



Value added and jobs resulting from joining technology in Germany and in Europe

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1. Introduction

In the past, DVS has already arranged for a series of investigations to be conducted in order to estimate the value added and the numbers of employees resulting from the manufacture and application of joining technology. The results are summarised in studies relating to the macroeconomic and sectoral value added by the manufacture and application of welding technology and joining technology from 2001, 2005 and 2009. The study from 2001 was restricted solely to the joining technologies of welding and brazing/soldering. Other joining technologies (such as structural adhesive bonding, mechanical joining, thermal cutting and, as a coating technology, thermal spraying) were considered in the studies from 2005 and 2009. The studies from 2001 and 2005 were restricted to Germany.

At the beginning of 2009, DVS - German Welding Society and EWF - European Federation for Welding, Joining and Cutting completely revised and updated the study from 2005 in preparation for the international Schweissen & Schneiden trade fair in September 2009. In this respect, the survey region in this study was extended to the European level. Consideration was given not only to Germany but also to other European countries which are important for joining technology. In detail, these include France, Italy, the Netherlands, Poland and the United Kingdom. Furthermore, all the European countries (EU 27) were considered in combination. The study from 2013 presented here (once again, in advance of Schweissen & Schneiden) updates these results with the fundamentally same structure of the study and of the representation of the results. However, the study from 2013 takes account of the Czech Republic instead of Poland (2009).

The objective of this study from 2013 is therefore to evaluate in the form of a summary all the statistical information available on the German and European levels in order to estimate the value added contribution and the numbers of employees resulting from the manufacture and application of joining technology in Germany, in the specified selected countries in Europe and throughout the European Union as a whole in 2010 or 2011 - that is the latest data boundary of the study. Values for 2010 and 2011 are indicated for Germany and values for 2010 are indicated for the selected European countries.

In this study, the manufacture of joining technology is fundamentally understood to refer to the manufacture of goods and the rendering of services which are necessary for the joining in each case. Consideration is given to two variables: on the one hand, the manufacture of devices for joining technology (i.e. the manufacture of devices, machines and systems, e.g. the manufacture of power sources, welding torches, welding machines or robot installations) and, on the other hand, the manufacture of complementary goods for joining technology (i.e. not only the manufacture of consumables and process materials, including consumables for welding, brazing/soldering and thermal spraying, welding gases, adhesives, mechanical joining elements, protective equipment as well as venting and testing machines but also the rendering of services, essentially meaning services in the field of training and further education, are assigned to these complementary goods for joining technology).

The application of joining technology relates to the utilisation of the joining processes in the various joining-intensive sectors.

For the manufacture and application of joining technology, it is possible to specify three direct value added effects, i.e.:

- Effect I: Direct value added and employment effects resulting from the manufacture of devices for joining technology.
- Effect II: Direct value added and employment effects resulting from the manufacture of complementary goods for joining technology (consumables and process materials as well as the rendering of services for training and further education).
- Effect III: Direct value added and employment effects resulting from the application of joining technology (essentially in the joining-intensive sectors).

In addition to these three direct value added sources, other sectors are also affected by the demand for intermediate inputs (e.g. for the utilisation of infrastructure or construction measures such as foundations for machines). The two (indirect) effects caused by these must be attributed to the value added contribution made by joining technology.

- Effect IV: The indirect (intermediate input) effects of the manufacture of devices for joining technology, i.e. the indirect effects belonging to Effect I.
- Effect V: The indirect (intermediate input) effects of the manufacture of complementary goods for joining technology, i.e. the indirect effects belonging to Effect II.

All five effects can be established precisely for Germany. The overall effect on the value added and the jobs results from the total of all five effects. In the study from 2001 which encompassed welding and brazing/soldering alone, a value added of € 16 billion and 428,000 employees were established for Germany. A value added of € 27 billion and 638,000 employees were quantified in the preceding study from 2005 in which the subject of the investigation was extended to all the joining technologies. The study from 2009 indicated a slightly decreased value of € 24.4 billion for this value added with 421,000 employees. The study from 2013 presented here now results in a value added of € 22.8 billion for Germany with a number of no fewer than 394,000 employees.

