markets	0	0	0	0
			South America	0	0	0	0
			Africa	0	0	0	0
			Others	0	0	0	0

Statement No	S007
Keywords	Flexible automation
Statement	Fully automated production in the man-less factory is as flexible as production with humans

			%	all experts	industry	research	government
Importance to European Manufacturing Industry		low - high		11	10	12	15
				17	18	16	16
				33	30	35	36
				39	42	37	33
Time of realisation	yes		<2010	7	8	5	4
			2010 - 2015	22	22	23	20
			2015 - 2020	25	23	30	21
			>2020	46	47	42	55
	never			23	22	24	21
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	82	80	84	85
			yes	18	20	16	15
	Technical feasibility		no	37	39	36	33
			yes	63	61	64	67
	Social acceptability		no	59	58	60	62
			yes	41	42	40	38
	EU legislation		no	93	94	92	97
			yes	7	6	8	3
	Economic viability		no	56	56	58	51
			yes	44	44	42	49
	Lack R&D Funding		no	77	78	75	80
			yes	23	22	25	20
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	7	8	7	7
			None	44	44	44	44
			Increase	48	48	49	49
	Living and Working conditions		Decrease	24	26	23	23
			None	14	15	13	16
			Increase	61	59	64	61
	Employment		Decrease	85	86	83	83
			None	9	8	10	13
			Increase	6	6	7	5
	Competitiveness		Decrease	6	6	5	6
			None	13	14	14	10
			Increase	81	80	81	84
	Regional Differences		Decrease	14	16	13	10
			None	30	29	29	41
			Increase	56	55	58	49
Highest R&D level			Europe	13	14	12	7
			USA	20	19	21	21
			Japan	66	65	66	71
			China	0	1	0	0
			Korea	0	0	0	1
			Australia	0	0	0	0
			emerging Asian markets	0	1	0	0
			South America	0	0	0	0
			Africa	0	0	0	0
			Others	0	0	0	0

Statement No	S008
Keywords	Barrier-free manufacturing
Statement	Manufacturing systems, where people aged 60 and above can work without difficulty, are in widespread use

			%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high			17	17	18	15
				23	23	23	18
				30	29	30	33
				30	31	29	34
Time of realisation	yes		<2010	22	25	21	9
			2010 - 2015	35	35	34	42
			2015 - 2020	27	26	27	26
			>2020	16	14	17	23
	never			10	10	11	8
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	65	65	64	65
			yes	35	35	36	35
	Technical feasibility		no	83	86	83	73
			yes	17	14	17	27
	Social acceptability		no	40	37	44	48
			yes	60	63	56	52
	EU legislation		no	70	69	69	77
			yes	30	31	31	23
	Economic viability		no	63	62	63	64
			yes	37	38	37	36
	Lack R&D Funding		no	88	90	85	85
			yes	12	10	15	15
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	1	2	0	1
			None	70	69	72	66
			Increase	29	29	28	32
	Living and Working conditions		Decrease	9	10	9	11
			None	11	12	10	8
			Increase	79	78	81	81
	Employment		Decrease	19	19	19	15
			None	20	20	20	17
			Increase	62	62	61	68
	Competitiveness		Decrease	9	9	9	7
			None	41	42	39	39
			Increase	50	48	52	54
	Regional Differences		Decrease	14	14	15	11
			None	52	55	47	54
			Increase	33	31	37	35
Highest R&D level			Europe	49	47	51	54
			USA	26	26	26	20
			Japan	23	24	23	23
			China	1	2	0	0
			Korea	0	0	0	0
			Australia	0	0	0	0
			emerging Asian markets	0	1	0	1
			South America	0	0	0	0
			Africa	0	0	0	0
			Others	1	1	0	2

Statement No	S009
Keywords	Reconfigurable Manufacturing Systems
Statement	A reconfigurable manufacturing system achieved by coupling simple machine modules to create complex systems (plug and produce) is in widespread use

			%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high			3	5	2	1
				13	13	13	9
				39	40	36	44
				46	43	49	46
Time of realisation	yes		<2010	18	21	13	16
			2010 - 2015	37	37	38	27
			2015 - 2020	30	27	31	47
			>2020	16	15	18	10
	never			2	2	1	1
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	70	68	71	78
			yes	30	32	29	22
	Technical feasibility		no	36	36	36	40
			yes	64	64	64	60
	Social acceptability		no	93	92	94	92
			yes	7	8	6	8
	EU legislation		no	92	92	93	83
			yes	8	8	7	17
	Economic viability		no	54	53	55	49
			yes	46	47	45	51
	Lack R&D Funding		no	62	65	57	66
			yes	38	35	43	34
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	2	2	3	1
			None	51	51	51	55
			Increase	47	47	47	44
	Living and Working conditions		Decrease	3	3	3	3
			None	35	36	35	35
			Increase	62	61	62	61
	Employment		Decrease	36	41	31	33
			None	39	39	39	41
			Increase	24	20	29	27
	Competitiveness		Decrease	1	2	0	0
			None	8	9	7	6
			Increase	90	89	92	93
	Regional Differences		Decrease	13	12	14	14
			None	48	47	49	49
			Increase	39	41	37	36
Highest R&D level			Europe	29	28	32	27
			USA	32	28	35	37
			Japan	38	43	32	36
			China	1	0	1	0
			Korea	0	0	0	0
			Australia	0	0	0	0
			emerging Asian markets	0	1	0	0
			South America	0	0	0	0
			Africa	0	0	0	0
			Others	0	1	0	0

Statement No	S010
Keywords	Process Integration
Statement	The integration of several processes into one machine makes the production of complete products from single machines standard ("Factory in a Machine")

			%	all experts	industry	research	government
Importance to European Manufacturing Industry		low - high		11	12	10	7
				18	18	19	20
				39	37	40	44
				33	34	32	28
Time of realisation	yes		<2010	17	20	16	8
			2010 - 2015	30	29	30	38
			2015 - 2020	27	27	28	27
			>2020	25	24	26	27
	never			11	12	11	12
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	78	77	78	80
			yes	22	23	22	20
	Technical feasibility		no	27	28	27	27
			yes	73	72	73	73
	Social acceptability		no	92	91	93	92
			yes	8	9	7	8
	EU legislation		no	97	97	96	96
			yes	3	3	4	4
	Economic viability		no	49	46	53	48
			yes	51	54	47	52
	Lack R&D Funding		no	64	67	60	66
			yes	36	33	40	34
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	3	3	4	3
			None	47	50	44	39
			Increase	49	47	51	58
	Living and Working conditions		Decrease	6	6	4	6
			None	35	34	37	36
			Increase	59	59	59	58
	Employment		Decrease	58	62	52	63
			None	28	26	32	27
			Increase	13	12	16	10
	Competitiveness		Decrease	3	4	2	4
			None	15	15	15	11
			Increase	82	81	83	85
	Regional Differences		Decrease	11	10	13	12
			None	45	47	43	45
			Increase	43	43	44	43
Highest R&D level			Europe	29	30	30	24
			USA	27	24	31	30
			Japan	42	44	39	45
			China	1	1	0	0
			Korea	0	0	0	1
			Australia	0	0	0	0
			emerging Asian markets	0	0	0	0
			South America	0	0	0	0
			Africa	0	0	0	0
			Others	0	1	0	0

Statement No	S011
Keywords	Integrated sustainable Manufacturing
Statement	Environmentally friendly technologies will be integrated into all production processes, so that zero waste and zero emission manufacturing is achieved without using technologies that reduce factory emissions at the end of the manufacturing process (filters etc.)

		%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high		7	8	6	2
			14	17	12	4
			29	27	30	38
			50	48	52	56
Time of realisation	yes	<2010	6	8	4	4
		2010 - 2015	26	27	25	24
		2015 - 2020	31	30	31	41
		>2020	36	35	40	31
	never		15	15	16	14
Main barriers in Europe blocking the realisation of the statement	Education/Qualification	no	84	85	83	88
		yes	16	15	17	12
	Technical feasibility	no	43	44	42	35
		yes	57	56	58	65
	Social acceptability	no	93	94	92	93
		yes	7	6	8	7
	EU legislation	no	76	76	75	83
		yes	24	24	25	17
	Economic viability	no	43	39	48	41
		yes	57	61	52	59
	Lack R&D Funding	no	66	68	62	66
		yes	34	32	38	34
Expected effects of Realisation for Europe compared to today	Environmental Quality	Decrease	1	1	0	0
		None	1	1	1	0
		Increase	98	98	99	100
	Living and Working conditions	Decrease	1	2	0	0
		None	7	7	7	5
		Increase	92	91	93	95
	Employment	Decrease	14	15	12	13
		None	51	52	50	53
		Increase	35	34	38	34
	Competitiveness	Decrease	22	24	20	18
		None	30	30	29	25
		Increase	48	46	51	57
	Regional Differences	Decrease	13	13	15	13
		None	35	34	34	43
		Increase	52	53	51	44
Highest R&D level		Europe	73	73	70	76
		USA	14	13	16	12
		Japan	12	13	13	10
		China	0	0	0	2
		Korea	0	0	0	0
		Australia	0	0	0	0
		emerging Asian markets	0	0	0	0
		South America	0	0	0	0
		Africa	0	0	0	0
		Others	1	1	1	0