However, the same data availability as for Germany does not exist on the European level. On the basis of official data on the European level, it is possible to establish the value added contributions made by the manufacture of devices for joining technology and the manufacture of complementary goods for joining technology, i.e. the direct Effects I and II. Furthermore, Effect III can be estimated reliably. This was made possible by the fact that, in part with the support of EWF's member organisations, DVS has carried out its own surveys and calculations with regard to the number of employees in welding occupations according to countries. Merely the indirect effects cannot be quantified in the European study since no data is available for these. In any case, the quantification of Effects I, II and III in the various European countries also constitutes a great increase in knowledge and contributes to the illustration of the significance of joining technology in Europe. Therefore, the following reporting essentially relates to these three effects in order to ensure that the results for Germany can be compared with those for the investigated European countries. The

original English-language version of this report which is also available shows exclusively Effects I, II and III. In the English-language version of this report presented here, Effects IV and V (however, exclusively for Germany) are indicated in addition.

Some core data of the latest study from 2013 is introduced below. Here, value added is defined as the difference resulting from the production value minus the intermediate inputs which are necessary in order to carry out the production. Value added is the value which is created by the production of goods or by the offering of services. The complete studies with comprehensive data material and more detailed analyses in the German and English languages are available from DVS.

2. Production values, value added and jobs resulting from the manufacture of devices for joining technology and from the manufacture of complementary goods for joining technology

In the study, the respective national inland production values for devices for joining technology (these encompass devices, machines and systems) are evaluated from the production statistics (Eurostat). In this respect, laser installations and robot installations for joining technology are recorded as well.

Table 1:

Production values for the manufacture of devices for joining technology - essential results from 2010: Germany was the largest producer of devices for joining technology in Europe. More than one third (36 %) of the European production of these goods originated from Germany. In 2010, these goods were manufactured in Germany with a production value of almost € 2,900 million while the figure in Europe was nearly € 8,000 million. Other important manufacturers of these devices were Italy with a production value of nearly € 900 million and France with more than € 500 million. In Europe, around € 5,900 million of the production values amounting to € 8,000 million was accounted for by devices for welding, brazing/soldering and cutting technology. This corresponded to a proportion of 74 %. While (as already said) almost 36 % of the European production originated from Germany, 11 % originated from Italy and France accounted for a 7 % share of this production. Notwithstanding all the reservations about the comparability with the data from the previous years, it was shown that there had been a distinct decline in the significance of Italy as a producer of devices and systems for joining technology.

The results summarised here for the production values for devices and systems are explained in greater detail on Figs. 1 - 3. On Fig. 1, the production values for 2011 are also specified for Germany in addition to the values for 2010. In this period, the production value increased by over € 900 million to a total production of € 3,800 million.

Note: The gross value added and the number of jobs for Germany and for EU 27 are already specified on Fig. 1. These values are dealt with in even greater detail below.

The production values for the manufacture of the complementary goods for joining technology (these production values also encompass the production values for the rendering of services) are recorded in addition to the production values for the devices for joining technology.

Table 2:

Production values for the manufacture of complementary goods for joining technology - essential results from 2010: As far as these goods were concerned, Germany was the number one with a production value of over € 2,100 million, followed by Italy and France each with around € 900 million. In Europe, the resulting production values for these goods amounted to over € 7,500 million. Germany, France and Italy stood out in particular due to high production values for the manufacture of welding consumables (for Germany, this production value amounted to € 549 million). The production values of welding gases were also high in these countries and in the same order of magnitude (€ 544 million in Germany). Moreover, the production values for training and further education were included in the total production values. For Germany, this value amounted to no less than nearly € 180 million. However, no information about these production values for training and further education was available for France or Italy. Therefore, the total actual production value of these goods in these countries might turn out to be even greater. It was interesting that the proportion of the adhesives in the production values in the EU amounted to around 25 %. In Germany, this figure was around 16 %.