Statement No	S012
Keywords	Rapid technologies
Statement	Technologies based on processes that add materials have replaced a substantial share of today's cutting and forming technologies

			%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high			7	9	5	3
				26	27	24	34
				42	40	44	41
				25	24	27	23
Time of realisation	yes		<2010	14	14	14	15
			2010 - 2015	30	32	29	23
			2015 - 2020	35	33	37	34
			>2020	21	22	20	28
	never			7	6	9	4
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	78	76	79	79
			yes	22	24	21	21
	Technical feasibility		no	27	29	26	22
			yes	73	71	74	78
	Social acceptability		no	97	96	98	97
			yes	3	4	2	3
	EU legislation		no	95	94	97	97
			yes	5	6	3	3
	Economic viability		no	51	49	53	54
			yes	49	51	47	46
	Lack R&D Funding		no	60	63	57	59
			yes	40	37	43	41
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	6	7	4	10
			None	28	31	28	16
			Increase	66	62	68	74
	Living and Working conditions		Decrease	3	3	3	1
			None	51	53	49	49
			Increase	46	44	48	50
	Employment		Decrease	22	24	18	28
			None	60	56	64	66
			Increase	18	20	18	7
	Competitiveness		Decrease	4	5	2	2
			None	17	15	19	14
			Increase	80	80	78	83
	Regional Differences		Decrease	10	10	9	9
			None	54	50	56	68
			Increase	37	40	35	24
Highest R&D level			Europe	34	34	35	30
			USA	44	42	47	44
			Japan	20	22	17	24
			China	0	0	0	0
			Korea	0	0	0	0
			Australia	0	0	0	0
			emerging Asian markets	1	1	1	2
			South America	0	0	0	0
			Africa	0	0	0	0
			Others	0	1	0	0

Statement No	S013
Keywords	Renewable Resources
Statement	Manufacturing processes are significantly altered to cope with the specific characteristics of renewable resources (materials and energy)

			%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high			4	5	3	2
				14	15	13	15
				37	37	38	35
				45	44	45	48
Time of realisation	yes		<2010	8	10	5	12
			2010 - 2015	31	31	31	30
			2015 - 2020	33	33	33	31
			>2020	28	26	31	28
	never			2	3	1	1
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	82	80	85	85
			yes	18	20	15	15
	Technical feasibility		no	43	45	42	44
			yes	57	55	58	56
	Social acceptability		no	94	94	94	94
			yes	6	6	6	6
	EU legislation		no	78	78	78	81
			yes	22	22	22	19
	Economic viability		no	44	40	48	49
			yes	56	60	52	51
	Lack R&D Funding		no	63	68	58	55
			yes	37	32	42	45
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	1	1	0	1
			None	2	3	1	3
			Increase	97	96	98	96
	Living and Working conditions		Decrease	1	1	1	1
			None	23	25	21	19
			Increase	76	74	79	80
	Employment		Decrease	10	12	7	10
			None	54	56	53	48
			Increase	36	32	39	43
	Competitiveness		Decrease	15	16	14	17
			None	26	28	26	18
			Increase	59	57	60	65
	Regional Differences		Decrease	12	11	13	12
			None	41	41	41	42
			Increase	47	48	46	47
Highest R&D level			Europe	68	69	66	68
			USA	17	17	17	20
			Japan	15	14	17	12
			China	0	0	0	0
			Korea	0	0	0	0
			Australia	0	0	0	0
			emerging Asian markets	0	0	0	0
			South America	0	0	0	0
			Africa	0	0	0	0
			Others	0	0	0	0

Statement No	S014
Keywords	Customatisation
Statement	All complex products will be treated individually throughout their lifespan by the manufacturing system

			%	all experts	industry	research	government
Importance to European Manufacturing Industry		low - high		10	14	7	4
				28	28	28	25
				36	37	35	41
				26	22	30	30
Time of realisation	yes		<2010	16	16	14	20
			2010 - 2015	30	29	31	27
			2015 - 2020	28	28	29	24
			>2020	26	26	26	29
	never			10	12	8	8
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	73	73	74	71
			yes	27	27	26	29
	Technical feasibility		no	41	43	39	39
			yes	59	57	61	61
	Social acceptability		no	90	88	92	91
			yes	10	12	8	9
	EU legislation		no	84	84	86	80
			yes	16	16	14	20
	Economic viability		no	46	44	45	55
			yes	54	56	55	45
	Lack R&D Funding		no	74	76	70	74
			yes	26	24	30	26
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	3	2	3	0
			None	34	34	35	33
			Increase	63	63	62	67
	Living and Working conditions		Decrease	2	2	2	3
			None	52	55	49	46
			Increase	46	43	49	51
	Employment		Decrease	11	14	7	15
			None	51	54	49	41
			Increase	38	33	44	44
	Competitiveness		Decrease	10	13	6	16
			None	25	29	22	17
			Increase	65	58	72	67
	Regional Differences		Decrease	10	11	9	6
			None	52	50	52	63
			Increase	38	38	39	32
Highest R&D level			Europe	48	47	49	42
			USA	28	29	28	26
			Japan	23	23	22	31
			China	0	0	0	0
			Korea	0	0	1	0
			Australia	0	0	0	0
			emerging Asian markets	0	0	0	0
			South America	0	0	0	0
			Africa	0	0	0	0
			Others	0	0	0	1

Statement No	S015
Keywords	Self-managing teams
Statement	Self-managing teams with a wide range of tasks, including planning and controlling, are widespread in the shop-floor organisation of production

			%	all experts	industry	research	government
Importance to European Manufacturing Industry		low - high		4	4	4	5
				16	15	19	16
				39	36	44	37
				41	46	34	41
Time of realisation	yes		<2010	38	44	30	33
			2010 - 2015	38	36	40	38
			2015 - 2020	18	14	23	21
			>2020	6	6	7	8
	never			4	4	4	5
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	20	16	24	27
			yes	80	84	76	73
	Technical feasibility		no	85	86	83	81
			yes	15	14	17	19
	Social acceptability		no	56	52	61	52
			yes	44	48	39	48
	EU legislation		no	91	93	87	91
			yes	9	7	13	9
	Economic viability		no	68	70	66	70
			yes	32	30	34	30
	Lack R&D Funding		no	91	93	89	91
			yes	9	7	11	9
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	1	1	1	1
			None	71	70	74	71
			Increase	28	30	26	28
	Living and Working conditions		Decrease	2	2	2	5
			None	11	10	11	10
			Increase	87	88	86	85
	Employment		Decrease	16	17	13	19
			None	45	44	48	46
			Increase	39	39	39	36
	Competitiveness		Decrease	3	3	2	5
			None	12	9	16	5
			Increase	86	88	81	90
	Regional Differences		Decrease	13	13	13	8
			None	49	47	50	53
			Increase	39	40	37	39
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S016
Keywords	Work specifications and procedures
Statement	Closely defined procedures and specifications of work methods are common in most companies to maximise the efficiency

			%	all experts	industry	research	government
Importance to European Manufacturing Industry		low - high		10	9	11	9
				19	17	21	20
				39	37	40	40
				33	37	28	30
Time of realisation	yes		<2010	53	59	45	48
			2010 - 2015	31	29	34	28
			2015 - 2020	13	10	17	20
			>2020	3	2	4	5
	never			8	7	9	7
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	31	26	35	45
			yes	69	74	65	55
	Technical feasibility		no	81	81	82	73
			yes	19	19	18	27
	Social acceptability		no	58	59	57	54
			yes	42	41	43	46
	EU legislation		no	83	84	82	82
			yes	17	16	18	18
	Economic viability		no	66	65	67	63
			yes	34	35	33	37
	Lack R&D Funding		no	93	95	89	93
			yes	7	5	11	7
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	1	1	2	1
			None	58	57	60	54
			Increase	41	42	37	46
	Living and Working conditions		Decrease	16	12	18	26
			None	28	29	31	17
			Increase	56	59	51	57
	Employment		Decrease	19	18	19	25
			None	56	56	58	56
			Increase	24	26	23	19
	Competitiveness		Decrease	7	7	8	8
			None	20	21	21	17
			Increase	72	73	71	75
	Regional Differences		Decrease	15	14	15	18
			None	58	58	59	54
			Increase	27	28	25	28
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S017
Keywords	Outsourcing
Statement	To reduce costs and to focus on core competencies, companies outsource twice the percentage of manufacturing activities and support functions outsourced today

			%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high			6	6	7	2
				19	20	18	24
				43	42	44	49
				31	32	31	25
Time of realisation	yes		<2010	44	48	39	36
			2010 - 2015	37	36	38	33
			2015 - 2020	16	12	20	28
			>2020	3	3	3	2
	never			6	6	7	3
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	63	62	63	68
			yes	37	38	37	32
	Technical feasibility		no	72	72	75	63
			yes	28	28	25	37
	Social acceptability		no	52	48	56	60
			yes	48	52	44	40
	EU legislation		no	77	78	77	75
			yes	23	22	23	25
	Economic viability		no	52	55	47	53
			yes	48	45	53	47
	Lack R&D Funding		no	96	97	95	94
			yes	4	3	5	6
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	17	17	16	20
			None	59	59	62	51
			Increase	23	24	21	29
	Living and Working conditions		Decrease	29	27	30	38
			None	41	40	42	39
			Increase	30	33	28	23
	Employment		Decrease	54	57	47	61
			None	23	22	26	13
			Increase	23	20	28	26
	Competitiveness		Decrease	9	9	10	5
			None	11	12	9	16
			Increase	80	78	81	80
	Regional Differences		Decrease	18	17	20	15
			None	35	36	33	26
			Increase	48	46	47	59
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S018
Keywords	Joint R&D
Statement	Competitive production sites in Europe are almost exclusively contained within technology clusters where pre-competitive R&D activities between various neighbouring industrial partners and research organisations are common