The production values summarised here are explained in greater detail on Figs. 4 - 6. On Fig. 4, the data for 2011 is also specified for Germany in addition to the data for 2010. For Germany, this production value increased by € 192 million to a total production of € 2,327 million.

Note: The gross value added and the number of jobs in Germany and in EU 27 are already specified on Fig. 4. These values are dealt with in even greater detail below.

As already specified on Fig. 1, not only the production values of joining technology but also the value added associated with them as well as the employment are indicated. That corresponds to Effect I specified above - direct value added by the manufacture of devices for joining technology. As said by the name and as already described, the value added indicates the extra value created by the production. It is calculated by deducting the intermediate inputs needed for the production from the production value. The relevant employment results from dividing the gross value added by the average working productivity.

Table 3:

Value added and jobs resulting from the manufacture of devices for joining technology - important results from 2010: In Germany, a value added of € 921 million and the employment of over 15,000 people were associated with the manufacture of devices and systems for joining technology. In Europe, the value added by these products amounted to € 2,700 million and the employment to nearly 45,000 people. The values indicated on Fig. 1 apply to Germany in 2011 and, in comparison with 2010, show a distinct rise in the value added (plus € 409 million) to € 1,330 million and a rise in the number of employees (plus 2,700) to 18,330 employees.

Table 3a:

For information: The indirect intermediate input effects of the manufacture of joining technology / devices and systems indicated a value added of € 1,200 million and a number of 18,000 employees for Germany in 2011. These values could be added to the already specified values. For Germany in 2011, this resulted in a total value added by the manufacture of devices and systems for joining technology amounting to € 2,530 million and a total number of over 36,000 employees.

The corresponding value added and the employment are portrayed in addition to the production values of the complementary goods for joining technology (cf. Fig. 4). This corresponds to Effect II described above - direct value added by the manufacture of complementary goods for joining technology.

Table 4:

Value added and jobs resulting from the manufacture of complementary goods for joining technology - important results from 2010: In Germany, the production of these goods led to a value added of € 762 million. Around 15,000 employees were associated with this. Thus, the production of these goods once again resulted in value added and employment similar to those resulting from the manufacture of devices for joining technology. One job in the manufacture of the devices safeguarded one more job in the production of complementary goods. In Europe, the production of the complementary goods led to a value added of € 2,500 million as well as the employment of over 36,000 people. All over Europe, the number of employees for the manufacture of complementary goods was lower than that for the manufacture of devices for joining technology. More than one fifth of the value added and employment resulting from the production of complementary goods in Europe arose in Germany. The value added shown on Fig. 4 for 2011 increased by € 136 million in relation to 2010 and the number of employees increased by 1,300 in this period.

Table 4a:

For information: The indirect intermediate input effects of the manufacture of joining technology / complementary goods and services indicated a value added amounting to € 600 million and a number of 9,300 employees for Germany in 2011. These values could be added to the already specified values. For Germany, this resulted in a total value added by the manufacture of complementary goods and the rendering of services amounting to around € 1.5 billion and a total number of 25,300 employees.

More detailed analysis of the data for the manufacture of joining technology:

In addition to these representations shown in the form of summaries until now, the study also includes production values for individual items (e.g. for the welding devices, for the systems for brazing/soldering technology, for the devices for adhesive bonding technology, for thermal spraying and for cutting) for all the investigated countries and for EU 27. The production values, for example, for the welding gases, for the systems for environmental protection and occupational health and safety as well as for testing technology are also included for all the investigated countries.

A few examples of more detailed information about the production values right into individual product fields in individual countries are shown below.

Example 1:

Production value of devices and systems / welding, brazing/soldering and cutting (€ 1,800 million in Germany)

Of which machines, apparatus and devices for the resistance welding of metals accounted for € 336 million.

Example 2:

Production value of complementary goods and services / consumables for welding, brazing/soldering and thermal spraying (€ 2,027 million in EU 27)

Of which € 193 million was accounted for by consumables in Italy of which, in turn, € 27 million was accounted for by covered electrodes for arc welding.