		%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high		8	11	6	5
			17	17	18	13
			36	36	36	34
			38	36	40	48
Time of realisation	yes	<2010	20	22	17	21
		2010 - 2015	39	38	39	40
		2015 - 2020	25	24	28	21
		>2020	16	16	16	18
	never		16	17	14	14
Main barriers in Europe blocking the realisation of the statement	Education/Qualification	no	60	60	60	57
		yes	40	40	40	43
	Technical feasibility	no	78	76	82	79
		yes	22	24	18	21
	Social acceptability	no	68	64	71	72
		yes	32	36	29	28
	EU legislation	no	82	81	82	85
		yes	18	19	18	15
	Economic viability	no	54	54	55	51
		yes	46	46	45	49
	Lack R&D Funding	no	65	70	57	64
		yes	35	30	43	36
Expected effects of Realisation for Europe compared to today	Environmental Quality	Decrease	5	3	7	2
		None	56	59	54	44
		Increase	40	38	39	54
	Living and Working conditions	Decrease	10	10	10	9
		None	37	39	35	30
		Increase	53	51	56	60
	Employment	Decrease	22	24	17	26
		None	33	35	33	20
		Increase	46	41	50	55
	Competitiveness	Decrease	4	5	2	2
		None	11	12	12	4
		Increase	85	83	86	93
	Regional Differences	Decrease	14	14	17	10
		None	23	23	24	17
		Increase	63	63	59	73
Highest R&D level		Europe				
		USA				
		Japan				
		China				
		Korea				
		Australia				
		emerging Asian markets				
		South America				
		Africa				
		Others				

Questions of cells with no value were not asked in survey.

Statement No	S019
Keywords	Industrial system
Statement	The improvement-speed for the value-chain, the performance of the industrial system, is more important for the competitiveness than the markets success of individual products

			%	all experts	industry	research	government
Importance to European Manufacturing Industry		low - high		9	9	9	6
				21	21	23	16
				34	33	35	38
				36	37	33	40
Time of realisation	yes		<2010	31	33	27	30
			2010 - 2015	40	40	40	44
			2015 - 2020	21	21	23	20
			>2020	8	7	9	6
	never			13	14	13	11
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	55	52	58	63
			yes	45	48	42	37
	Technical feasibility		no	65	64	65	76
			yes	35	36	35	24
	Social acceptability		no	76	77	75	79
			yes	24	23	25	21
	EU legislation		no	87	88	86	83
			yes	13	12	14	17
	Economic viability		no	52	54	51	42
			yes	48	46	49	58
	Lack R&D Funding		no	74	73	76	73
			yes	26	27	24	27
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	6	7	6	3
			None	59	59	59	63
			Increase	35	35	35	34
	Living and Working conditions		Decrease	12	14	10	7
			None	48	49	48	45
			Increase	40	36	43	49
	Employment		Decrease	21	24	16	21
			None	38	38	36	45
			Increase	41	38	48	34
	Competitiveness		Decrease	5	5	4	4
			None	10	9	12	13
			Increase	85	86	84	83
	Regional Differences		Decrease	14	14	16	8
			None	45	44	42	58
			Increase	42	42	43	34
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S020
Keywords	Workforce Diversity
Statement	In order to strengthen their innovation capabilities, the companies have ensured workforce diversity, employing people with completely different educational, professional and cultural backgrounds

			%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high			6	6	6	2
				19	20	19	15
				37	36	39	37
				38	39	36	46
Time of realisation	yes		<2010	31	33	29	25
			2010 - 2015	37	37	34	44
			2015 - 2020	22	21	24	19
			>2020	11	9	13	12
	never			6	6	7	5
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	26	26	28	23
			yes	74	74	72	77
	Technical feasibility		no	92	92	92	91
			yes	8	8	8	9
	Social acceptability		no	51	49	52	57
			yes	49	51	48	43
	EU legislation		no	87	87	86	92
			yes	13	13	14	8
	Economic viability		no	64	65	63	66
			yes	36	35	37	34
	Lack R&D Funding		no	89	91	87	86
			yes	11	9	13	14
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	1	1	0	1
			None	66	65	66	70
			Increase	33	34	33	29
	Living and Working conditions		Decrease	3	3	2	0
			None	24	26	21	21
			Increase	74	71	77	78
	Employment		Decrease	7	7	6	6
			None	27	30	26	15
			Increase	66	63	68	79
	Competitiveness		Decrease	3	3	2	1
			None	12	13	13	9
			Increase	85	84	85	90
	Regional Differences		Decrease	21	20	23	17
			None	39	41	36	35
			Increase	41	40	41	49
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S021
Keywords	Knowledge sharing
Statement	Companies promote the sharing of knowledge amongst individuals through the establishment of a communication friendly organisational culture and the provision of communication channels across formal structures

		%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high		4	3	4	3
			15	16	13	19
			41	40	40	43
			41	40	43	35
Time of realisation	yes	<2010	39	44	35	23
		2010 - 2015	36	34	35	49
		2015 - 2020	17	14	20	23
		>2020	9	8	10	5
	never		5	4	5	7
Main barriers in Europe blocking the realisation of the statement	Education/Qualification	no	23	23	23	24
		yes	77	77	77	76
	Technical feasibility	no	86	85	89	84
		yes	14	15	11	16
	Social acceptability	no	48	44	51	55
		yes	52	56	49	45
	EU legislation	no	90	90	90	92
		yes	10	10	10	8
	Economic viability	no	70	72	69	68
		yes	30	28	31	32
	Lack R&D Funding	no	92	93	89	93
		yes	8	7	11	7
Expected effects of Realisation for Europe compared to today	Environmental Quality	Decrease	1	0	1	2
		None	64	65	60	68
		Increase	36	34	39	30
	Living and Working conditions	Decrease	1	1	1	3
		None	8	10	5	10
		Increase	90	89	94	87
	Employment	Decrease	6	7	4	8
		None	51	54	49	45
		Increase	43	39	47	47
	Competitiveness	Decrease	2	2	2	5
		None	13	13	12	11
		Increase	85	85	86	84
	Regional Differences	Decrease	20	19	18	31
		None	47	46	52	36
		Increase	33	35	30	32
Highest R&D level		Europe				
		USA				
		Japan				
		China				
		Korea				
		Australia				
		emerging Asian markets				
		South America				
		Africa				
		Others				

Questions of cells with no value were not asked in survey.

Statement No	S022
Keywords	SME networks
Statement	Networks of specialised SMEs compete successfully in the global marketplace

			%	all experts	industry	research	government
Importance to European Manufacturing Industry			low - high	3	3	2	4
				10	10	9	9
				35	37	36	24
				52	49	53	63
Time of realisation	yes		<2010	34	40	31	20
			2010 - 2015	36	35	34	44
			2015 - 2020	21	19	23	21
			>2020	9	7	12	14
	never			6	7	6	4
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	51	53	50	45
			yes	49	47	50	55
	Technical feasibility		no	79	78	80	75
			yes	21	22	20	25
	Social acceptability		no	79	76	80	86
			yes	21	24	20	14
	EU legislation		no	74	74	75	73
			yes	26	26	25	27
	Economic viability		no	47	49	44	49
			yes	53	51	56	51
	Lack R&D Funding		no	79	79	78	81
			yes	21	21	22	19
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	3	3	4	2
			None	67	67	68	63
			Increase	30	30	28	35
	Living and Working conditions		Decrease	4	3	5	2
			None	38	41	34	29
			Increase	58	56	61	69
	Employment		Decrease	5	6	4	3
			None	12	13	13	7
			Increase	83	81	84	90
	Competitiveness		Decrease	1	2	1	0
			None	4	5	4	1
			Increase	94	93	95	99
	Regional Differences		Decrease	28	26	32	23
			None	28	30	26	24
			Increase	44	44	43	53
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S023
Keywords	Virtual Company
Statement	The internal structure of most companies is characterised by constantly changing networks of different individual specialists

			%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high			10	13	6	10
				28	26	33	23
				37	37	36	38
				25	24	26	29
Time of realisation	yes		<2010	26	28	22	28
			2010 - 2015	37	37	38	40
			2015 - 2020	24	25	23	24
			>2020	12	10	16	8
	never			9	9	10	8
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	27	27	26	34
			yes	73	73	74	66
	Technical feasibility		no	82	79	84	92
			yes	18	21	16	8
	Social acceptability		no	54	53	56	54
			yes	46	47	44	46
	EU legislation		no	88	88	87	86
			yes	12	12	13	14
	Economic viability		no	67	68	69	53
			yes	33	32	31	47
	Lack R&D Funding		no	90	92	87	93
			yes	10	8	13	7
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	3	3	2	2
			None	80	79	81	81
			Increase	17	18	16	17
	Living and Working conditions		Decrease	13	13	13	16
			None	33	33	33	32
			Increase	54	54	54	52
	Employment		Decrease	13	12	15	11
			None	44	49	39	41
			Increase	42	39	46	48
	Competitiveness		Decrease	6	5	7	6
			None	18	22	14	13
			Increase	76	73	79	81
	Regional Differences		Decrease	16	17	15	16
			None	50	48	54	42
			Increase	34	35	30	41
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S024
Keywords	Sustain-ability
Statement	Social, environmental and economic aspects are given equal importance in companies' decision-making processes

			%	all experts	industry	research	government
Importance to European Manufacturing Industry		low - high		10	12	7	9
				25	26	24	19
				33	29	40	27
				32	33	28	45
Time of realisation	yes		<2010	19	23	15	16
			2010 - 2015	32	32	34	30
			2015 - 2020	23	22	21	33
			>2020	25	23	30	20
	never			30	27	33	36
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	62	65	58	57
			yes	38	35	42	43
	Technical feasibility		no	85	86	84	83
			yes	15	14	16	17
	Social acceptability		no	61	56	66	71
			yes	39	44	34	29
	EU legislation		no	72	70	74	76
			yes	28	30	26	24
	Economic viability		no	37	37	35	39
			yes	63	63	65	61
	Lack R&D Funding		no	93	95	90	93
			yes	7	5	10	7
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	1	1	2	2
			None	10	10	11	10
			Increase	88	89	87	88
	Living and Working conditions		Decrease	2	2	1	3
			None	7	7	7	11
			Increase	92	92	92	86
	Employment		Decrease	13	15	11	7
			None	34	37	31	29
			Increase	53	48	58	64
	Competitiveness		Decrease	27	30	23	18
			None	26	26	25	27
			Increase	47	44	51	55
	Regional Differences		Decrease	26	26	29	24
			None	36	34	39	37
			Increase	37	41	32	39
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S025
Keywords	Innovation competence - big companies vs. SMEs
Statement	Innovation in big multinational companies is exclusively achieved by corporate venturing activities with spin-offs or by the acquisition of innovative SMEs

			%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high			15	17	13	11
				27	25	29	30
				34	33	37	30
				24	25	22	29
Time of realisation	yes		<2010	27	28	27	25
			2010 - 2015	39	40	39	40
			2015 - 2020	22	20	23	27
			>2020	11	12	11	9
	never			30	29	32	29
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	67	68	67	68
			yes	33	32	33	32
	Technical feasibility		no	75	76	75	67
			yes	25	24	25	33
	Social acceptability		no	73	70	76	77
			yes	27	30	24	23
	EU legislation		no	77	77	76	80
			yes	23	23	24	20
	Economic viability		no	42	42	38	52
			yes	58	58	62	48
	Lack R&D Funding		no	77	78	78	71
			yes	23	22	22	29
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	6	8	4	4
			None	73	72	74	76
			Increase	21	20	22	20
	Living and Working conditions		Decrease	20	21	18	17
			None	49	50	47	55
			Increase	31	29	35	28
	Employment		Decrease	32	33	29	32
			None	30	29	28	36
			Increase	39	38	43	32
	Competitiveness		Decrease	14	13	14	13
			None	15	17	14	10
			Increase	71	69	72	77
	Regional Differences		Decrease	16	14	18	17
			None	42	45	39	35
			Increase	42	41	42	49
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S026
Keywords	Innovation together with Stakeholder
Statement	External stakeholders are incorporated into product development processes by the majority of companies

			%	all experts	industry	research	government
Importance to European Manufacturing Industry		low - high		12	13	11	7
				21	21	20	24
				34	34	35	28
				33	31	34	41
Time of realisation	yes		<2010	35	40	30	21
			2010 - 2015	38	34	42	44
			2015 - 2020	17	15	20	18
			>2020	10	10	9	17
	never			9	10	8	8
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	54	57	52	47
			yes	46	43	48	53
	Technical feasibility		no	76	76	75	78
			yes	24	24	25	22
	Social acceptability		no	63	59	67	68
			yes	37	41	33	32
	EU legislation		no	84	83	83	90
			yes	16	17	17	10
	Economic viability		no	47	51	44	46
			yes	53	49	56	54
	Lack R&D Funding		no	85	84	87	82
			yes	15	16	13	18
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	4	3	4	4
			None	55	57	54	56
			Increase	41	40	42	40
	Living and Working conditions		Decrease	5	6	4	5
			None	52	54	50	51
			Increase	43	40	46	44
	Employment		Decrease	13	15	11	4
			None	47	48	42	54
			Increase	41	37	47	42
	Competitiveness		Decrease	5	7	3	3
			None	16	17	16	10
			Increase	79	76	82	87
	Regional Differences		Decrease	17	16	18	13
			None	51	52	51	48
			Increase	32	32	31	38
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S027
Keywords	Knowledge based activities
Statement	The share of knowledge based activities (engineering, R&D etc.) reaches 80% of the value of manufacturing product. (The remainder comprises direct labor costs, material and purchased services)

			%	all experts	industry	research	government
Importance to European Manufacturing Industry			low - high	5	6	5	3
				12	13	11	9
				32	33	33	22
				51	48	51	66
Time of realisation	yes		<2010	16	18	15	12
			2010 - 2015	29	28	35	15
			2015 - 2020	30	30	26	50
			>2020	24	24	24	22
	never			15	18	11	9
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	40	43	33	47
			yes	60	57	67	53
	Technical feasibility		no	68	63	75	66
			yes	32	37	25	34
	Social acceptability		no	89	90	88	93
			yes	11	10	12	7
	EU legislation		no	93	94	93	91
			yes	7	6	7	9
	Economic viability		no	59	56	64	62
			yes	41	44	36	38
	Lack R&D Funding		no	57	61	53	49
			yes	43	39	47	51
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	2	3	2	2
			None	42	43	41	40
			Increase	55	54	57	57
	Living and Working conditions		Decrease	5	5	6	2
			None	31	34	25	30
			Increase	64	61	69	68
	Employment		Decrease	32	38	24	32
			None	25	27	24	22
			Increase	43	35	52	46
	Competitiveness		Decrease	4	5	4	1
			None	10	10	9	6
			Increase	86	85	87	93
	Regional Differences		Decrease	16	16	17	12
			None	36	34	37	36
			Increase	48	49	46	52
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S028
Keywords	Smart materials
Statement	Smart materials that adapt to different conditions by changing properties (e.g. dynamics, size, shape, thermal behaviour) are in widespread use.

			%	all experts	industry	research	government
Importance to European Manufacturing Industry			low - high	4	6	2	4
				13	14	12	12
				39	40	39	30
				44	40	47	54
Time of realisation	yes		<2010	7	8	6	10
			2010 - 2015	26	27	26	27
			2015 - 2020	30	28	35	21
			>2020	36	38	33	41
	never			3	2	4	4
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	81	81	80	81
			yes	19	19	20	19
	Technical feasibility		no	24	21	25	32
			yes	76	79	75	68
	Social acceptability		no	97	98	97	98
			yes	3	2	3	2
	EU legislation		no	96	97	96	100
			yes	4	3	4	0
	Economic viability		no	60	58	65	55
			yes	40	42	35	45
	Lack R&D Funding		no	47	50	42	45
			yes	53	50	58	55
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	3	2	3	3
			None	23	25	21	23
			Increase	74	73	76	74
	Living and Working conditions		Decrease	1	1	0	0
			None	32	37	28	26
			Increase	67	62	72	74
	Employment		Decrease	13	15	9	19
			None	50	49	48	57
			Increase	37	36	43	24
	Competitiveness		Decrease	0	0	1	0
			None	8	9	6	10
			Increase	91	91	93	90
	Regional Differences		Decrease	13	14	11	8
			None	49	45	54	53
			Increase	38	40	35	38
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S029
Keywords	Number of materials reduced
Statement	The number of different materials in each product is reduced by half

			%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high			11	13	10	8
				17	13	21	16
				36	37	35	37
				36	37	35	40
Time of realisation	yes		<2010	13	15	10	15
			2010 - 2015	33	34	32	28
			2015 - 2020	32	27	36	39
			>2020	23	24	22	18
	never			17	16	19	12
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	83	83	82	88
			yes	17	17	18	12
	Technical feasibility		no	18	17	21	18
			yes	82	83	79	82
	Social acceptability		no	98	98	98	97
			yes	2	2	2	3
	EU legislation		no	93	93	93	94
			yes	7	7	7	6
	Economic viability		no	56	53	59	60
			yes	44	47	41	40
	Lack R&D Funding		no	59	63	55	55
			yes	41	37	45	45
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	2	1	3	3
			None	12	14	9	11
			Increase	86	85	88	85
	Living and Working conditions		Decrease	2	2	2	0
			None	60	61	60	59
			Increase	38	37	38	41
	Employment		Decrease	22	23	18	32
			None	63	64	63	54
			Increase	15	13	18	14
	Competitiveness		Decrease	3	3	5	0
			None	18	16	23	13
			Increase	79	81	72	87
	Regional Differences		Decrease	11	11	12	7
			None	63	63	65	64
			Increase	25	26	23	29
Highest R&D level			Europe	32	31	33	25
			USA	37	37	33	57
			Japan	30	29	33	18
			China	1	1	0	0
			Korea	0	0	0	0
			Australia	0	0	0	0
			emerging Asian markets	0	0	0	0
			South America	0	0	0	0
			Africa	0	0	0	0
			Others	1	1	1	0