Example 3:

Production value of complementary goods and services / consumables for welding, brazing/soldering and thermal spraying (€ 2,027 million in EU 27)

Of which € 298 million was accounted for by welding gases in France of which, in turn, € 51.2 million was accounted for by argon.

With a production value of € 4,591 million, the six countries considered in the study produced over 58 % of the total production of devices and systems in EU 27. Thus, the remaining 21 countries merely accounted for nearly 42 % of this production. As far as the production of welding, brazing/soldering and cutting technology was concerned, this concentration was not quite as high: it amounted to 48 %. The strongest concentration was to be found in adhesive bonding technology and in mechanical joining technology. Here, over 88 % of the production took place in these six countries. A similar distribution arose with regard to the complementary goods and the services: the six selected countries in the study produced almost two thirds of the entire European production of complementary goods.

If the data for the value added by the manufacture of devices and the manufacture of complementary goods is combined, this leads to the following results:

Table 5:

In Germany in 2010, the manufacture of products for joining technology and the rendering of services generated a value added of € 1,683 million (in 2011: € 2,228 million) and safeguarded 30,700 jobs (in 2011: 34,700 jobs).

In Europe in 2010, the value added by the manufacture of products for joining technology and the rendering of services amounted to € 5,200 million and safeguarded 81,000 jobs.

Table 5a:

For information: In Germany in 2011, the value added by the manufacture of joining technology and the rendering of services, taking account of the intermediate inputs, amounted to € 4,028 million and the resulting number of employees was 62,030 (cf. Fig. 7).

3. Value added and employment resulting from the application of joining technology

Value added and employment resulting from joining technologies arise not only during the manufacture of devices for joining technology as well as during the manufacture of the complementary goods for joining technology but also (i.e. to a particular extent) due to the application of joining technology, above all, in the joining-intensive sectors - e.g. vehicle construction, mechanical engineering or the manufacture of metal products.

In the now updated study, the value added proportion resulting directly from the application of joining technology is assessed for these joining-intensive sectors. For this purpose, the number of employees in welding technology and joining technology is established as the prerequisite.

For Germany, the number of employees in welding technology and in joining technology can be read from the economic sectors / occupations matrix from the Federal Statistical Office. On the European level or for other European countries, it is necessary to call upon other data sources and calculations of the numbers of employees. As early as 2008, DVS therefore already conducted a Europe-wide survey about the number of welders and their allied occupational groups amongst the members of EWF - European Federation for Welding, Joining and Cutting. In 2012, DVS made its own more extensive calculations about the employees in joining technology. In this respect, the estimation of the number of welders is oriented to the example of the available data about the welder qualification tests which were held.

In addition to the welders, there are naturally also other extremely significant occupational groups in welding technology (e.g. welding supervisors, welding inspectors, welding designers as well as personnel in research and materials testing) about which DVS has explicitly collected data too. These occupational groups also make a crucial contribution to the value added by application.

As is well-known, the subjects under investigation in the study are not only the technology of welding but also other joining technologies such as structural adhesive bonding, mechanical joining, thermal cutting and coating technology (e.g. thermal spraying). For the people dealing with these technologies, the numbers of employees are also established and are added to the numbers of employees in welding technology. The full-time equivalents for employees in joining technology are specified for this purpose. (The number of employees in welding technology and in joining technology is then composed of the number of welders, the number of employees in the other occupational groups as well as the number of employees in the fields characterised by joining technology.) Fig. 8 explains this personnel in welding technology and in joining technology.

Table 6:

Full-time-equivalent employees in welding technology - important results from 2010: In Europe, there were nearly 647,000 welders. When the other occupational groups in welding technology specified above with a number of 311,300 employees and the occupational groups in joining technology with a number of 165,900 employees were added, the number of full-time-equivalent employees in welding technology and joining technology in Europe increased to 1.12 million. In Germany, there were 156,000 welders (which corresponded to a proportion of 24 % of the total number of welders in Europe). The other occupational groups in welding technology in Germany encompassed 105,320 employees and the occupational groups in joining technology encompassed 71,200 employees in Germany. This resulted in the total number of 332,500 full-time-equivalent employees in welding technology and joining technology in Germany (which corresponded to a proportion of nearly 30 % of the employees in Europe). Fig. 9 summarises this data broken down according to the occupational groups.