Statement No	S030
Keywords	Nanomaterials for coatings
Statement	Nanomaterials are in widespread use to apply coatings with special features (e.g. self-cleaning, anti-reflexive, anti-fouling) to a variety of products

			%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high			2	3	1	0
				12	13	10	15
				35	36	34	30
				51	47	54	55
Time of realisation	yes		<2010	14	15	11	15
			2010 - 2015	36	36	38	24
			2015 - 2020	31	30	32	26
			>2020	20	19	19	34
	never			1	1	1	2
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	81	82	79	81
			yes	19	18	21	19
	Technical feasibility		no	26	23	29	34
			yes	74	77	71	66
	Social acceptability		no	97	97	97	97
			yes	3	3	3	3
	EU legislation		no	94	93	95	92
			yes	6	7	5	8
	Economic viability		no	60	59	61	53
			yes	40	41	39	47
	Lack R&D Funding		no	47	50	41	52
			yes	53	50	59	48
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	5	5	5	7
			None	13	11	14	18
			Increase	82	84	82	74
	Living and Working conditions		Decrease	1	1	1	0
			None	33	35	27	44
			Increase	66	64	72	56
	Employment		Decrease	11	12	10	15
			None	51	52	50	48
			Increase	38	36	41	37
	Competitiveness		Decrease	1	1	0	0
			None	11	14	6	12
			Increase	89	85	93	88
	Regional Differences		Decrease	12	12	11	9
			None	53	53	54	53
			Increase	36	35	35	38
Highest R&D level			Europe	25	28	22	20
			USA	51	48	54	57
			Japan	23	24	23	23
			China	0	0	1	0
			Korea	0	0	0	0
			Australia	0	0	0	0
			emerging Asian markets	0	0	0	0
			South America	0	0	0	0
			Africa	0	0	0	0
			Others	0	0	0	0

Statement No	S031
Keywords	Used parts / remanufacturing
Statement	Most products contain used parts that have been remanufactured

			%	all experts	industry	research	government
Importance to European Manufacturing Industry		low - high		9	11	7	3
				21	22	20	22
				36	34	38	34
				34	33	35	40
Time of realisation	yes		<2010	16	17	16	7
			2010 - 2015	33	34	29	46
			2015 - 2020	28	27	32	21
			>2020	23	22	23	26
	never			10	11	8	12
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	86	86	84	89
			yes	14	14	16	11
	Technical feasibility		no	35	35	37	34
			yes	65	65	63	66
	Social acceptability		no	86	86	85	85
			yes	14	14	15	15
	EU legislation		no	78	78	78	82
			yes	22	22	22	18
	Economic viability		no	44	42	48	42
			yes	56	58	52	58
	Lack R&D Funding		no	76	78	73	81
			yes	24	22	27	19
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	3	2	3	2
			None	5	7	3	7
			Increase	92	91	94	92
	Living and Working conditions		Decrease	4	5	3	4
			None	54	54	55	56
			Increase	42	41	42	40
	Employment		Decrease	10	11	9	15
			None	45	44	47	38
			Increase	45	45	44	47
	Competitiveness		Decrease	11	13	11	7
			None	28	27	29	28
			Increase	61	61	61	65
	Regional Differences		Decrease	14	15	13	14
			None	57	56	59	51
			Increase	29	28	28	35
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S032
Keywords	Companies take back products
Statement	Companies generally take back their products and take care of their end-of-life treatment

			%	all experts	industry	research	government
Importance to European Manufacturing Industry		low - high		8	10	4	4
				19	17	21	15
				35	35	35	32
				39	37	39	49
Time of realisation	yes		<2010	17	19	15	21
			2010 - 2015	35	37	37	20
			2015 - 2020	26	24	28	36
			>2020	21	21	21	23
	never			7	6	7	12
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	83	83	83	83
			yes	17	17	17	17
	Technical feasibility		no	58	55	60	67
			yes	42	45	40	33
	Social acceptability		no	83	83	84	77
			yes	17	17	16	23
	EU legislation		no	61	64	58	62
			yes	39	36	42	38
	Economic viability		no	33	32	35	32
			yes	67	68	65	68
	Lack R&D Funding		no	90	91	87	91
			yes	10	9	13	9
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	1	1	1	3
			None	3	3	2	2
			Increase	96	96	97	95
	Living and Working conditions		Decrease	4	3	4	5
			None	37	38	37	37
			Increase	59	59	60	58
	Employment		Decrease	6	6	5	4
			None	33	36	28	31
			Increase	62	58	67	64
	Competitiveness		Decrease	29	33	23	27
			None	31	31	32	22
			Increase	40	35	45	52
	Regional Differences		Decrease	12	13	12	9
			None	50	48	50	55
			Increase	38	39	38	36
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S033
Keywords	Purchase of use
Statement	Customers do not buy products that they use in the long-term: they buy the products' functionality. The manufacturers of the product maintain their ownership and provide services as needed

			%	all experts	industry	research	government
Importance to European Manufacturing Industry		low - high		11	14	8	8
				23	25	18	31
				36	34	39	38
				29	27	34	23
Time of realisation	yes		<2010	18	21	17	10
			2010 - 2015	31	31	33	20
			2015 - 2020	27	24	28	38
			>2020	24	25	22	32
	never			13	15	10	15
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	79	77	80	88
			yes	21	23	20	12
	Technical feasibility		no	71	71	71	72
			yes	29	29	29	28
	Social acceptability		no	46	47	45	49
			yes	54	53	55	51
	EU legislation		no	81	82	82	76
			yes	19	18	18	24
	Economic viability		no	40	40	41	37
			yes	60	60	59	63
	Lack R&D Funding		no	89	90	88	88
			yes	11	10	12	12
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	8	10	5	9
			None	38	39	38	31
			Increase	54	51	57	61
	Living and Working conditions		Decrease	5	6	4	4
			None	48	53	44	39
			Increase	47	42	52	57
	Employment		Decrease	14	16	12	10
			None	45	48	40	44
			Increase	41	36	48	46
	Competitiveness		Decrease	7	10	4	4
			None	28	33	22	19
			Increase	65	57	74	77
	Regional Differences		Decrease	13	13	15	5
			None	54	54	52	62
			Increase	33	33	33	33
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S034
Keywords	Electronic labels
Statement	Electronic labels (e.g. RFID-tags) containing relevant product and process information are embedded in most manufactured products

			%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high			5	5	5	3
				21	22	20	17
				39	38	38	44
				36	35	37	35
Time of realisation	yes		<2010	28	31	26	22
			2010 - 2015	39	34	45	42
			2015 - 2020	24	26	20	28
			>2020	9	9	9	8
	never			1	0	2	0
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	84	82	85	86
			yes	16	18	15	14
	Technical feasibility		no	51	48	52	61
			yes	49	52	48	39
	Social acceptability		no	80	83	74	81
			yes	20	17	26	19
	EU legislation		no	66	67	66	67
			yes	34	33	34	33
	Economic viability		no	43	42	45	33
			yes	57	58	55	67
	Lack R&D Funding		no	84	84	84	89
			yes	16	16	16	11
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	3	2	3	7
			None	50	55	47	38
			Increase	47	43	51	55
	Living and Working conditions		Decrease	3	2	4	4
			None	47	52	41	43
			Increase	50	45	55	52
	Employment		Decrease	10	11	8	13
			None	69	70	69	70
			Increase	20	19	24	17
	Competitiveness		Decrease	3	4	1	4
			None	27	30	24	22
			Increase	70	66	75	75
	Regional Differences		Decrease	12	13	11	14
			None	62	61	60	67
			Increase	26	26	29	19
Highest R&D level			Europe	27	30	20	37
			USA	44	38	50	39
			Japan	29	31	29	24
			China	0	0	0	0
			Korea	0	1	0	0
			Australia	0	0	0	0
			emerging Asian markets	0	0	0	0
			South America	0	0	0	0
			Africa	0	0	0	0
			Others	0	0	0	0

Statement No	S035
Keywords	Customisation by Software
Statement	The functionality of complex products is mainly achieved by software programming or by the adaptation of electronic components. Therefore only a few suitable hardware variations are necessary

			%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high			6	6	6	7
				17	16	19	14
				40	39	40	47
				36	39	34	32
Time of realisation	yes		<2010	17	21	12	19
			2010 - 2015	38	39	38	27
			2015 - 2020	27	25	29	29
			>2020	18	16	21	25
	never			10	8	12	10
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	70	66	73	76
			yes	30	34	27	24
	Technical feasibility		no	29	32	27	25
			yes	71	68	73	75
	Social acceptability		no	92	93	92	93
			yes	8	7	8	7
	EU legislation		no	95	95	96	91
			yes	5	5	4	9
	Economic viability		no	56	57	53	60
			yes	44	43	47	40
	Lack R&D Funding		no	63	62	64	67
			yes	37	38	36	33
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	2	2	2	1
			None	49	48	50	51
			Increase	49	50	48	48
	Living and Working conditions		Decrease	3	3	3	2
			None	42	43	41	48
			Increase	55	54	56	50
	Employment		Decrease	32	33	28	38
			None	47	47	48	39
			Increase	22	21	24	23
	Competitiveness		Decrease	3	4	3	0
			None	13	13	11	15
			Increase	84	83	86	85
	Regional Differences		Decrease	16	18	12	12
			None	56	52	59	66
			Increase	29	30	29	22
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S036
Keywords	Self-Service
Statement	Premium industrial products, sold and distributed in a Dell/ IKEA-like fashion, controlled by self-diagnostic functions and assembled and maintained on a do it yourself base, are the norm