Table 7:

Full-time-equivalent employees in joining technology - important results from 2010: In Europe, there were around 1.12 million full-time-equivalent employees in welding technology and joining technology (including 958,000 welding technologists). In Germany, there were 332,500 employees in welding technology and joining technology (including 261,000 welding technologists).

The numbers of employees in joining technology and in welding technology amounted to 211,000 in Italy (including 156,000 welding technologists) and 103,000 in France (including 88,500 welding technologists). Fig. 10 shows these numbers of employees for these countries, for the other selected countries and for EU 27.

Figs. 9 and 10 therefore show the employees in fields which are interesting for joining technology, i.e. the number of welders, the number of employees in the other fields relating to welding technology and the number of joining technology personnel.

Fig. 9 summarises the number of employees with activities relating to welding technology. For this purpose, the total number of these employees is specified and additional information is provided with regard to welding supervisors, welding inspectors, welding designers, research personnel, welding trainers, personnel in non-destructive testing, planning engineers and robot operators. Taking account of the joining technology personnel, this results in the total number of 1.12 million employees in joining technology in EU 27. For Germany, this total number amounts to 332,000 employees.

With these numbers of employees, it is possible to calculate the values added by the application of joining technology, see [Fig. 11](#).

Table 8:

For 2010, a value added amounting to € 18,800 million as a result of the application of joining technology was associated with these 332,500 full-time-equivalent joining technologists in Germany via the sectorally specific working productivities. The value added by the application of joining technology thus amounted to eleven times the value added by the manufacture of joining technology. For Europe, a value added of almost € 60,000 million could be calculated with the specified 1.12 million full-time-equivalent joining technologists and the sectorally specific working productivities. Over 31 % of this value added was generated in Germany. Second place was occupied by Italy where a value added of around € 12,400 million was yielded by around 211,000 employees. In France (the third important country where a crucial value added was generated by joining technology), 103,000 employees yielded around € 6,400 million. For Europe, this value added by the application of joining technology thus amounted to around 14 times the value added by the manufacture of joining technology.

4. Value added and employment resulting from joining technology

The entire resulting value added proportion for joining technology can be calculated after the analysis of the figures resulting from the manufacture of joining technology (as described, the manufacture of joining technology as devices and systems, the manufacture of complementary goods and the rendering of services are combined here) and from the application of joining technology.

Table 9:

For 2010, the entire value added by joining technology in EU 27 amounted to € 65,191 million and the total number of people to 1.21 million.

Germany contributed to the total value added in EU 27 with a value of € 20,483 million (i.e. 32 %). Italy followed with 18 % while France, Poland and Great Britain were located in the regions of 10 %, 9 % and 8 % respectively.

The proportions of the value added generated by joining technology, measured in relation to the total value added by the manufacturing sector, were different in the investigated countries: In all the states of EU 27, 3.9 % of the total value added by the manufacturing sector was produced by joining technology. Germany was located at the same value. Joining technology accounted for 5.3 % of the total value added by the manufacturing sector in Italy and for 3.5 % in France.

Figs. 12 and 13 once again summarise the value added proportions for Germany and Europe. The value added proportions accounted for by the manufacture of joining technology and the application of joining technology result in the above values for the total value added and for the number of people.

The above value of around € 65 billion specified for the total value added in Europe relates to joining technology. The proportion of welding technology in joining technology is estimated at 65 %. This leads to a total value added amounting to no less than € 42 billion as a result of welding technology and this is associated with around 800,000 employees.

5. Summary

(1) Joining technology constitutes a cross-sectional technology which is used for the manufacture of an abundance of products in many sectors. With regard to the utilised materials and the applied technologies, there are close relationships between manufacturers, suppliers, customers and users.

(2) The objective of the study summarised here is to quantify the significance of joining technology for the German national economy, for selected countries in Europe as well as for Europe as a whole. In this respect, the value added and the numbers of employees were calculated for the manufacture of devices for joining technology, for the manufacture of complementary goods for joining technology and for the application of joining technology in joining-intensive sectors.

(3) For Germany, the manufacture and application of joining technology in 2011 resulted in a value added of € 20.5 billion (i.e. 3.9 % of the total value added by the manufacturing sector in Germany) with the employment of 363,000 people. Taking account of intermediate inputs during the manufacture of joining technology, this results in a value added of € 22.9 billion (that corresponds to 4.2 % of the total value added by the manufacturing sector in Germany) and a number of 395,000 employees.

(4) The value added by the manufacture and application of joining technology in the states of EU 27 amounted to around € 65.1 billion in 2010. Around 1.2 million employees were associated with this value added in Europe in 2010.

(5) Of the total of € 20.5 billion of value added by joining technology in Germany, a proportion of € 921 million was accounted for by the manufacture of devices for joining technology. In Germany, around 15,600 people were employed for this purpose. In Germany, the manufacture of the required complementary goods for joining technology resulted in a value added of € 762 million also with around 15,100 employees.

(6) However, the largest proportion of the value added was not created by the manufacture of joining technology but instead by its application in the joining-intensive sectors. In the German national economy, a value added of around € 18.8 billion was achieved by the application of joining technology. In this respect, 332,500 joining technologists were employed in the joining-intensive sectors. Fundamentally, it may thus be stated that one value added unit during the manufacture of joining technology induces one additional value added unit during the manufacture of complementary goods and the rendering of services and that this, in turn, induces no fewer than 22 additional value added units resulting from the application of joining technology. [Fig. 14](#) shows a representation of this "leverage" in the form of a summary.

(7) The fundamental orders of magnitude for the extents to which the individual effects contribute to the overall effect coincide in all the countries: Strong leverage emanates from joining technology: Value added and employment are created by the manufacture of joining technology to a small degree only. The overwhelming proportion of the value added and the employment results from the application of joining technology in the joining-intensive sectors.

Excursus: Value added by cutting technology

The data available from the study from 2013 permits an evaluation with regard to the value added which is produced by the manufacture of devices, systems and complementary goods for cutting technology as well as by the application of cutting technology in the relevant sectors. In this respect, the same structure as for joining technology / welding technology can fundamentally be chosen for the representation of the results.

On this subject, Fig. S1 shows the production values for the manufacture of devices and systems for cutting technology (these mean not only the devices for cutting technology but also the laser and robot technology systems utilised for cutting) as well as information about the value added and the number of employees. In 2010, the total production in EU 27 amounted to € 595 million. A value added of € 190 million was generated by 2,800 employees. The total production in Germany amounted to € 322 million with a value added of € 98 million and 1,250 employees.

Fig. S2 shows the complementary goods which are used for cutting technology. These result in production values, values added and numbers of employees in comparable orders of magnitude as those for the devices and the systems: 1,800 employees in Germany generate a value added amounting to € 98 million while 3,100 employees in EU 27 generate a value added amounting to € 215 million.

Fig. S3 summarises the value added data and the numbers of employees. In relation to the value added by joining technology, the proportions accounted for by the value added by cutting technology are around 12 % in Germany and around 8 % in EU27.

In 2010, the total number of employees in the application of cutting technology amounted to 3,515 in Germany and to 8,670 in Europe. These generated values added amounting to € 250 million and € 460 million respectively (cf. Fig. S4). In relation to the value added by joining technology, the proportions accounted for by cutting technology are thus around 1.5 % in Germany and around 1 % in Europe. Once again, the reason for this relatively small proportion is to be found in the relatively low number of employees in cutting technology in comparison with the high number of employees in joining technology (Fig. S5).

In summary, the manufacture of cutting technology and the application of cutting technology result in total values added of € 446 million in Germany and € 865 million in Europe. Thus, cutting technology represents a number of around 7,000 employees in Germany and a number of around 15,000 employees all over Europe (cf. the representation in the form of a summary on Fig. S6).