			%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high			13	16	9	9
				29	29	30	22
				36	33	37	42
				23	22	24	27
Time of realisation	yes		<2010	19	19	18	20
			2010 - 2015	34	33	35	36
			2015 - 2020	27	26	26	31
			>2020	21	22	21	14
	never			19	19	22	14
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	69	67	73	71
			yes	31	33	27	29
	Technical feasibility		no	55	55	56	52
			yes	45	45	44	48
	Social acceptability		no	49	50	46	54
			yes	51	50	54	46
	EU legislation		no	89	88	90	87
			yes	11	12	10	13
	Economic viability		no	57	58	55	56
			yes	43	42	45	44
	Lack R&D Funding		no	88	88	87	93
			yes	12	12	13	7
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	12	16	7	4
			None	53	53	55	48
			Increase	35	31	38	48
	Living and Working conditions		Decrease	17	17	16	18
			None	43	48	38	37
			Increase	41	36	47	45
	Employment		Decrease	47	47	49	48
			None	32	35	29	28
			Increase	21	19	23	24
	Competitiveness		Decrease	7	9	6	6
			None	24	24	23	22
			Increase	69	67	70	72
	Regional Differences		Decrease	14	15	15	7
			None	57	54	60	65
			Increase	29	31	26	28
Highest R&D level			Europe	33	32	35	25
			USA	48	48	44	62
			Japan	18	17	19	13
			China	1	1	1	0
			Korea	0	0	0	0
			Australia	0	0	1	0
			emerging Asian markets	1	1	1	0
			South America	0	0	0	0
			Africa	0	0	0	0
			Others	1	1	1	0

Statement No	S037
Keywords	Local small scale production
Statement	The majority of products are almost completely produced in local small scale production sites using multifunctional equipment

			%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high			15	15	16	11
				24	22	25	21
				34	35	34	32
				27	27	25	37
Time of realisation	yes		<2010	17	20	16	7
			2010 - 2015	31	30	32	30
			2015 - 2020	26	26	26	28
			>2020	26	24	26	34
	never			32	32	34	21
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	67	66	68	68
			yes	33	34	32	32
	Technical feasibility		no	49	48	49	48
			yes	51	52	51	52
	Social acceptability		no	87	87	86	90
			yes	13	13	14	10
	EU legislation		no	90	89	90	92
			yes	10	11	10	8
	Economic viability		no	29	29	31	30
			yes	71	71	69	70
	Lack R&D Funding		no	87	89	85	81
			yes	13	11	15	19
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	22	22	23	14
			None	41	44	37	40
			Increase	38	35	40	46
	Living and Working conditions		Decrease	11	10	12	10
			None	32	35	29	30
			Increase	57	55	59	60
	Employment		Decrease	12	12	10	12
			None	21	22	19	20
			Increase	67	65	70	68
	Competitiveness		Decrease	21	24	17	12
			None	20	19	21	18
			Increase	59	56	62	70
	Regional Differences		Decrease	29	27	34	28
			None	33	33	34	28
			Increase	38	40	32	44
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S038
Keywords	JIT/Multi modal transport
Statement	Transport by train and ship prevails in the EU due to restrictions on delivery by truck

			%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high			16	18	16	5
				25	26	24	26
				32	28	33	39
				28	28	26	31
Time of realisation	yes		<2010	14	14	14	13
			2010 - 2015	31	30	32	33
			2015 - 2020	30	30	29	28
			>2020	25	26	24	26
	never			29	27	34	16
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	95	94	95	100
			yes	5	6	5	0
	Technical feasibility		no	64	62	65	68
			yes	36	38	35	32
	Social acceptability		no	72	72	70	69
			yes	28	28	30	31
	EU legislation		no	53	52	57	44
			yes	47	48	43	56
	Economic viability		no	30	30	29	33
			yes	70	70	71	67
	Lack R&D Funding		no	96	96	95	98
			yes	4	4	5	2
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	3	3	4	3
			None	6	6	6	9
			Increase	90	91	90	88
	Living and Working conditions		Decrease	7	7	5	10
			None	30	29	31	33
			Increase	63	63	64	58
	Employment		Decrease	30	31	30	30
			None	50	52	47	50
			Increase	20	18	23	21
	Competitiveness		Decrease	34	43	22	26
			None	37	33	44	37
			Increase	29	25	33	37
	Regional Differences		Decrease	17	15	18	24
			None	32	31	36	25
			Increase	51	54	46	51
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S039
Keywords	Relocation outside EU
Statement	Production is subsidised or almost completely relocated outside Europe

			%	all experts	industry	research	government
Importance to European Manufacturing Industry		low - high		15	15	15	13
				11	9	15	10
				24	20	26	35
				50	56	44	42
Time of realisation	yes		<2010	19	20	15	24
			2010 - 2015	33	34	32	32
			2015 - 2020	25	20	32	24
			>2020	23	26	20	20
	never			43	42	44	47
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no				
			yes				
	Technical feasibility		no				
			yes				
	Social acceptability		no				
			yes				
	EU legislation		no				
			yes				
	Economic viability		no				
			yes				
	Lack R&D Funding		no				
			yes				
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	22	20	25	21
			None	24	26	21	19
			Increase	54	53	54	60
	Living and Working conditions		Decrease	55	58	52	52
			None	18	17	19	17
			Increase	27	25	29	31
	Employment		Decrease	87	87	86	91
			None	6	6	8	1
			Increase	7	7	6	8
	Competitiveness		Decrease	50	50	49	53
			None	13	12	15	11
			Increase	37	38	36	36
	Regional Differences		Decrease	19	16	22	27
			None	16	17	16	11
			Increase	64	66	62	63
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S040
Keywords	R&D near production
Statement	R&D within companies is, as a rule, performed close to manufacturing sites

			%	all experts	industry	research	government
Importance to European Manufacturing Industry			low - high	13	12	16	8
				16	17	14	14
				32	32	33	33
				39	39	37	45
Time of realisation	yes		<2010	38	45	30	25
			2010 - 2015	34	30	39	34
			2015 - 2020	19	18	18	21
			>2020	9	7	13	20
	never			24	24	26	23
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	50	49	50	58
			yes	50	51	50	42
	Technical feasibility		no	74	73	75	78
			yes	26	27	25	22
	Social acceptability		no	81	82	78	85
			yes	19	18	22	15
	EU legislation		no	90	89	92	94
			yes	10	11	8	6
	Economic viability		no	44	44	46	38
			yes	56	56	54	62
	Lack R&D Funding		no	67	70	65	58
			yes	33	30	35	42
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	2	2	4	0
			None	67	67	66	65
			Increase	31	31	30	35
	Living and Working conditions		Decrease	5	5	6	1
			None	45	45	44	45
			Increase	50	50	49	54
	Employment		Decrease	14	12	17	12
			None	43	48	38	39
			Increase	43	41	45	50
	Competitiveness		Decrease	9	8	11	8
			None	22	24	22	10
			Increase	69	67	67	82
	Regional Differences		Decrease	19	18	21	21
			None	39	43	37	23
			Increase	42	38	42	56
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S041
Keywords	transport costs
Statement	High transport costs outweigh the advantages of lower production costs outside the EU

			%	all experts	industry	research	government
Importance to European Manufacturing Industry		low - high		8	7	11	1
				14	12	15	20
				33	33	30	38
				45	48	44	40
Time of realisation	yes		<2010	25	28	24	13
			2010 - 2015	34	36	25	50
			2015 - 2020	21	17	29	20
			>2020	20	19	21	17
	never			23	21	28	12
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no				
			yes				
	Technical feasibility		no				
			yes				
	Social acceptability		no				
			yes				
	EU legislation		no				
			yes				
	Economic viability		no				
			yes				
	Lack R&D Funding		no				
			yes				
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	20	22	20	14
			None	34	37	30	23
			Increase	46	41	50	63
	Living and Working conditions		Decrease	20	19	23	16
			None	41	42	39	37
			Increase	39	39	39	47
	Employment		Decrease	25	27	24	27
			None	17	16	19	14
			Increase	58	58	57	59
	Competitiveness		Decrease	32	32	32	26
			None	22	23	21	21
			Increase	47	46	47	53
	Regional Differences		Decrease	18	16	19	26
			None	30	29	34	20
			Increase	52	56	47	55
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S042
Keywords	Relocation because of environmant legislation
Statement	European companies almost completely relocate production (except final assembly) because of environmental standards set by the EU

			%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high			9	8	10	8
				13	12	14	13
				29	28	28	36
				49	53	47	43
Time of realisation	yes		<2010	19	21	19	14
			2010 - 2015	35	37	32	34
			2015 - 2020	28	25	31	39
			>2020	17	17	19	14
	never			37	34	41	35
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no				
			yes				
	Technical feasibility		no				
			yes				
	Social acceptability		no				
			yes				
	EU legislation		no				
			yes				
	Economic viability		no				
			yes				
	Lack R&D Funding		no				
			yes				
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	16	14	19	10
			None	14	16	12	12
			Increase	70	69	70	78
	Living and Working conditions		Decrease	43	44	41	43
			None	19	20	20	11
			Increase	38	36	39	47
	Employment		Decrease	82	80	86	77
			None	7	7	6	6
			Increase	11	13	8	17
	Competitiveness		Decrease	52	53	51	48
			None	14	13	17	10
			Increase	34	34	32	42
	Regional Differences		Decrease	17	13	22	27
			None	20	21	20	12
			Increase	63	66	58	62
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S043
Keywords	pay per part produced
Statement	80% of all industrial equipment is not bought and owned by manufacturing companies, but instead the equipment providers are paid per parts produced

			%	all experts	industry	research	government
Importance to European Manufacturing Industry		low - high		12	14	10	12
				24	23	23	28
				37	38	35	38
				27	25	32	22
Time of realisation	yes		<2010	15	16	13	14
			2010 - 2015	38	38	40	35
			2015 - 2020	27	26	28	33
			>2020	20	20	19	18
	never			18	20	15	17
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no	84	83	86	81
			yes	16	17	14	19
	Technical feasibility		no	65	68	61	57
			yes	35	32	39	43
	Social acceptability		no	68	66	69	83
			yes	32	34	31	17
	EU legislation		no	80	76	85	79
			yes	20	24	15	21
	Economic viability		no	22	22	23	15
			yes	78	78	77	85
	Lack R&D Funding		no	93	95	90	96
			yes	7	5	10	4
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	6	4	8	8
			None	71	73	70	69
			Increase	23	23	22	23
	Living and Working conditions		Decrease	11	10	14	12
			None	68	70	64	69
			Increase	21	20	22	20
	Employment		Decrease	25	25	29	20
			None	54	57	46	59
			Increase	21	18	25	21
	Competitiveness		Decrease	10	11	10	10
			None	23	26	18	32
			Increase	66	63	73	58
	Regional Differences		Decrease	15	14	16	23
			None	55	54	56	57
			Increase	30	32	28	20
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S044
Keywords	Local manufacturing
Statement	Local manufacturing is widely used to minimise the risks of global distribution chains

		%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high		13	13	14	4
			23	20	28	23
			37	38	33	40
			28	29	25	32
Time of realisation	yes	<2010	21	24	20	10
		2010 - 2015	36	40	30	36
		2015 - 2020	28	25	29	36
		>2020	15	11	21	17
	never		26	24	32	16
Main barriers in Europe blocking the realisation of the statement	Education/Qualification	no				
		yes				
	Technical feasibility	no				
		yes				
	Social acceptability	no				
		yes				
	EU legislation	no				
		yes				
	Economic viability	no				
		yes				
	Lack R&D Funding	no				
		yes				
Expected effects of Realisation for Europe compared to today	Environmental Quality	Decrease	18	18	21	10
		None	45	47	42	44
		Increase	36	35	37	45
	Living and Working conditions	Decrease	12	11	14	7
		None	35	37	32	31
		Increase	54	52	53	62
	Employment	Decrease	8	10	7	6
		None	17	17	19	8
		Increase	74	73	74	86
	Competitiveness	Decrease	29	30	28	21
		None	25	25	27	19
		Increase	47	45	46	60
	Regional Differences	Decrease	26	23	27	43
		None	30	31	29	21
		Increase	44	46	44	35
Highest R&D level		Europe				
		USA				
		Japan				
		China				
		Korea				
		Australia				
		emerging Asian markets				
		South America				
		Africa				
		Others				

Questions of cells with no value were not asked in survey.

Statement No	S045
Keywords	High automation
Statement	The benefits of high automation outweigh the advantages of lower labour costs outside EU

			%	all experts	industry	research	government
Importance to European Manufacturing Industry		low - high		2	1	3	1
				9	7	11	11
				30	28	32	31
				60	63	54	57
Time of realisation	yes		<2010	17	21	12	10
			2010 - 2015	37	39	36	30
			2015 - 2020	28	25	30	38
			>2020	18	15	22	22
	never			12	11	13	12
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no				
			yes				
	Technical feasibility		no				
			yes				
	Social acceptability		no				
			yes				
	EU legislation		no				
			yes				
	Economic viability		no				
			yes				
	Lack R&D Funding		no				
			yes				
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	7	7	8	5
			None	37	38	35	36
			Increase	56	55	56	58
	Living and Working conditions		Decrease	10	9	11	8
			None	19	21	16	17
			Increase	72	70	73	75
	Employment		Decrease	50	49	51	51
			None	11	10	12	10
			Increase	39	41	36	39
	Competitiveness		Decrease	5	5	6	3
			None	9	11	7	3
			Increase	85	84	87	93
	Regional Differences		Decrease	16	14	17	26
			None	31	29	34	23
			Increase	53	56	49	52
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S046
Keywords	Learning in the company
Statement	A fixed part of working time is used for acquiring new competencies, using resources provided by the employer

		%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high		2	2	2	8
			12	12	12	23
			37	36	38	35
			49	49	49	35
Time of realisation	yes	<2010	32	37	26	25
		2010 - 2015	39	41	37	38
		2015 - 2020	19	14	27	21
		>2020	10	9	10	16
	never		7	7	8	5
Main barriers in Europe blocking the realisation of the statement	Education/Qualification	no				
		yes				
	Technical feasibility	no				
		yes				
	Social acceptability	no				
		yes				
	EU legislation	no				
		yes				
	Economic viability	no				
		yes				
	Lack R&D Funding	no				
		yes				
Expected effects of Realisation for Europe compared to today	Environmental Quality	Decrease	1	1	0	0
		None	66	66	64	70
		Increase	34	33	36	30
	Living and Working conditions	Decrease	1	2	1	1
		None	5	6	6	2
		Increase	93	93	93	97
	Employment	Decrease	6	8	2	10
		None	29	30	27	26
		Increase	66	63	71	63
	Competitiveness	Decrease	4	5	3	2
		None	10	11	8	8
		Increase	86	84	89	89
	Regional Differences	Decrease	22	23	22	14
		None	39	34	43	51
		Increase	39	43	35	35
Highest R&D level		Europe				
		USA				
		Japan				
		China				
		Korea				
		Australia				
		emerging Asian markets				
		South America				
		Africa				
		Others				

Questions of cells with no value were not asked in survey.

Statement No	S047
Keywords	Qualification Certification
Statement	Occupational training certificates for production workers which can be acquired at any point of the professional career are developed throughout Europe

		%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high		8	9	6	4
			23	24	23	20
			35	33	36	32
			35	34	34	44
Time of realisation	yes	<2010	25	27	23	21
		2010 - 2015	38	38	38	44
		2015 - 2020	21	21	21	21
		>2020	16	14	18	14
	never		5	6	4	8
Main barriers in Europe blocking the realisation of the statement	Education/Qualification	no				
		yes				
	Technical feasibility	no				
		yes				
	Social acceptability	no				
		yes				
	EU legislation	no				
		yes				
	Economic viability	no				
		yes				
	Lack R&D Funding	no				
		yes				
Expected effects of Realisation for Europe compared to today	Environmental Quality	Decrease	1	1	0	4
		None	76	76	78	75
		Increase	23	23	22	21
	Living and Working conditions	Decrease	2	1	2	5
		None	16	17	16	13
		Increase	82	82	82	82
	Employment	Decrease	3	3	3	6
		None	27	31	21	27
		Increase	70	66	77	66
	Competitiveness	Decrease	1	1	1	2
		None	22	27	15	15
		Increase	77	73	83	83
	Regional Differences	Decrease	35	34	37	36
		None	38	38	38	33
		Increase	27	28	26	30
Highest R&D level		Europe				
		USA				
		Japan				
		China				
		Korea				
		Australia				
		emerging Asian markets				
		South America				
		Africa				
		Others				

Questions of cells with no value were not asked in survey.

Statement No	S048
Keywords	Self-Employment
Statement	The majority of workers in production are self-employed and offer their services to a number of customers in different places

			%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high			25	27	25	16
				33	30	34	46
				28	28	28	25
				14	15	14	13
Time of realisation	yes		<2010	11	11	11	8
			2010 - 2015	32	33	30	31
			2015 - 2020	28	27	29	36
			>2020	29	29	30	25
	never			43	43	42	43
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no				
			yes				
	Technical feasibility		no				
			yes				
	Social acceptability		no				
			yes				
	EU legislation		no				
			yes				
	Economic viability		no				
			yes				
	Lack R&D Funding		no				
			yes				
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	17	13	19	23
			None	71	74	71	63
			Increase	12	12	11	14
	Living and Working conditions		Decrease	47	44	48	63
			None	19	21	16	18
			Increase	34	35	36	19
	Employment		Decrease	27	24	28	42
			None	26	30	22	25
			Increase	46	45	51	33
	Competitiveness		Decrease	14	15	12	12
			None	28	28	25	32
			Increase	58	56	63	57
	Regional Differences		Decrease	25	26	25	20
			None	36	35	37	35
			Increase	39	38	38	44
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S049
Keywords	Share of Females
Statement	The proportion of female employees amongst technical specialists and management in the manufacturing sector has reached their share of the population

			%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high			20	18	23	19
				33	32	32	43
				31	34	29	27
				16	16	16	11
Time of realisation	yes		<2010	10	11	10	5
			2010 - 2015	27	28	24	27
			2015 - 2020	27	27	26	30
			>2020	36	33	40	37
	never			25	22	30	18
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no				
			yes				
	Technical feasibility		no				
			yes				
	Social acceptability		no				
			yes				
	EU legislation		no				
			yes				
	Economic viability		no				
			yes				
	Lack R&D Funding		no				
			yes				
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	1	2	1	1
			None	82	82	80	84
			Increase	17	17	18	15
	Living and Working conditions		Decrease	5	5	5	4
			None	40	41	37	43
			Increase	55	55	57	53
	Employment		Decrease	5	6	4	2
			None	51	54	48	44
			Increase	44	40	48	54
	Competitiveness		Decrease	6	7	6	5
			None	56	56	55	54
			Increase	38	38	39	40
	Regional Differences		Decrease	21	21	20	21
			None	52	51	54	57
			Increase	27	29	26	22
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S050
Keywords	Work from home
Statement	Most jobs at all working levels in manufacturing (shop-floor, management, support) include tasks that are done from home

			%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high			22	26	18	17
				31	33	27	38
				29	24	35	30
				18	16	20	15
Time of realisation	yes		<2010	10	10	9	9
			2010 - 2015	32	35	30	23
			2015 - 2020	27	27	25	35
			>2020	32	28	36	33
	never			32	35	27	28
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no				
			yes				
	Technical feasibility		no				
			yes				
	Social acceptability		no				
			yes				
	EU legislation		no				
			yes				
	Economic viability		no				
			yes				
	Lack R&D Funding		no				
			yes				
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	7	5	7	15
			None	45	46	45	41
			Increase	48	49	48	45
	Living and Working conditions		Decrease	16	14	17	25
			None	10	11	8	12
			Increase	74	75	75	64
	Employment		Decrease	14	15	12	16
			None	39	42	36	34
			Increase	47	43	52	50
	Competitiveness		Decrease	8	10	6	8
			None	40	44	35	31
			Increase	52	47	59	61
	Regional Differences		Decrease	28	25	31	30
			None	44	45	44	35
			Increase	29	30	25	35
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S051
Keywords	24 hours economy
Statement	Due to the 24 hours economy, research, engineering and design departments work around the clock

			%	all experts	industry	research	government
Importance to European Manufacturing Industry		low - high		17	16	17	17
				26	24	29	30
				32	31	32	33
				25	28	22	20
Time of realisation	yes		<2010	18	18	23	4
			2010 - 2015	28	32	21	22
			2015 - 2020	30	25	34	47
			>2020	24	25	22	26
	never			32	29	36	29
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no				
			yes				
	Technical feasibility		no				
			yes				
	Social acceptability		no				
			yes				
	EU legislation		no				
			yes				
	Economic viability		no				
			yes				
	Lack R&D Funding		no				
			yes				
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	14	14	15	10
			None	72	72	72	72
			Increase	14	14	12	18
	Living and Working conditions		Decrease	73	71	74	78
			None	13	13	13	10
			Increase	15	16	13	12
	Employment		Decrease	20	18	20	29
			None	33	32	34	36
			Increase	47	49	45	35
	Competitiveness		Decrease	4	4	4	6
			None	20	20	21	17
			Increase	75	75	75	78
	Regional Differences		Decrease	19	19	20	15
			None	39	38	40	45
			Increase	42	43	40	39
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S052
Keywords	Office factory
Statement	Innovations in machine technology will transform the factory's environment into one that resembles an office environment (e.g. no noise, no pollution, space, no accidents)

		%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high		9	9	10	5
			23	24	21	20
			35	32	37	43
			34	35	32	32
Time of realisation	yes	<2010	5	7	3	5
		2010 - 2015	27	30	25	20
		2015 - 2020	28	25	32	28
		>2020	40	39	39	46
	never		11	10	13	14
Main barriers in Europe blocking the realisation of the statement	Education/Qualification	no				
		yes				
	Technical feasibility	no				
		yes				
	Social acceptability	no				
		yes				
	EU legislation	no				
		yes				
	Economic viability	no				
		yes				
	Lack R&D Funding	no				
		yes				
Expected effects of Realisation for Europe compared to today	Environmental Quality	Decrease	1	1	1	1
		None	10	9	10	10
		Increase	89	90	89	89
	Living and Working conditions	Decrease	1	0	1	0
		None	2	2	2	0
		Increase	98	97	97	100
	Employment	Decrease	13	15	12	10
		None	61	62	61	52
		Increase	26	24	28	38
	Competitiveness	Decrease	12	14	11	9
		None	41	44	39	27
		Increase	47	42	50	64
	Regional Differences	Decrease	17	18	16	15
		None	49	48	49	48
		Increase	34	33	35	36
Highest R&D level		Europe				
		USA				
		Japan				
		China				
		Korea				
		Australia				
		emerging Asian markets				
		South America				
		Africa				
		Others				

Questions of cells with no value were not asked in survey.

Statement No	S053
Keywords	Reduction of unskilled labour
Statement	Knowledge based manufacturing leads to a share of less than 10% of unskilled labour in the workforce

		%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high		6	7	6	2
			15	16	13	20
			39	37	41	31
			40	40	40	46
Time of realisation	yes	<2010	12	14	11	5
		2010 - 2015	31	33	27	40
		2015 - 2020	31	31	31	32
		>2020	26	23	30	23
	never		9	8	11	4
Main barriers in Europe blocking the realisation of the statement	Education/Qualification	no				
		yes				
	Technical feasibility	no				
		yes				
	Social acceptability	no				
		yes				
	EU legislation	no				
		yes				
	Economic viability	no				
		yes				
	Lack R&D Funding	no				
		yes				
Expected effects of Realisation for Europe compared to today	Environmental Quality	Decrease	1	0	2	2
		None	65	67	61	66
		Increase	34	33	37	32
	Living and Working conditions	Decrease	6	6	6	2
		None	21	22	17	22
		Increase	74	71	77	76
	Employment	Decrease	43	43	42	46
		None	26	28	24	18
		Increase	31	29	34	36
	Competitiveness	Decrease	4	4	3	2
		None	16	17	15	8
		Increase	80	79	82	90
	Regional Differences	Decrease	17	18	18	13
		None	34	34	33	35
		Increase	49	48	49	52
Highest R&D level		Europe				
		USA				
		Japan				
		China				
		Korea				
		Australia				
		emerging Asian markets				
		South America				
		Africa				
		Others				

Questions of cells with no value were not asked in survey.

Statement No	S054
Keywords	Work-Life Balance
Statement	Tailored configurations of working conditions and benefits reflecting age and family situation are the norm in manufacturing companies

			%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high			14	15	13	7
				28	30	24	23
				36	34	37	40
				23	20	27	30
Time of realisation	yes		<2010	9	9	9	6
			2010 - 2015	30	33	26	26
			2015 - 2020	30	28	29	41
			>2020	32	30	36	28
	never			22	21	23	21
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no				
			yes				
	Technical feasibility		no				
			yes				
	Social acceptability		no				
			yes				
	EU legislation		no				
			yes				
	Economic viability		no				
			yes				
	Lack R&D Funding		no				
			yes				
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	1	0	2	0
			None	75	75	75	74
			Increase	24	25	23	25
	Living and Working conditions		Decrease	2	2	1	3
			None	6	5	6	5
			Increase	93	93	92	92
	Employment		Decrease	14	16	11	20
			None	35	38	30	30
			Increase	51	46	59	50
	Competitiveness		Decrease	20	22	17	14
			None	32	38	28	19
			Increase	48	40	55	66
	Regional Differences		Decrease	22	23	20	24
			None	41	42	41	38
			Increase	37	36	38	38
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.

Statement No	S055
Keywords	New role of trade unions
Statement	Co-management of the development of competences for the company and its workforce by trade unions or other representatives of employees is widespread practice

			%	all experts	industry	research	government
Importance to European Manufacturing Industry	low - high			21	23	20	13
				30	30	28	25
				31	27	35	34
				19	20	17	29
Time of realisation	yes		<2010	18	18	20	13
			2010 - 2015	33	36	27	39
			2015 - 2020	24	23	25	29
			>2020	25	24	28	19
	never			30	30	32	24
Main barriers in Europe blocking the realisation of the statement	Education/Qualification		no				
			yes				
	Technical feasibility		no				
			yes				
	Social acceptability		no				
			yes				
	EU legislation		no				
			yes				
	Economic viability		no				
			yes				
	Lack R&D Funding		no				
			yes				
Expected effects of Realisation for Europe compared to today	Environmental Quality		Decrease	3	3	2	3
			None	79	81	80	70
			Increase	18	16	18	28
	Living and Working conditions		Decrease	5	6	4	1
			None	24	28	19	15
			Increase	71	66	77	84
	Employment		Decrease	17	22	11	9
			None	40	44	37	25
			Increase	43	35	52	66
	Competitiveness		Decrease	29	33	27	10
			None	33	33	33	34
			Increase	38	35	40	56
	Regional Differences		Decrease	21	18	25	24
			None	46	45	46	51
			Increase	33	37	29	25
Highest R&D level			Europe				
			USA				
			Japan				
			China				
			Korea				
			Australia				
			emerging Asian markets				
			South America				
			Africa				
			Others				

Questions of cells with no value were not asked in survey.